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*"To the solid ground
Of nature trusts the Mind that builds for aye."*—WORDSWORTH.

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Retrospect and Prospect

THE public announcement of my retirement from the editorship of *NATURE* was made only a few days before my departure for the United States to deliver the Elihu Root Lecture at the Carnegie Institution of Washington on December 8, and to give a few other addresses at universities, as well as at the Richmond meeting of the American Association, on social and international aspects of science. Before leaving England, it was not possible for me to thank more than a few of my personal and other friends for their kind messages, but to them, and to all who have helped me with contributions and advice during the forty-five years of my association with *NATURE*, first as assistant editor to Sir Norman Lockyer, and later as editor, I welcome the opportunity now given me of expressing my very grateful appreciation of their interest and aid.

Throughout its existence, *NATURE* has had the active support of leading workers in scientific fields in many parts of the world. The aim has always been to record results of research of wide interest or particular importance wherever it has been carried out, and to present authoritative thought and opinion upon progressive scientific developments and their influence. In the early years of the journal, there was little recognition of the practical services which science can render to industry, or of the place which it should occupy in a modern State. Appeals for endowment of scientific research were perversely described as implying the search of scientific workers themselves for endowment in privileged positions rather than

as a means of promoting intellectual and industrial progress. Much still remains to be done before our statesmen and industrial leaders are fully aware of the power which science can give to the community, both socially and materially, yet the general principle that expenditure on research is a profitable investment may be said to have been conceded.

Forty-five years ago, the annual grants of the British Government for scientific investigation and related subjects, as shown in the Civil Estimates, were about £45,000. At the present time, they amount to nearly £2,000,000, of which the Department of Scientific and Industrial Research administers about £700,000. Less than one quarter of the net expenditure of the Department represents, however, grants for purposes directly or indirectly connected with industry; and the actual annual economies introduced into industries as the result of research have a financial value many times greater than the amounts expended upon them. On the most generous estimate, the grants for direct and indirect support of scientific research in Great Britain, including those expended in departments of armed forces, represent only one tenth of one per cent of the national income. While, therefore, it is gratifying to be able to record that the policy of State endowment of scientific research consistently advocated in *NATURE* has been accepted, industrial and social conditions are now changing so rapidly that a much bolder and broader financial scheme will have to be undertaken if the advancing front of

knowledge is to be made available for wise planning and efficient action in times of peace or of war.

Even, however, when adequate provision has been made for scientific research in biological as well as physical fields, whether purely with the object of increasing natural knowledge or for the purpose of industrial development, scientific workers will neglect their special responsibilities as citizens if they are indifferent to the social consequences of their discoveries. To the enlightened public, science signifies the disinterested pursuit of truth by patient observation, critical inquiry, unprejudiced examination of evidence and convincing judgment; but there are still many people who associate it with the conversion of pleasant natural scenes into industrial slums and with clouds of poison gas and other barbarous means of destroying man and his noblest works. It is the duty of scientific workers on one hand to do nothing which would shake the confidence of the community in the principles for which they stand, and on the other to take every opportunity to absolve themselves of responsibility for the prostitution of the gifts with which they endow the human race. It would be a betrayal of the scientific movement if those who represent it failed to play an active part in solving the social problems which their contributions to natural knowledge have created.

It is with such social and international relationships of science that *NATURE* has been largely

concerned during the past twenty years or so; and the recent formation of the new Division of the British Association, as well as the steps taken by the American Association and similar organizations of scientific workers to make their promotion a common cause, represent the beginning of an international movement which may save the world from the disasters now threatening it.

The correspondence columns of *NATURE* have become an international clearing-house of contributions to natural knowledge; and in this field the standard of value is independent of race or nationality or any other measure than originality and scientific worth. Liberty of thought and action are essential for creative scientific work; and progress is impossible when restrictions are placed upon them.

These principles of scientific freedom have been won through generations of struggle with Church and State, and when science neglects to assert them as fundamental conditions of creative work it will commit suicide. The policy of *NATURE* is to establish these rights not only in the interests of scientific workers themselves but also in those of the whole community. My particular mission has been to make men of science conscious of their power and influence in shaping civilized life, and I am happy to know that my successors will continue to proclaim this message as an inspiring intellectual stimulus and a means of promoting the welfare and the brotherhood of the human race.

R. A. GREGORY.

Science for Africa

An African Survey:

A Study of Problems arising in Africa south of the Sahara. By Lord Hailey. (Issued by the Committee of the African Research Survey under the auspices of the Royal Institute of International Affairs.) Pp. xxviii+1838. (London, New York and Toronto: Oxford University Press, 1938.) 21s. net.

FOLLOWING an appeal for a comprehensive survey of Africa and its problems made by General Smuts in his Rhodes Memorial Lecture in 1929, an authoritative committee was formed to give effect to his proposal. Thanks to the generosity and vision of the Carnegie Corporation of New York, funds were made available, and Lord Hailey agreed to undertake the task on his retirement from the governorship of the United Provinces

in India. Five years intensive work has produced a comparative study of the countries, peoples and their indigenous institutions and the influence of the different European Colonial Powers on the development of both in connexion with the exploitation of the natural resources of the whole of the mainland of Africa lying south of the Sahara, with the exception of the Anglo-Egyptian Sudan, the Italian possessions and Liberia. The survey therefore covers an area in which a Dominion of the British Commonwealth, Great Britain, France, Belgium and Portugal "are engaged in a common task, though in some respects with widely different methods of approach".

"The sole object for undertaking the Survey", says Lord Hailey, "was the hope that it might prove of some service to the Powers which have possession of territories in Africa, and of some

benefit to the African people". Understatement and humility could go no further.

In reality, the survey was conceived on a grand scale and has been compiled with imaginative insight and rare judgment. It takes into account every important aspect of the African scene. It is no mere compilation of facts, but a study in breadth and depth enriched by the intuitive and persevering genius of the master mind responsible for its direction and shape and the actual material it contains. To quote its author, "it is not limited to a discussion of the state of our knowledge regarding the problems which are involved in the development of Africa; it attempts also to describe the physical and social background out of which these problems have arisen and to analyse the factors which . . . must determine their solution". Where there are gaps, and they are not obvious, they must be attributed, not to the author and his collaborators, but to those administrations in Africa which, either deliberately or through lack of system, have not made available to the public essential information concerning their activities and problems.

The survey will commend itself to scientific workers because of its freedom from dogmatism, bias, cant or censoriousness. It will make a special appeal to those who have imbibed the spirit of the 'scientific humanism' which has been conjured up by our post-War perplexities. Some years ago, Mr. H. G. Wells expressed the opinion that the only duty of science was exact statement; its only service, truth. We have added to these the responsibility for attempting to ensure that the results of science shall be properly applied. Lord Hailey's great work satisfies all three criteria. This is his approach: "Africa presents itself as a living laboratory, in which the reward of study may prove to be not merely the satisfaction of an intellectual impulse, but an effective addition to the welfare of a people. A scientific approach to the questions of African development demands the study of problems of a social nature equally with those involving the application of the physical sciences. . . . No one question can be studied in isolation. There is close interdependence among all the essential problems of Africa".

The point needs no emphasis that Africa is undergoing a transformation rather than a development along evolutionary lines. Its impact with Western civilization has been so sudden and in many territories so catastrophic that the social and economic institutions which the different tribes have evolved through the centuries have in every case been seriously undermined. Administrations and Christian missions, often from the highest motives, have compelled changes in African social customs and habits, the results of which have

been demoralization rather than the regeneration of the peoples it was hoped to benefit. We have interfered with their marriage customs, their methods of cultivation, their systems of land tenure, their tribal methods of combating disease, their ideas of crime and punishment. In fact, we have attempted to impose on them by decree an entirely new set of values without making adequate provision for the education services which would enable them to understand and appreciate the changes forced on them.

It is now more generally appreciated by the European peoples with colonial possessions that a closer study of the social institutions of the subject races, with the object of attuning our systems of administration to what is valuable in Africa itself, will make the task of development easier and not necessarily slower. The view taken in this survey is that the social conceptions and practices of Africans are the result of a natural process of accommodation to their economic and physical environment. Their social conceptions do not necessarily indicate, what certain subjective investigators would have us believe, that there is any intrinsic difference of character or mental capacity between them and other peoples. A great deal more research is needed on the educability of the African before we can dogmatize on his inherent mental inferiority to the average European or Asiatic.

Take another assumption. The belief was widely held until recently that the relative low density of population in Africa was due to native customs, inter-tribal warfare and the ravages of the slave-trade. In the light of the researches of Orr, Keeble and others on the problems of nutrition it would now seem more probable, however, that the comparatively small population of Africa can be attributed to mineral deficiencies of the soil and other physical characteristics, which militate against the maintenance of dense populations as well as increase their susceptibility, due to malnutrition, to a variety of diseases. If this be the case—and it is certainly a more satisfactory explanation than any other which has been put forward—and if Africa is to be made capable of maintaining a large settled population, remedies must be found. These must be sought for by a more intensive investigation by African Governments of the interrelated problems of anthropology, agriculture, animal husbandry, water supply and health.

Lord Hailey emphasizes other points in connexion with population. In the last hundred years, the estimates given of the population of Africa have varied from 28,000,000 to 205,000,000, based on various methods of computation. Present-day experts give the population as lying between 138,100,000 and 163,300,000, "a fact which affords

an indication of the value which scientific opinion attaches to the systems of enumeration now in use". The discrepancy is so great that it is obviously impossible to state with any assumption of truth whether the population is declining, stationary or increasing. It is just as obvious that statements made with regard to the effect of certain customs on birth-rate and mortality, or the effect of migration of labourers to the mines and other large centres of gainful occupation on population, lack the validity which could be attached to them were accurate vital statistics available.

Students of African problems will find the chapters on political and social objectives, systems of government, law and justice, and native administration a mine of information. There is no other publication where these matters have been dealt with so comprehensively or with such complete objectivity. The problem inherent in the application of the British system of indirect rule to territories where there is a large and powerful white minority, as in Southern Rhodesia, or a small, semi-aristocratic and extremely vocal white settler community, as in Kenya, is clearly outlined. We are shown, too, how the task of French administrators has been none too simple in applying the logic of their own policy of 'Frenchification' to tribes at various stages of development. French critics of British colonial policy assert that while our interest in colonial issues is genuine and well-informed, our policy is characterized by its deficiency in definition of objective and of the method of approach to our problems. They regard our policy as "a series of improvisations which depend for success not on a logical outlook, but on the exercise of a traditional skill in accommodating principles to circumstances". It is interesting to note that the French are now in the process, at least in some of their territories, of reconciling their expedients to their logic. Nevertheless, there is one matter in which the French and the Belgians appear to have been more successful than the British. So far, we have kept too many minor administrative posts for highly-paid British personnel. We have neither been successful in training Africans, nor in recruiting a type of British subordinate official, for routine duties. The consequence is that "British officers appear to be unduly occupied with routine work", due largely to the lack of any clear policy as to the extent or manner of the employment of educated Africans in the administrative or technical services.

The chapters on law and justice, land and agriculture and animal husbandry are all illustrative of the effects of European conceptions and practices upon peoples with entirely different sets of values based on fundamental differences of outlook and

environment. This has resulted in a good deal of confusion, a great deal of friction and the loss of much that was valuable in African customary practice. On all three subjects, Lord Hailey pleads for considerably more research. If native customary law is to adjust itself to meet the needs of advancing society, students of jurisprudence must make a comprehensive study of African law and justice and attempt to evolve a system of law which will combine the best elements of African with those conceptions of European law which are calculated to evoke the greatest measure of agreement from the Africans themselves. Again, the question of legal titles to land is intimately connected with the methods of agriculture of different tribes, their attitude to domestic stock and their migratory customs. We still know too little to dogmatize on any of these subjects. Our interference with the method of shifting cultivation practised by many tribes led, for example, to pressure on the soil in fixed areas, with the result that the necessary period of regeneration was curtailed and the vegetal cover destroyed, the precursor to soil erosion.

In his penultimate chapter, on "The Future of African Studies", Lord Hailey pleads for the creation of two British bodies, the first, an official body charged with the central directions of research, the second, a voluntary bureau of information. The need for the first is due to the lack of direction in certain branches of research work and inevitable duplication of effort owing to the variety of authorities dealing with African problems. Lord Hailey gives full praise for the research work being done in the different African territories, by the tropical research stations, the Imperial Bureaux and the workers commissioned by the special committees of the Economic Advisory Council of the Cabinet, but suggests that a large fund should be created, preferably in the form of a non-lapsing grant-in-aid, under the administration of a committee of the Privy Council or the Economic Advisory Council, whose duty it would be to devise, in association with the appropriate scientific authorities, "the measures for making the most profitable use of the agencies concerned in any one branch of study, be it anthropology, medicine, or agriculture, and for maintaining the necessary contact between them and the agencies concerned with kindred branches of work". Such a committee, he thinks, would be effective in creating a greater interest in, and securing a larger measure of co-operation of, the universities in the solution of African problems, as well as a greater measure of co-operation between Great Britain and other colonial Powers.

Lord Hailey considers that the furtherance of research is the most important contribution Great Britain has to make to Africa at this critical stage

in its development. Unless I mistake him, he is of opinion that money devoted to research must be regarded as in the nature of a capital investment, more important than capital invested in railways and other public utility undertakings. "Errors now made for lack of knowledge which a well-considered [and generous] scheme of special study might supply may well create situations which the future can rectify only at the cost of great effort and much human distress". Every year which passes threatens to rob the effort of investigators of its value, "since conditions are likely to develop which make it progressively more difficult to apply the results of investigation and experiment".

As regards the second and voluntary body, Lord Hailey suggests that a means is required for making information concerning Africa more readily available. The present sources of information are very scattered, difficult of access and there is also difficulty in obtaining readily all the information required by those who take an interest in the economic or scientific aspects of African development.

The Bureau which he envisages would act as a source of information on practically every aspect of activity in Africa, a convenient body to maintain close contact with institutions and voluntary organizations in Great Britain and other countries interested in Africa, and to provide guidance to those who seek to pursue a special study in any subject of interest in Africa. It would publish periodically a survey of contributions made to knowledge of the continent, and generally act as a clearing-house of information and form a common meeting-ground where personal contact could be established between those who desired to improve their knowledge of African affairs.

Enough has been said, it is hoped, to indicate the remarkable quality of this eagerly awaited publication. There is no important problem in connexion with Africa to which new interest has not been given. It is the most brilliantly suggestive and stimulating contribution to the welfare of the peoples of Africa and those who will benefit by the development of that continent that it has been my privilege to read. A. G. CHURCH.

An Anthology of Anthropology

Anthologia Anthropologica:

The Native Races of Africa and Madagascar. A Copious Selection of Passages for the Study of Social Anthropology from the Manuscript Note-books of Sir James George Frazer. Arranged and edited from the MSS. by Robert Angus Downie. Pp. xii+578+10 plates. (London: Percy Lund, Humphries and Co., Ltd., 1938.) 35s. net.

SIR JAMES FRAZER'S method of exposition, not only in "The Golden Bough", but also in all his anthropological works, reveals both the widest reading and the meticulous care of the scholarly mind in exact quotation, or full paraphrase. This is based on a practice, which he has followed now for more than fifty years, of transcribing in his note-books the exact words of any and every authority he has consulted, when it has provided material bearing on his work. Much of this extracted material by now is familiar to his readers through his laudable habit of quotation; but there is still a considerable residue, upon which he has not drawn; and of this quite a considerable proportion comes from authors whose works are now rare, inaccessible, or forgotten. In order that this valuable collection of facts—for the extracts almost invariably are factual—may not be lost, Mr. Downie, under the supervision of Sir James, has made an anthology of the more significant and interesting passages, with

bibliographical details, which he has arranged in geographical order with the view of publication in a number of volumes. The first, dealing with the native races of Africa and Madagascar, is now issued. Volumes dealing with other parts of the world (Australia, Asia, Indonesia, etc.) are to follow in due course. Sir James contributes a foreword, in which he explains the purpose of the volumes as a storehouse of valuable information from authors whose work might otherwise be lost or forgotten.

The African material here presented is arranged in seven books, each covering a part of the continent—South, East, West and so forth. Some of the material is drawn from manuscript sources communicated personally to Sir James by the authors, as for example, Prof. C. G. Seligman on his now famous investigations among the Dinka and Shilluk of the Upper Nile, and the Hon. C. K. Dundas on the peoples of Mount Elgon. Broadly speaking, authors from whom Sir James has already quoted freely, or who do not antedate the twentieth century are omitted, except where they are needed to fill what would otherwise be a gap in information, owing to recent discovery. The advantage is obvious. The facts as given here, for the most part, cannot be impeached as being in any way influenced by anthropological theory, which, as is well known, has been profoundly influenced for more than forty years by the views of Sir James on the development of the human mind.

and of social and religious institutions, customs and beliefs. Thus there are no quotations from J. Roscoe's works on the natives of Uganda and related peoples. Not only has Sir James made a liberal use of Roscoe's work in his own books, but also this work was carried out in close consultation with him throughout. On the other hand, such books as H. Dale and E. W. Smith on the Ba-Ila, or C. W. Hobley's work in East Africa, are well represented, though published since the Great War, as providing evidence not otherwise available.

Detailed criticism of such a volume as this is perhaps not desired, nor is it readily feasible. Certain general reflections present themselves. Criticism may be directed against a collection of this kind on the ground that this or that item is omitted. Here the reason has been explained in part above; but it must also be remembered that an anthology is not a source-book. Its selective character must be allowed; but when the anthologist has a profound knowledge of the sources such as belongs to Sir James, criticism of his choice is a work of supererogation.

A more serious criticism attacks the value of collections of fact as such. This is a criticism of the comparative method in general, now somewhat in disfavour. It is contended that this method of study detaches the facts from their context, and further, in the hands of certain of its

exponents has tended to be uncritical of its sources. The latter is a defect of the individual critical apparatus and tends to correct itself in the view of the judicious. The gravity of the former charge, however, must depend on the way in which the facts are used. Obviously, in comparative study the whole cultural context cannot be incorporated in the text of an argument; the correct use of a fact depends not on the mode of its statement in argument, but on the extent to which its user has appreciated its place in its cultural environment. Further, the purpose of the inquiry must be taken into account. The end of anthropology is the study of man as such. The inquiries to which Sir James Frazer has devoted his whole life are directed to the elucidation of the course of evolution of the human mind, not of the minds of particular groups of men. However valuable and essential the intensive study of cultural and social groups may be, especially at a time like the present when the backward races are changing with extreme rapidity, anthropology, as a science, cannot rest in the study of the particular, but must pass to the universal, if it is to vindicate its title to be a science at all.

In conclusion, it must be mentioned that this first volume of "*Anthologia Anthropologica*" has been produced in sumptuous manner, and the editing has been done both judiciously and with extreme care.

Science and the Chemical Industry

British Chemical Industry :

its Rise and Development. By Sir Gilbert T. Morgan and Dr. D. Pratt. Pp. xii + 387 + 32 plates. (London : Edward Arnold and Co., 1938.) 21s. net.

THE story of chemical industry is the story of man's attempts to convert the raw materials of Nature into something more useful to himself, not by mere mechanical means, as weapons were fashioned from flints, but by transforming them into something entirely different, as, by the action of fire, limestone is changed to quicklime, or a mixture of sand and soda into glass. Some of the industries involving chemical change are of considerable antiquity, including those producing iron, gunpowder, soap, glass and pottery and the extraction of dyes from vegetable materials.

It is to the great outburst of scientific activity during the nineteenth century, following on the pioneering work of those old masters of chemistry, Priestley, Cavendish, Black, Lavoisier, Dalton and others, that modern chemical industry owes its existence. The researches of these men, by putting

chemistry on a sound theoretical basis, established scientific law where formerly there was but a rough empiricism. During the nineteenth century, chemical knowledge and understanding expanded at a great rate, and not only were the changes which matter can undergo unravelled, but also the mineral and vegetable kingdoms were diligently explored, and many new and unsuspected kinds of matter were discovered. If necessity is the mother of invention, surely discovery is the father. The application of these discoveries to arts and manufactures followed, as time went on, with less and less delay until, in the twentieth century the process occurs with bewildering rapidity.

To-day, although it may not be obvious to the 'man in the street', we live in a chemical age. Superficially it may be a mechanical age, but the immense strides in the design of all kinds of machinery have been made possible only by the work of the chemists who have discovered the metals and alloys essential for their manufacture and functioning. Chemistry so pervades all branches of human activity that it is indeed difficult to distinguish, as Sir Gilbert Morgan and

Dr. Pratt point out in the book under notice, which industries should be included in the category of chemical, and which should be omitted. With reluctance they must have decided to leave out the great iron and steel industry from their survey, and also the bleaching, dyeing and finishing industries which, although not producing chemical products, are predominantly chemical in that their operations use vast quantities of chemicals and are controlled by chemists. The authors have, however, given us a most entertaining and enlightening survey of many of the most important chemical industries of Great Britain.

The book is written by chemists for chemists; that is to say, the authors' first aim is to make sure that the chemical changes underlying every process are clearly explained. Nevertheless, successful manufacture in a competitive world depends on the design of the most suitable plant for the necessary operations, and accordingly the book contains a large number of admirable diagrams and illustrations of plant and lay-out. It must be admitted, however, that a photograph of a piece of chemical plant gives as little information about how it works as does one of a modern stream-lined locomotive, and has even less æsthetic appeal. The feature of the book which distinguishes it from others of its kind is the authoritative nature of the matter it contains. The authors have been fortunate, or sufficiently persuasive, to get all the important chapters in the book reviewed and amplified by recognized authorities; it may be taken, therefore, that there are few misstatements, and that, for the more modern industrial developments, as much has been revealed of manufacturing detail as is possible at the present time.

From a descriptive point of view, there is a good deal in favour of classifying the chemical industries according to the raw materials from which they start—salt, coal, cellulose, petroleum and so on. This classification, which has been adopted in this book, immediately distinguishes those industries depending on native supplies from those which have to import their raw material. That the opening chapter should deal with the salt industries is a happy choice, since this leads to descriptions of the Le Blanc and ammonia-soda processes for sodium carbonate. The setting up of the Le Blanc process in Great Britain appears, historically speaking, to have established Britain as a great manufacturing country for heavy chemicals, and some of the greatest names in industrial chemistry are associated with its development and that of its offshoots—such names as Gamble, Crossfield, Tennant, Gossage, Chance, Claus, Deacon and Weldon. The manufacture of soda involved that of immense quantities of sulphuric acid, hydrochloric acid, chlorine, bleaching powder, caustic

soda, and so on. Advances in scientific knowledge, particularly the coming of the electrolytic process for caustic soda and chlorine, provided the opportunity for a rival process, the ammonia-soda process, which starts with salt, ammonia and carbon dioxide instead of salt, limestone and sulphuric acid, to displace the Le Blanc process, which has now become obsolete. In a similar way, the contact process for sulphuric acid is gradually displacing the old lead chamber process; and since the publication of this book it has been announced that a new vanadium catalyst which cannot be poisoned has been put into the most recent plant for the contact process.

It is impossible in a short notice to say a tithe of what might be said of the romance of the rise of the chemical industry: of the spectacular increase in the production of metallic aluminium, and more recently of magnesium; of the intricacies of the isolation of the metals of the platinum group and their present-day key position; of the dyestuff industry, its rise, recession and rejuvenation in Great Britain, and the recent British discovery of the extraordinarily stable 'Monastral' (phthalocyanine) pigments, one of which is used effectively for the cover of the book; of the discovery of new drugs, including the vitamins, some of which are now being manufactured in Great Britain; of the coming of chemistry into the petroleum industry and the use of catalytic processes for improving fuels; of the utilization of the gases of the atmosphere, nitrogen for ammonia and nitric acid, argon, neon, and even krypton and xenon for electrical lamps. We cannot omit to mention the chemical processes which have given us new textile fibres, viscose and cellulose acetate, now manufactured all over the world; the importance of chemistry in agriculture; and finally chemical warfare.

What is the conclusion of the whole matter? Britain's prosperity is based on her industries, and the whole world is becoming industrialized. Progress in industry has long passed the empirical stage and is dependent on the application of science—chemistry, physics, biology—in its highest forms. It is imperative that we have a succession of men of the highest type to staff our industries, thoroughly equipped scientifically, with abundant opportunities for research. The big industries of Great Britain are providing the research opportunities; auxiliary to them are the research associations and such establishments as the National Physical Laboratory and the Chemical Research Laboratory. It is for the universities to supply the trained men for industry whilst retaining within their own walls persons whose gifts are for teaching or for the pursuit of fundamental knowledge. There is some danger that the demands of industry may denude the universities to an alarming extent.

Background to Modern Science

Ten Lectures at Cambridge arranged by the History of Science Committee, 1936, by F. M. Cornford, Sir W. Dampier, Lord Rutherford, W. L. Bragg, F. W. Aston, Sir A. S. Eddington, J. A. Ryle, G. H. F. Nuttall, R. C. Punnett, J. B. S. Haldane. Edited by Joseph Needham and Walter Pagel. (Cambridge Library of Modern Science.) Pp. xii+248. (Cambridge: At the University Press, 1938.) 7s. 6d. net.

THE ten lectures which make up the present volume were delivered in Cambridge during 1936, under the auspices of the then newly formed History of Science Committee, and it is not surprising to learn from the preface that they were attended by crowded and enthusiastic audiences. A glance at the list of authors will show that the Committee was fortunate in being able to enlist the services of a most distinguished team of lecturers, and as the volume itself shows, it was equally fortunate in being able to secure the manuscripts of the lectures in a form suitable for publication.

Apart from introductory lectures on Greek natural philosophy and on the period stretching from Aristotle to Galileo, the remainder of the volume consists of accounts of the progress, during the past forty years, of some of the more active branches of science. Radioactivity, crystal physics, atomic theory, astronomy, pathology, parasitology, evolution theory and genetics have been selected as representing what the dust cover describes as "the cutting edge of human scientific activity". To praise the work of the distinguished authors would be both superfluous and impertinent. Within the very brief space at his disposal—some twenty-four pages—each author has succeeded in giving a vivid, personal, and authoritative 'eye-witness's account' of the progress on his own section of the scientific front. Perhaps some future volume in this excellent library will give us a co-ordinated account of the campaign as a whole.

J. A. O.

The Atlas of To-day and To-morrow

By Alexander Radó. Pp. ix+198. (London: Victor Gollancz, Ltd., 1938.) 10s. 6d. net.

AS, with the advance of science, the world shrinks, human geography grows in importance. Scarcely a generation passes but new States are created or the boundaries of old ones are revised. The present volume is admirable in scope and execution. Its aim is not to dwell upon the more or less static geographical features which find their place in the usual type of atlas, but to provide a cartographic record of that bewildering mass of political and economic problems which have such an important bearing upon the future of mankind.

A more accurate title would be "The Atlas of Yesterday and To-day". Starting from 1875 the authors picture the progressive division of the world by the great powers, the building up of colonial empires, the struggle for world markets and the control of communications, concluding with a brief summary of significant differences in religion, race, nationality and forms of government. The statistical

tables are numerous, concise and instructive, but the reader is left to discover for himself which figures are well grounded and which, at best, can only be rough estimates. In the next edition, to which we may look forward confidently, the use of a comma both as comma and as decimal point (for example, in Table 4) should be avoided, and a serious error throughout the first column of figures in Table 7 should be corrected.

Library Guide for the Chemist

By Prof. Byron A. Soule. (International Chemical Series.) Pp. xiii+302. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 15s.

THERE are published every twelve months about fifteen hundred books, forty thousand articles and 20,000 patents of chemical interest; this flood is increasing at the rate of 6 per cent per annum. The chemist, whether he be research worker or engaged in industry, must be in touch with some portion of this literature if he is to avoid repeating work which has been done elsewhere, whilst there are many others who seek to locate chemical information beyond the purely obvious. The research student gets some kind of training in the use of a chemical library, but it is not always easy to know where to look; moreover, critical judgment as to the quality of the work consulted is an important element for success. It is valuable therefore to have a book entirely devoted to acting as a guide to this enormous literature. That before us is well done, and though of trans-Atlantic origin it will be equally serviceable in a British or European laboratory. A corollary of such work is the existence of really good libraries. Chemists are strangely lacking in a proper sense of co-operative effort and it is a stigma that the library of the Chemical Society, which is still the best in the world, is still inadequately housed and supported.

The Elements of Quantum Mechanics

By Dr. Saul Dushman. Pp. xiii+462. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 25s. net.

DR. DUSHMAN'S admirable book is the outcome of a series of lectures on quantum mechanics delivered by him at the Ohio State University. They were addressed to students who had not received "any intensive training in mathematics beyond calculus". This being so, the development of the various theses is somewhat leisurely but, from the pedagogic point of view, is all the better on that account. The author has selected his topics for discussion with discretion and presents them most skilfully. He deals in turn with the Schrödinger equation, potential barriers, the linear harmonic oscillator, the rigid rotator, the hydrogen and helium atoms, the hydrogen molecule, valence bonds, and the theory of radiation.

The treatment is as elementary as may be; the exposition is remarkably clear, and the book may be warmly commended as an introduction to more advanced treatises.

A. F.

Cancer: Radiological Treatment and Research

THE radiological policy of the Medical Research Council immediately after the Great War was determined by its acceptance from the Ministry of Munitions in 1919 of about two and a half grams of radium element for the purposes of experimental and clinical research. Since then the Council has systematically helped the advance of radiology, especially in its relation to cancer, and from 1922 onwards, with only one omission, it has published yearly reports from research centres in the "Medical Uses of Radium" series. The current issue for 1937* has just been published and maintains in every way the traditions of these publications. A larger section each year is devoted to pure experimental research. One of the chief values of this publication is that it gives a summary of the results of radium treatment of cancer in various parts of the body. The results are given as survival rates, and in many cases the data extend back over a period of ten years or more.

About the same time another valuable contribution, the "Report on Radium Beam Therapy Research", also under the aegis of the Council, has been published†. This report relates in detail the way in which a clinical investigation into the value of large radium units (five grams of radium element) was carried out. The research was begun in 1934 with one five-gram unit, and another similar unit was available in 1936. At the outset, it was decided to limit the research to cases of cancer of the mouth, pharynx and larynx, the reasons for this choice being that they are accessible to direct examination, and that adequate surgery is in many cases difficult and mutilating.

It is impossible here to refer to the many features which give the impression of work admirably planned and no less admirably carried out; there is scarcely a question that comes to the mind that is not answered in the text. It is a welcome sign in the radiological outlook to find a paragraph such as the following:

"It is already noteworthy that doses as large as 8,000 r have failed to sterilize some growths, whereas 4,000 r has been successful in others. It would appear that there are many factors other than dosage which have a profound influence on the response of cancer to radiation."

Turning from radiological research and treatment of cancer to the policy that is to guide its development in the future, two publications call

for comment; one is the "Annual Report of the Radium Commission, 1937-1938"*, the other the text of a Cancer Bill introduced into the House of Commons on November 30 by the Minister of Health, Mr. Walter Elliot. The Bill is the result of the efforts made in the last ten years by those actively concerned in the radiological treatment of cancer. Whether it be an individual or a group or an organizing body, like the Council and Commission already mentioned, or a co-ordinated effort by the British Empire Cancer Campaign and King Edward's Hospital Fund, the result is the sum total of these efforts, and it is to show that radiological methods are of great value in the diagnosis and treatment of cancer. A national policy to ensure more facilities for cancer treatment is overdue, but none the less welcome. The main provision of the Cancer Bill is to establish a service under which, in every part of the country, modern facilities for diagnosis and treatment of cancer will be available. The Bill places an obligation on the major local authorities to consult with the Radium Commission and bodies representing voluntary hospitals and the local medical profession, and to make arrangements for securing the necessary facilities. The Bill provides for an Exchequer grant towards the cost of the new service. When the service is in full operation, the additional expenditure will amount to about £800,000 per annum for England and Wales, and £100,000 for Scotland.

A clause of the Bill provides for "loans to be made to the National Radium Trust for the purchase of additional quantities of radium. Provision is also made enabling money to be lent to the Trust under the section for the purchase of other radioactive substances and apparatus and appliances required for radiotherapeutic treatment. It is proposed that the moneys to be advanced to the Trust, not exceeding £500,000 in all, shall be repayable to the Minister with interest by way of annuities spread over appropriate periods".

Only brief reference can be made to the annual report of the Radium Commission, which includes a statistical report. The outstanding feature of the report is the information upon the use of the bigger radium units, made possible by the provision of another 10 grams of radium. Units ranging from 1 to 3 grams of radium element are in use at no fewer than seven of the national centres throughout Great Britain.

The Government purchase is going to give

* Medical Research Council. Special Report Series, No. 222: Medical Uses of Radium; Summary of Reports from Research Centres for 1937. Pp. 48+2 plates. (London: H.M. Stationery Office, 1938.) 1s. net.

† Medical Research Council. Special Report Series, No. 221: Report on Radium Beam Therapy Research, 1934-1937. By Constance A. P. Wood, L. G. Grimmett, T. A. Green and others. Pp. 77+23 plates. (London: H.M. Stationery Office, 1938.) 4s. net.

* Ninth Annual Reports of the National Radium Trust and Radium Commission, 1937-1938, including a Statistical Report. (Ond. 5953.) Pp. 63. (London: H.M. Stationery Office, 1938.) 1s. net.

Great Britain a big interest in radium as a 'possession'. This will inevitably entail continuous technical and chemical work, such as the filling, redistribution and concentration of radium in containers. The National Physical Laboratory has served the country well in physical measurements, but radium services have always been and will remain incomplete until a physical chemistry laboratory becomes part of the national radium and cancer service.

It is very doubtful whether any country of size and population of Great Britain is better supported and staffed in the fight against cancer, and to their credit it should be remembered that the voluntary hospitals have borne the brunt of radiotherapeutic research. It now remains to be seen how successfully individual efforts can be co-ordinated to the common good.

S. RUSS.

Scientific Centenaries in 1939

By Eng.-Capt. Edgar C. Smith, O.B.E., R.N.

ON May 26, 1639, three hundred years ago, in the ancient convent of the Jacobins, in the historic Rue St.-Honoré, Paris, there passed away at the age of seventy-one years the refugee Italian philosopher Tomaso Campanella, one of those inquiring men of unquenchable spirit, who by their determination to destroy "those errors which had become venerable by antiquity" paved the way for the free exercise of thought and investigation which is one of the treasures of the world to-day. Born at the little town of Stillo, Calabria, on September 5, 1568, he was a contemporary of Kepler and Galileo, and like the latter he incurred the hostility of the Church, although a member of it. Owing to his political activities, he was kept in confinement in Naples by the Spanish Government for more than a quarter of a century, but he was able to write several books, among which was "An Apology for Galileo". He was nearly sixty years of age when set free, but even then was kept under close observation, and in 1634, when sixty-five, he escaped from Rome to Marseilles. In France he was befriended by Louis XIII and Richelieu, and was given lodgings in the convent of the Jacobins in Paris.

The year 1639 also witnessed, not the birth or death of a famous astronomer, but the epoch-making astronomical observation of a transit of Venus, by the young Lancashire clergyman Jeremiah Horrocks. On Sunday, November 24, 1639, in between his religious duties, Horrocks had the intense gratification of witnessing, as he had expected and laboured for, the passage of the planet across the sun's disk. His friend Crabtree at Broughton, near Manchester, through Horrocks, in the late afternoon of that Sunday, also caught a glimpse of the same spectacle. "Thus did two young men, cultivating astronomy together in a state of almost complete seclusion in one of the northern counties of England, enjoy the privilege of witnessing a phenomena which human eyes had never before beheld, and which no one was destined

again to see until more than a hundred years had passed away" (Grant). Hundreds of observers watched the transits of 1761 and 1769, and those of 1874 and 1882, and it was through the interest aroused by that of 1874, that a tablet to Horrocks, with an inscription by Dean Stanley, was placed on the memorial to Newton's nephew, John Conduitt, at the west end of Westminster Abbey.

Cambridge had no chair of mathematics when Horrocks was an undergraduate at Emmanuel College, and it was not until 1663 that the Lucasian professorship was founded. The first occupant of the new chair was Barrow, the second was Newton, the third was Whiston and the fourth was Nicolas Saunderson, who died at the age of fifty-seven years on April 19, 1739. Saunderson had held the chair twenty-eight years, having been appointed to succeed Whiston, who in 1710 was deprived of his post owing to his religious opinions. At this time, mathematics at Cambridge may, as Prof. Turner said, have entered a dark century which it is difficult to contemplate, but assuredly Newton had no more devoted disciple than Saunderson. Blind from the age of a year, Saunderson owed his knowledge of mathematics to the patience and generosity of friends, one of whom, Joshua Durn, took him to reside at Cambridge in 1707. Lord Chesterfield, who was at Cambridge in 1712-14, described Saunderson as a professor "who had not the use of his own eyes, but taught others to use theirs".

Contemporaries of Saunderson in Italy, and France, who made contributions to physical science and who also died in 1739, were Eustachio Manfredi (1674-1739), the elder of the two Bolognese mathematicians and hydraulic engineers bearing that surname, and Charles François Du Fay (1698-1739), who repeated and extended Gray's electrical experiments and was the discoverer of two kinds of electricity which he named the *vitreous* and the *resinous*. He also noticed the discharging power of flames. Du Fay had first been a soldier, but

abandoned the army for science and at his death was comptroller of the Jardin des Plantes, in which post he was followed by Buffon. Manfredi was for a number of years astronomer to the Bolognese Institute and was made a foreign member of both the Paris Academy of Sciences and the Royal Society.

Another tercentenary of much interest is that of the birth of Thomas Tompion (1639-1713), the 'Father' of English clockmaking, whose grave is in the nave of Westminster Abbey.

Among the men of science born two hundred years ago was the Scottish natural philosopher John Robison (1739-1805), an interesting figure in many ways. When twenty years of age, as a tutor to the son of an admiral, he was with Wolfe at the landing at Quebec; at twenty-three years of age he assisted in testing at sea John Harrison's chronometers. He lectured on chemistry at Glasgow, held the chair of natural philosophy at Edinburgh, was the first secretary of the Royal Society of Edinburgh and was the intimate of Watt, Black, Hutton, Playfair, Adam Smith and Hume. His son, Sir John Robison, was a founder of the Scottish Society of Arts.

The mathematicians George-Simon Klugel (1739-1812) and Jacques-Antoine-Joseph Cousin (1739-1800) were also born in the same year as Robison. Klugel, a professor at Halle, was the author of a dictionary of mathematics (1803-8), which was added to by some of his countrymen, while Cousin held a chair at the Collège de France for thirty-two years and another at the École Militaire for twenty years. During the French Revolution, he held public offices with success, and though imprisoned at one time, to him fell the task of ordering the use of the new system of weights and measures.

To these names may be added those of Hewson and Townsend. William Hewson (1739-74) was associated as pupil and assistant with both John and William Hunter, and at the age of thirty-one years was awarded the Copley Medal for researches on the lymphatic system in oviparous vertebrates. His promising career was cut short by poisoning from a wound received while dissecting. The Rev. Joseph Townsend (1739-1816), rector of Pewsey, Wiltshire, travelled and studied mineralogy, and in his writings endeavoured to reconcile the Mosaic record with the findings of science. He was a close friend of William Smith and was one of the first honorary members of the Geological Society.

William Smith (1769-1839) was one of three engineers who achieved fame, and passed away a century ago, the others being William Murdock (1754-1839), the right-hand man of Boulton and Watt, and the inventor of gas-lighting, for which he was awarded the Rumford Medal in 1806, and Gaspard-Clair-François-Marie-Riche de Prony

(1755-1839), writer of many scientific and engineering works, engineer-in-chief of the Corps des Ponts et Chaussées and director of the Survey of France. Smith was a contemporary of Telford and Macadam, and like them travelled on his professional duties the length and breadth of Great Britain. His surveys and inspection of canals, drainage works, mines, quarries, embankments and suchlike all yielded him material for his famous geological map of England and Wales published in 1815, "the first attempt," said Von Zittel, "to represent on a large scale the geological relations of any extensive tract of ground in Europe". Smith in his later years fell on hard times, but seven years before his death he was given a Civil List pension of £100 a year. Another English man of science who died in 1839 was Davies Gilbert, who though himself an accomplished mathematician and physicist, furthered the advance of science more by his public activities than by his researches. He was president of the Royal Society from 1827 until 1830 and for a long while sat in Parliament. "He was," wrote Weld, "emphatically the representative of scientific interests in the House of Commons, and contributed by his exertions to carry many very important objects."

When Smith was laying the foundation of his fame, geology as we know it was in its infancy; when he died, geological societies were active in England, Scotland and France, the Geological Survey of Great Britain had been founded, and instead of being the pursuit mainly of a few men of leisure and of independent means, the science could count its students by the hundred. The growth of the science during last century is to some extent reflected by the fact that the year 1839 saw the birth of at least six men who achieved distinction as geologists. Henry Govier Seeley (d. 1909), a link with Sedgwick, and a Lyell medallist, was born on February 18; Arnold von Lessaulx (d. 1886) of Bonn, a pioneer in microscopic petrography, was born on June 14; James Geikie (d. 1915), the holder of the Murchison chair at Edinburgh, was born on August 23; Karl von Zittel (d. 1904) of Munich, the author of the well-known "History of Geology and Palaeontology", was born on September 25; Edmund Mojsisovics von Mojsvár (d. 1907) a pupil of Suess, and vice-director of the Geological Institute of Vienna, was born on October 18, while the French geologist Albert de Lapparent (d. 1908) who served as president of the French Geological Society and as permanent secretary to the Paris Academy of Sciences, was born on December 30, 1839.

Of men famous in other branches of science who also were born a century ago, the list includes the names of Mond, Eliot, Kundt, Gibbs and Thurston, Ludwig Mond (1839-96), the great industrial

chemist, came to England fresh from the laboratories of Kolbe, Bunsen and Kirchhoff, and stayed to build up the famous firm of Brunner, Mond and Co. and to found the Davy Faraday Research Laboratory at the Royal Institution. Sir John Eliot (1839-1908), from St. John's College, Cambridge, went to teach mathematics in India and became the Director-General of the Indian Meteorological Service, benefiting both those ashore and afloat by his study of cyclones. August Kundt (1839-94), the successor of Helmholtz at Berlin, is remembered for his original investigations in sound and light. Josiah Willard Gibbs (1839-1903), of Yale, was Copley medallist in 1901. He was", said Sir William Huggins, "the first to apply the second law of thermodynamics to the discussion of the relation between chemical, electrical and thermal energy". His name will always be associated with the Phase Rule.

In his own particular sphere, none occupied a more prominent place than the American engineer and educationist Robert Henry Thurston (1839-1903). At the Stevens Institute, Hoboken, Thurston organized the first mechanical engineering laboratory in the United States, while at Sibley College, Cornell University, whither he went in 1885, he saw the number of engineering students under him grow from a total of sixty to 900. He was a founder and the first president of the American Society of Mechanical Engineers.

In conclusion, attention may be directed to one or two of the outstanding scientific books published in the year 1839, and one or two events which excited considerable interest, or proved of lasting importance, to the world of science. Among the books were the first volume of Faraday's "Experimental Researches in Electricity" and Darwin's "Journal and Remarks, 1832-36", which appeared as the third volume of Fitz Roy's

"Voyages of the Adventure and Beagle". Of Darwin's work the *Quarterly Review* said, "We find ample materials for deep thinking; we have the vivid description that fills the mind's eye with brighter pictures than painter can present, and the charm arising from the freshness of heart which is thrown over these virgin pages of a 'strong intellectual man, and an acute and deep observer'". Another notable book was Murchison's "The Silurian System", which Sir Archibald Geikie called a "splendid monograph with which it was now possible to carry the vision across a vast series of ages, of which hitherto no definite knowledge existed", and yet another, W. H. Miller's "Treatise on Crystallography".

The year 1839 was also marked by the announcement by the naturalists Theodor Schwann (1810-82) and Matthias Jakob Schleiden (1804-81) that all the higher animals and plants are made up of cells; by the invention by Sir W. R. Grove of his battery experiments with which Schönbein was led to his observations on ozone; by the discovery by Charles Goodyear of his process of the vulcanization of rubber, and by the first trials of the historic pioneer screw-driven vessel *Archimedes*. But nothing excited more enthusiasm in scientific circles than the publication of the account of Daguerre's method of obtaining pictures on metal plates. On January 7, 1839, Arago communicated Daguerre's invention to the Paris Academy of Sciences, and in the summer the French Government purchased the invention, making the inventor an officer of the Legion of Honour and awarding him a pension of 8,000 francs. A fortnight after Arago lectured at the Academy of Sciences, Faraday at the Royal Institution described Fox Talbot's invention of "photogenic drawing". These were both notable steps in the early progress of photography.

Potato Problems*

By Dr. S. Linné, Ethnographical Museum of Sweden, Stockholm

THE native peoples of America were clever botanists, and the culture inherited from the Indians has supplied humanity with numerous cultivated plants of inestimable value; for example, the potato, maize, cacao, tobacco, tomato, etc. The potato is certainly the most important,

along with maize. In four Masters Lectures before the Royal Horticultural Society, Dr. Salaman has presented the latest discoveries and the results of his own investigations and of those of others concerning the potato in ancient and present times in America, and its introduction into Europe.

It is certainly not surprising that this important cultivated plant, and the question as to its origin, have attracted the attention of botanists, but Dr. Salaman is the first scientist to have studied the potato problem not only from an archaeological,

*The Potato in its Early Home and its Introduction into Europe, Masters Lectures, 1936, by Redcliffe N. Salaman (*Journal of the Royal Horticultural Society*, Vol. 62, Pp. 53+46 figs. London, 1937.)

A brief summary in which certain points of view have been revised has since been given in a discourse entitled "The Origin of the Potato and its Influence on Man's Early Settlement in South America," published in the *Proceedings of the Royal Institution of Great Britain* (80, No. 141, pp. 25+9 figs., 1938).

but also from a 'psychological' point of view. By way of introduction he points out that Russian savants conducted several expeditions during 1928-32 and greatly increased our botanical knowledge of the potato, establishing, among other things, that the majority of the thirteen tuber-bearing species of *Solanum* have, from earliest times, been cultivated by the Indians of South America. They have further demonstrated that the potato, numerous wild forms of which exist from Colorado to Chile, but which was only cultivated in South America in pre-Columbian times, developed in two distinct areas. They are the Peruvian and Bolivian plateaux (*Solanum andigenum*) and the Island of Chiloe and neighbouring parts of the Chilean coast (*Solanum tuberosum*). The common domestic potato of Europe, and *S. tuberosum*, are identical, and according to the Russian investigators it then follows that the potato introduced into Europe towards the end of the sixteenth century came from Chile.

Dr. Salaman, however, holds an entirely different opinion, and the evidence presented by him appears to be irrefutable. First of all, the parts of the Chilean coast referred to had not yet been conquered by the Spaniards, for the natives made very stubborn resistance, and it must thus have been rather a difficult task to obtain potatoes there. Even though it may have been possible, the crop would then have been harvested at a very unsuitable time for the potatoes to be set in Europe. Chile is in the southern hemisphere and the potato is harvested in April. Considering the communications at that time, the potatoes would be of no use for planting on their arrival in Europe; and they also would have been stored for some time in the tropics. In the Peruvian and Bolivian highlands with their varying nature, however, it would have been possible to select a more suitable time. The difficulties of transportation would have been considerably simplified if seed had been taken instead of tubers, but this must be considered excluded. The Indians, who taught the Spaniards how to cultivate potatoes, always planted tubers, and still do, and it was European botanists who later became interested in the seeds.

Also, from a botanical point of view, difference between *S. andigenum* and *S. tuberosum* is so small that, according to Dr. Salaman's analyses, it cannot be definitely determined whether the European potato had its origin in one or the other. It is known from the time that the potato was first cultivated in Europe that it set seed freely, which is a characteristic of *S. andigenum*. Seedlings were raised, and new varieties were soon produced. The Indians cultivate about one hundred varieties, and everything indicates that they had a very rich

assortment also in early times. At village fairs in southern Peru, the natives have been seen to offer for sale more than sixty different varieties of potatoes.

As regards the introduction of the potato into Europe, it has hitherto been considered that 1588 was the earliest fixed date. The potato was then cultivated in Italy, having come from Spain. However, thanks to various data in the literature hitherto overlooked, Salaman has succeeded in demonstrating that it was cultivated in the neighbourhood of Seville in 1572, and he considers it likely that it was first introduced at least ten years earlier.

A little later, but quite independent of Spain, the potato made its second entry into Europe, this time into England. However, it did not come from Virginia, as is often stated; for it is not native there and was not introduced there until more than a hundred years later. Salaman is of the opinion that Sir Walter Raleigh should have the credit of being the first to introduce and plant potatoes in England, and that this was in 1586. There is as yet no absolutely conclusive proof of this very momentous event, but apparently the introduction occurred on two occasions, quite independently; in Spain and in England, the potato thence finding its way to the rest of Europe. In both cases, the potato derived its origin from Peru, Bolivia, Ecuador, or Columbia, but scarcely from Chile.

We can obtain a knowledge of the early history of the potato and of its use in America from the chroniclers of the conquest and from the pottery found in pre-Spanish graves on the Peruvian coast. Seeing that the art of writing was unknown in South America, it is the archaeological investigations alone that can throw light upon the history of the country prior to the arrival of the Spaniards. The pottery thus plays a prominent part; for the wonderfully shaped ware of the Peruvian people portrays human beings and animals, weapons and tools, scenes of everyday life, battles and religious ceremonies. The pottery from Chimú, on the northern part of the Peruvian coast, is especially outstanding in virtue of its ever-varying choice of motifs, vivid naturalism combined with a keen eye for artistic effects and unsurpassed technical skill. Five consecutive periods can be distinguished and be dated approximately, from the beginning of our era up to the arrival of the Spaniards and the downfall of Inca in 1533. The Chimú ware is thus also the main source of our knowledge of the use of the potato in prehistoric times and of the religious conceptions attached to it.

The potato was cultivated in the highland valleys and plateaux of the Andes, but for climatic reasons it was not cultivated on the slopes towards

the coast or on the actual coast, that is, in the river valleys, which, separated from each other by stretches of deserts, were the only districts suitable for agriculture, especially for the cultivation of maize. Several types must have been raised at a very early date: *inter alia*, a hybrid form which was rather frost-hardy. It is very probable that, in its native country, the potato has been cultivated for three millenniums.

It is strange that only in the pottery of the coastline do we find reproductions of the potato. This is due to the fact that the highland ware on



YELLOW ANTHROPOMORPHIC POT FROM CHIMBO. FIGURE COMPOSED OF POTATO TUBERS WITH PRONOUNCED 'EYES'. NOTE THE EXCISED NOSE AND EMERGED UPPER LIP. Reproduced by permission of the Council from J. Roy. Hort. Soc., 62 (1937).

the whole has no reproductions of either human beings, animals, or other objects. Thanks to the dry climate—there is practically no rain—and the high nitrate content of the soil, everything that was deposited in the graves on the coast has been preserved. Even in the graves dating from the oldest Chimú culture has there been discovered pottery in the shape of potatoes and chuflo, that is, preserved potatoes. The manner of producing chuflo, freezing, treading on the tubers spread on the ground, with the view of squeezing the water out of them, and drying, is to this day the same as that described by the Spaniards four hundred

years ago, and was undoubtedly the same two thousand years earlier. Probably chuflo is one of the first preserved foodstuffs that ever existed. Not until potatoes were cultivated and this method of preservation introduced could the Peruvian and Bolivian highlands feed a more numerous and permanent population. It is thus impossible to over-rate the importance not only of the potato but also of chuflo for man's conquest of these territories.

One of the theories upon which Salaman founds considerable parts of his historical comments is that the Peruvian coastal population crossed the mountains from the South American primitive forests. This is connected with his opinions as to how man originally took possession of the continent, and here the presence of chuflo in the graves on the Peruvian coast plays a prominent part. Salaman considers that the immigrants were unable to penetrate the Isthmus of Panama on account of its rain-forests and its generally inhospitable nature. In the event of their crossing from Central America to South America in canoes, chuflo, which did not exist in Central America, would not have been found in the graves on the coast. Certainly the woods in the Isthmus of Panama are difficult to penetrate, and I know from my own experience that this is true with reference to Europeans but not as regards the natives. Nor must the fact be forgotten that the whole Isthmus has from ancient times been inhabited by native tribes, and that even they have produced cultures of a high level. Furthermore, the Peruvian coast was undoubtedly populated long before the potato was common food and before the culture flourished from which Salaman has obtained his archaeological proof. This is demonstrated, *inter alia*, by the remains found after the primitive fisher population at Arica and other places.

That "the original settlers reached South America via the great river systems of the Orinoco and the Amazon" is a hypothesis that remains to be proved, and can be accepted only when further reasons have been produced. According to Salaman, these early immigrants found little attraction in the forest and river districts and made their way up the high Andes. The reason for their doing so he considers can be expressed "in the one word fear", which would appear to be rather too simple an explanation, especially as the forests had quite a considerable Indian population which have produced rather highly developed cultures, suited to the conditions, and satisfactory for their existence. We are unable to determine what occurred in a dim and distant past when South America was gradually becoming populated by immigrants from the north. Weaker peoples were elbowed out by stronger ones; migrations and

displacements were continually occurring due to various causes. Undoubtedly, the jungle and rain-forests were not populated very extensively until comparatively late; primitive culture as well as real civilization belonging to the dry territories.

The above-mentioned Chimu vessels with potato motifs have been arranged by Dr. Salaman in certain groups with special reference to the motifs, these groups also being chronologically separated from each other. Those dating from the oldest period are mainly anthropomorphic, that is, having human shapes, but they display tuber-like parts in which the 'eyes' of the potato are represented.

like form, are increasingly suppressed. During the Inca period, finally, there are seen only faint traces of the eyes, the potato-shape, too, having almost vanished.

Dr. Salaman is of the opinion that the mutilation of the nose and lips is a kind of ritual sacrifice. For reasons unknown, he assumes that "for the sake of the potato" the coastal population originally sacrificed human beings, but that later they contented themselves with the mutilation, which was finally replaced by merely removing the upper lip. The Peruvian potato tuber is often blood-red, with very deep eyes surrounded by a brow.



PROTO-CHIMU ANTHROPOMORPHIC POT FROM TRUJILLO. CREAM AND RED. FRONT AND BACK VIEW SHOWING EXTREME MUTILATION OF NOSE AND MOUTH. BACK OF HEAD ORNAMENTED WITH POTATO EYES. Reproduced by the permission of the Council from *J. Roy. Hort. Soc.*, 62 (1937).

The majority portray human beings with mutilated faces; nose and lips have been cut off. The oldest vessels are most severely mutilated; in the later ones the mutilation is often merely indicated, and finally it was limited to the removal of the upper lip.

Later, there appear no mutilations, though the pots maintain their anthropomorphic type, but with tuber-like projections and the stigmata of the potato eye. Gradually the human shape attracts less and less interest and the potato-shape becomes more and more predominant. During the Late Chimu period the realism at last almost disappears: thus also the mutilations, and the tuber-

According to Dr. Salaman's hypothesis, the natives looked upon the eyes as a mouth from which the new buds stood out like teeth. As the potato-spirit had to be given new strength to replace what had been consumed, this would be accomplished by a sacrifice which in some manner was connected with the potato's most important part. Experience had taught the native that the bigger the mouth and the more prominent the teeth, the richer was the crop. By removing the lips and denuding the teeth of the sacrifice, the resemblance to the potato mouth was created, and the potato-spirit could not be mistaken as to what was expected from him.

I regret to say that I can scarcely follow, and still less agree with, these views. We do not know the part played by the potato in the household of the coastal population, nor do we know whether or not chuffo was present in the graves of pilgrims from the mountains. It certainly seems very improbable that the coastal population should have made sacrifices to the potato-spirit operating in the highland districts, with which they had nothing to do but to purchase his products. There are, moreover, numerous vessels portraying mutilated faces which have nothing whatever to do with the potato, and which medical specialists have presumed to represent morbid changes, *inter alia*, syphilis. It would not appear very remarkable that, in their art, which need not always be of a magic character, the natives found reason to express a resemblance between a face deformed by a disease and the potato, which resemblance certainly may be striking.

As a support for his theory, Dr. Salaman has collected a large number of instances of sacrifices and ceremonies of various kinds connected with the setting and harvesting of potatoes from the discovery of South America to the present day. These rites subsist as an echo of ancient times, but they do not prove that the coastal people sacrificed human beings to the potato-spirit, or that the mutilation portrayed by the pots is an expression of a fertility rite.

Dr. Salaman's studies overflow with interesting, personal working theories, which, however, in many cases cannot very well be made to agree with our knowledge of the customs of the South American natives. It is indeed very satisfactory, though in many cases one may feel sceptical of the results, that an important problem is discussed so extensively without considering ordinary archaeological and ethnological methods and with fresh points of view.

News and Views

Sir Richard Gregory, Bart., F.R.S.

A PERIOD of forty-five years is but as a day in the life of a State; it is a large fraction of the life of one man. Yet, as will be seen from the first article in this issue, it represents the period during which Sir Richard Gregory has been associated with *NATURE*; and since 1919 he has governed the policy of the journal, which has become intimately associated with his name. His retirement will come as a shock to many readers, and it will be a loss to all that his great qualities of leadership, matured by long association with the journal, will no longer be directly available to us. In his message to readers of *NATURE*, in the present issue, he has stated in his own inimitable fashion the policy that has ever guided and encouraged his labours for science and for humanity, and there is no need to elaborate them here. They may be summed up in two phrases: a clear recognition of the importance of the reactions of advances in science on the well-being of the community, and intense faithfulness to the ideals of the freedom of learning and its independence of national boundaries, of caste and of creed.

NATURE, probably more than any other periodical of its age and status—it will shortly celebrate the seventieth anniversary of its birthday—has preserved a consistency of outlook which has widened rather than changed fundamentally with the changing years. This is in great measure due to the wisdom and foresight of the two editors, Sir Norman Lockyer and Sir Richard Gregory, who have for so long a period guided its fortunes. Sir Richard, in particular, clearly perceived the increasingly large share which science was bound to take in moulding the social life

of the community, and the corresponding increase in the responsibilities of the man of science towards that community whose fate may, nay, will, be determined by the use, or misuse, of the powers that he puts into its hands. These views have, of late years, been elaborated with increasing force in these columns, and the world at large is deeply indebted to Sir Richard Gregory for the vigour and clarity with which he has expounded them. His retirement from active participation in *NATURE* will, we trust, release him for yet further public work for the advancement of civilization and progressive science.

Sir James Jeans, O.M., F.R.S.

THE appointment by His Majesty the King of Sir James Jeans to the Order of Merit is a well-deserved reward for outstanding work in mathematical physics and astronomy. Jeans's earliest investigations were concerned with the dynamical theory of gases; by the use of generalized co-ordinates, he gave a rigid proof of Maxwell's law of distribution of molecular velocities, and of the theorem of equipartition of energy. He also improved the theory of viscosity and made important contributions to the theory of radiation and of quanta. When a pupil of Sir George Darwin, he had become interested in the difficult problem of the stability of the pear-shaped form of rotating, incompressible, gravitating fluid. Darwin, Poincaré and Liapounoff had discussed this with discordant results. By a masterly piece of analysis, carried to a third-order approximation, Jeans was able to show that this form was unstable. He then turned to the more difficult problem, which is of greater importance for cosmogony, of a rotating mass of compressible fluid, and showed that for a

density greater than a certain critical value, the behaviour is generally similar to that of the incompressible fluid, but that for lower densities equatorial break-up, by ejection of matter from the equator, will occur. These results were applied to the evolution of the solar system, binary stars and spiral nebulae in an essay that was awarded the Adams Prize in 1916. The conception of gravitational instability as a cause of the separation of primitive material was due to Jeans. In his important investigations in stellar dynamics, the methods that he had developed for the kinetic theory of gases were applied to the stars.

In recent years, Jeans has written a number of popular books on astronomy and physics which have had a world-wide circulation and have done much to create an interest in the more recent developments in these branches of science. Jeans served as secretary of the Royal Society from 1919 until 1929, and as president of the Royal Astronomical Society from 1925 until 1927. He received a Royal Medal of the Royal Society in 1919 and the Gold Medal of the Royal Astronomical Society in 1922. He was president of the British Association in 1934, and president of the Indian Science Congress at its jubilee meeting in 1938.

New Year Honours

The following names of men of science and others associated with scientific work also appear in the New Year Honours list: *Baronet*: Hon. Surgeon Commander J. D. Pollock, for benefactions and services to education. *G.C.M.G.*: Lord Hailey, director of the African Research Survey. *G.C.V.O.*: Sir John Reith. *G.B.E.*: Sir Frank Smith, Secretary of the Department of Scientific and Industrial Research, lately secretary of the Royal Society. *K.C.M.G.*: Sir Algernon Aspinall, lately secretary to the West India Committee. *Knights*: The Hon. Walter Gordon Duncan, president of the Royal Agricultural and Horticultural Society, South Australia; Prof. W. W. Jameson, dean and professor of public health, London School of Hygiene and Tropical Medicine; Prof. R. Robinson, Waynflete professor of chemistry in the University of Oxford; Mr. Will Spens, master of Corpus Christi College, Cambridge; Prof. R. G. Stapledon, professor of agricultural botany, University College of Wales, and director of the Welsh Plant Breeding Station, Aberystwyth. *C.B.*: Mr. A. T. A. Dobeon, fisheries secretary, Ministry of Agriculture and Fisheries. *C.M.G.*: Mr. J. N. Oliphant, director of the Imperial Forestry Institute, Oxford. *C.I.E.*: Dr. W. Burns, agricultural expert to the Government of India in the Imperial Council of Agricultural Research Department; Lieut.-Colonel G. Covell, director of the Malaria Survey of India; Mr. A. C. Hiley, chief conservator of forests, Bombay; Mr. H. B. Dunnilliff, chief chemist, Central Revenues Chemical Service, and principal of the Government College, Lahore; Lieut.-Colonel E. W. O'G. Kirwan, professor of ophthalmic surgery, Medical College, Calcutta, Bengal. *G.B.E.*: Mr. W. F. Brown, chief mineral adviser to

the Commissioners of Crown Lands, member of the board of governors of the Imperial Institute and of the Institute's Advisory Council on Minerals; Dr. A. S. Griffith, bacteriologist, Medical Research Council; Mr. R. P. Nicholson, lately secretary of the Royal African Society; Mr. F. C. Starling, assistant secretary and director of the Petroleum Department, Mines Department.

O.B.E.: Prof. W. E. Agar, professor of zoology, University of Melbourne; Dr. H. R. Angell, senior pathologist of plant industry, Council for Scientific and Industrial Research, Commonwealth of Australia; Lieut.-Colonel K. R. Krishnaswami Ayyangar, lately director of the Pasteur Institute of Southern India, Coonoor; Mr. B. E. Frayling, chief inspector of mines, Tanganyika Territory; Mr. P. A. Godwin, director of surveys and lands, Sierra Leone; Mr. D. K. S. Grant, conservator of forests, Tanganyika Territory; Prof. C. J. Hawkes, professor of engineering, King's College, Newcastle, member of the Departmental Committee on the Examination of Engineers in the Mercantile Marine, 1937; Mr. W. F. Higgins, secretary of the National Physical Laboratory, Department of Scientific and Industrial Research; Miss Hilda Matheson, secretary to the African Research Survey; Mr. T. Rowatt, director of the Royal Scottish Museum; Mr. J. E. A. Wolryche-Whitmore, for services to agriculture in Kenya. *M.B.E.*: Mr. D. O. Drummond, deputy conservator of forests, United Provinces, India; Mr. R. T. M. Hayter, assistant director of the School of Tropical Medicine and resident medical officer, Carmichael Hospital, Calcutta, Bengal; Mr. O. H. C. Shelswell, lately personal assistant to the chief conservator of forests, Madras.

Captain B. S. Cohen, O.B.E.

CAPTAIN BERTRAM S. COHEN, who retired from the post of staff engineer in charge of the Post Office Research Station at Dollis Hill, London, at the end of December, has been for forty years improving instruments and developing methods used in telephony. He joined the National Telephone Co. in 1896, the year in which the Post Office bought the long-distance telephone lines throughout the United Kingdom. As early as 1900, when Sir Oliver Lodge demonstrated his hornless loudspeaker before the Institution of Electrical Engineers, Cohen was one of the first to recognize the clearness of the articulation of the device, the faithful reproduction of radio telephony greatly impressing him. In conjunction with G. M. Shepherd, he did excellent work in applying some of Heaviside's work to long-distance transmission over telephone lines. With impressive thoroughness, they evaluated the solutions of the very lengthy and difficult equations, sometimes involving inverse hyperbolic functions, which were continually arising in their experimental work. Cohen contributed a paper to the Physical Society in which he discussed the alterations in the everyday solutions due to the fact that the 'constants', such as the resistance, in some of the differential equations were really variables, and the solutions consisted of terms having

different frequencies. He received the O.B.E. for the excellent work he did in telephony during the Great War. The Institution of Electrical Engineers awarded him the Fahie Premium and an 'extra' premium for two of his papers; he is now president of the Meter and Instrument Section of the Institution. He leaves the Post Office with the good wishes of all his colleagues.

South Africa's 'Men-Apes'

THE chief findings of a report on the teeth of the fossil 'men-apes' of South Africa by Prof. W. K. Gregory and Dr. Milo Hellman of the American Museum of Natural History, New York, which are cited in a communication by them in another column of this issue of NATURE (see p. 25) tend both to confirm, and at the same time to extend, the implication of Dr. Broom's diagnosis of the human affinities of his recently discovered relics of new types of fossil prehomnids. As a result of a personal inspection of the finds, these two authorities, whose judgment carries conclusive weight in view of their experience in the examination of the dentition of fossil apes from the Himalayan tertiary deposits, give it as their considered opinion that "the dentition of the adult forms described by Broom present many transitional or annectant conditions between the pithecioid and human stages". They go on to support and illustrate this pronouncement by reference to details of the dentition of one of these forms, namely *Plesianthropus*. For example, a canine of the female specimen is said to "require but little additional modification to attain the human status". What, however, is of special significance is that Prof. Gregory and his colleague find in the Indian fossil forms transitional stages leading to the almost human premolar of *Plesianthropus*, while another tooth of the South African type takes an intermediate position between *Sivapithecus*, one of the fossil anthropoids from the Siwaliks, and Peking man. A further significant suggestion, based on comparative evidence, is that the general condition of the teeth points to a stage of transition from the frugivorous habits of the ape to the omnivorous habits of man.

Phylogeny and Chronology in the Descent of Man

It may be noted that the conclusions at which Prof. Gregory and Dr. Hellman have arrived in regard to the dentition of the South African fossil men-apes by no means dissipate, but rather intensify, the chronological difficulties which, as has been pointed out previously, arise from these discoveries and from the inferences drawn from them by Dr. Broom. A phylogenetic succession is in process of being established in South Africa which chronologically is at variance with—that is, is later in time than—the chronological position assigned on geological and palaeontological evidence to early types, definitely human in character, found elsewhere, such as, for example, Peking man. In other words, this South African series is too late in date for inclusion in the human phylum, and must belong to an analogous line of development which ultimately dies out.

In this connexion, reference may be made to a communication which has been received from Prof. Franz Weidenreich, of the Cenozoic Research Laboratory, Peiping, who directs attention to the fact that he had already arrived at the conclusion from the *Sinanthropus* findings that the adoption of the upright posture and gait had preceded the decisive changes of brain and dentition; and he goes on to suggest that the parts upon which Dr. Broom relies, especially the lower end of the humerus, are not so strikingly different from those of modern chimpanzees as are the shafts and proportions of the long bones. In regard to the chronological problem in particular, he refers to two communications by himself, one appearing in *Biomorphosis* (1, 1; 1938), and the other presented to the Congress of Anthropological and Ethnological Sciences, Copenhagen (1938), in the course of which the discrepancy between the morphological and the chronological sequences of hominid remains is set out in detail in relation to geographical distribution. The interpretation of the evidence put forward by Prof. Weidenreich in an attempt to reconcile the two series, is that we must not look for a single place of origin in man's evolution, but that there must have been at least four centres in which the line of man has developed independently: south-eastern Asia, giving rise to the Australian type of modern man; eastern Asia, giving rise to the Mongolian; Africa, where Rhodesian man affiliates with the Negro; and Palestine or western Asia, from which the European type originated. He is careful to point out that this polycentric evolution of man does not imply a polygenetic origin.

The Kut Barrage Irrigation Scheme

THE last day of 1938 was notable in the sphere of civil engineering operations by reason of the completion of an important four-year undertaking (begun in December, 1934) which has comprised the construction in Iraq of a barrage, 1,500 ft. long, across the River Tigris, and, as an adjunct, of an irrigation canal, $2\frac{1}{2}$ miles in length and 230 ft. wide, with a head regulator to control the flow of water down the Gharraff River. The object of the Government of Iraq in executing the work is to bring into cultivation extensive areas of land on both sides of the Shatt-el-Gharraff from Kut to Ur, between the Rivers Tigris and Euphrates, on the traditional site of the Garden of Eden. Previously, supplies of water have been available for the Gharraff River only during periods of flood in the Tigris; henceforward, the Kut Barrage will retain the water of the Tigris and cause it to flow at all seasons along the diversion canal into the Gharraff River. The barrage has fifty-six sluice gates, each 20 ft. wide, to control the rate of flow, while a navigation lock will enable river craft to pass the obstruction and maintain the service of boats between Bagdad and Basrah. The formation of the canal involved the excavation of 1,600,000 cubic yards of material and the employment of 3,500 Arabs and Kurds. In addition, 250,000 cubic yards of concrete were placed in the barrage. The regulator at the head of the canal is equipped with seven sluice

gates, each 20 ft. wide, and there is a small navigation lock. The constructional operations were seriously hampered in November 1936 by extensive rains, which produced the highest flood on record on the Tigris for that season of the year, and rose with such unprecedented rapidity that the works were entirely inundated and brought to a standstill. A further difficulty was the extraordinary range of temperature, which varied from freezing point in winter to 125° F. in the shade in summer. The engineers for the undertaking were Messrs. Coode, Wilson, Mitchell and Vaughan-Lee of Westminster, and the contract was entrusted to Messrs. Balfour, Beatty and Co., Ltd., of London.

School of Oriental Studies

THE School of Oriental Studies in the University of London, it is stated in the report of the Governing Body for the academic year 1937-38, will vacate the premises at Vandon House, Westminster, now in temporary occupation, for the new building on the Bloomsbury site of the University, in March 1941. Owing to the inconvenience of present arrangements, removal at the earliest possible date has become imperative. At the moment, not only has the library to be housed in another part of Westminster, away from the academic and administrative work of the School, but also a large part of the collection of Chinese and Far-Eastern books, some 16,000 in number, brought together by the late Sir Reginald F. Johnston, professor of Chinese in the University of London, and presented to the library by his executrix, cannot be utilized and must be kept in store. The work of the School, which covers a wide range, now includes in addition to the study of languages, lectures on the religions of the Orient, Indian art, archaeology, and philosophy, Burmese law, history, and economics, Buddhist law, and Indian social welfare. In the school of languages during the academic year instruction was given in Arabic, Persian, Sanskrit, Malay, Hindustani, Chinese, Japanese, and Burmese, the number of students in each being in the order named; while in the African Department there were students in such little known tongues as Efik, Ibo, Lunyoro, Shona, Tswana, Twi, Yao, Yoruba, and Zande. The extent to which these facilities are appreciated is shown by the fact that there were in 1937-38, 85 full-time students, 94 part-time, 197 occasional, and 73 inter-collegiate students, making 449 in all, an increase of 21 on the numbers of the preceding year. Since the death of Sir Montague Butler, chairman of the governing body, in March last, Lord Harlech, formerly Secretary of State for the Colonies, has accepted that office.

Geological Museum: Recent Acquisition

RECENT additions to the collections of the Geological Museum include a number of specimens of beautifully banded pink rhodochrosite, from Minas Capillitas, Catamarca, Argentina. This mineral, which is the carbonate of zinc, is of a rich pink colour, the specimens being of stalactitic formation. Although previously employed as a semi-precious

stone, its use has hitherto been relatively rare: but rhodochrosite from the same source as the Museum specimens was recently utilized in London under the name of 'Inca Rose', in various Christmas gifts, to form an inlay at the edges of white marble-onyx cigarette boxes, and in similar ornamental work in which malachite or lapis lazuli is frequently used. The mineral was collected by Dr. Franz Mansfeld from an old mine, until recently deserted, situated at an altitude of about 10,000 ft., in the Andes. The Museum has also received as a gift from Mr. T. C. F. Hall a small collection of specimens of alluvial gold from Abyssinia and Korea. The Abyssinian specimens include a sample of gold dust, associated with particles of iron ore, in a feather quill, as brought in by the natives. Other acquisitions include two very fine stalagmitic and stalactitic specimens of melanterite (ferrous sulphate) from Millelose Mine, Warrencar, Derbyshire, presented by Prof. W. G. Fearnside; and a large crystal of corundum or impure ruby some five inches in length and three inches in diameter. A number of specimens of seepages of mineral oil found associated with British coal-seams have also been placed on exhibition.

Articulation of Secondary with University Education

THE United States Office of Education has issued a report, entitled "Some Factors in the Adjustment of College Students", of elaborate investigations of university entrance conditions in relation to the varying needs and capacities of individual students. Seven factors have been studied: articulation of high-school and university subject areas, extra-curricular activities, lapse of time between leaving high school and admission to university, age on admission, high-school marks, aptitude and achievement test results, effect on university students of simultaneously engaging in gainful occupations. It is suggested that university courses be made to fit entering students either by dovetailing them with the high-school courses or "by setting up a few broad, comprehensive courses which challenge the interest and ability of the student" as in the University of Chicago (the humanities, the social sciences, the physical sciences, and the biological sciences). The report concludes with a formulation of the following desiderata: a more comprehensive system of record-keeping in the high-school for use in guidance of students; utilization by universities in admitting or guiding the student of as many items of knowledge concerning him or her as possible and, to this end, the provision by them of facilities for testing and interviewing them; integration of the work of the high school and the university through facilities for students of different levels of general scholastic aptitude; and shepherding of students into particular courses in accordance with their past achievements.

Library Service in the United States

A REPORT on library service, prepared by C. B. Joeckel for the Advisory Committee on Education, has been issued by the U.S. Government Printing Office. The survey indicates that the total library

resources of the United States are great but are unequally distributed among the major geographic regions, the different population groups and the various kinds of library service. In all types of library service the north-east and the far west are in a preferred position, while the southern regions are definitely inferior. Urban population is much better served than rural areas, and the library needs of the scholar and the student are usually better supplied than those of the general reader. Again, more than four fifths of public libraries in the United States have incomes of less than the lowest limit usually defended as efficient and only four per cent have incomes of more than 25,000 dollars, the minimum income for an efficient library unit, according to some investigators. Control over the many types of libraries is dispersed among the Federal, State and local Governments, and between public and private educational authorities. Only a small beginning has been made in the planned integration of the library resources of the nation. The library services of the Federal Government itself are generally excellent, but could be improved and extended at relatively moderate cost; and the report details ways in which the Federal Government could improve the general situation by improving the organization and national services of its own libraries, by assistance in the development of regional library service and by grants-in-aid to libraries.

Mortality Rates in the 'Depressed Areas'

In a report entitled "A Study of the Trend of Mortality Rates in Urban Communities of England and Wales, with Special Reference to 'Depressed Areas'" (*Reps. on Pub. Health and Med. Subjects*, No. 86. London: H.M. Stationery Office. 1s. net), Dr. Lewis-Fanning gives the results of an investigation on the effect of trade depression on the national health. Such investigation must be based upon mortality rates, as complete statistics of sickness rates are not available. Standardized death-rates of all the county boroughs within the depressed areas were calculated, and were compared with the standardized rate of mortality for the whole country and with that of a group of county boroughs in prosperous areas, for the same periods. Dr. Lewis-Fanning's conclusion is that there is no evidence from the trend of mortality rates from all causes of death that the health of the population of the depressed areas of the North and of Wales has been unfavourably affected by the economic depression. Excessive mortality these areas certainly have, both when compared with England and Wales as a whole and with other sections of the country, but this excess is not peculiar to the years of depression; it has been a consistent feature of the depressed areas for at least the past twenty years. It is possible that there are a few exceptions to this general conclusion, and in Merthyr-Tydfil the mortality experience in respect of tuberculosis presents grounds for misgiving, but the evidence as a whole is strong testimony of the success of national and local efforts to mitigate evils of great magnitude.

Rural School Hygiene in France

L. FAURE-MURET (*Thèse de Paris*, No. 276; 1938) states that the organization of rural school hygiene in France is practically dependent upon the local authorities, especially as regards financial support. Much more attention, therefore, is given to the subject of school hygiene in large urban communities than in country districts. At the present day, the rural school in France is very much behind the times as regards progress in hygiene. The buildings are often in a state of decay and without proper sanitary annexes. The health of the school child is not properly cared for, and instruction in the theory of hygiene is quite inadequate. In certain country districts medical inspection scarcely exists, and even when it is provided, the medical man is not properly supplied with what he requires. M. Faure-Muret maintains that school hygiene should assume a far more important place in rural areas than in towns, as the conditions of life in the country, in spite of a certain number of favourable natural conditions, are inferior to those of life in towns. Urgent measures are needed for the benefit of the race.

Garden Plants from Equatorial East Africa

ENGLISH gardens owe much of their present floral beauty to plants of other geographical regions, brought by botanical explorers. It is perhaps rather surprising that the flora of high mountains in equatorial East Africa has as yet made no such contribution to European horticulture. Mr. Patrick M. Syngé has shown, moreover (*J. Roy. Hort. Soc.*, 63, Pt. 10, Oct. 1938) that many plants of this region are also found in the English flora. It is therefore to be expected that the more striking indigenous flowering plants of Ruwenzori, the "Mountains of the Moon", and Mt. Eggon, might prove amenable to cultivation in our more temperate latitudes. Mr. Syngé indicates some of the more promising of these; species of giant *Lobelia*, arborescent *Senecio*, *Heli-chrysum* (everlasting), *Impatiens*, *Hypericum*, *Kniphofia*, and others. Some species, as *Kniphofia Snowdenii*, are already to be found in the catalogues of enterprising nurserymen, and Mr. Syngé's illustrations give potent promise of many other striking plants.

The Physical Society's Annual Exhibition

THE Catalogue of the twenty-ninth Annual Exhibition of Scientific Instruments and Apparatus held at the Imperial College of Science and Technology on January 3, 4 and 5 by the Physical Society covers 241 pages, 187 of which are devoted to trade exhibits, and 37 to research and educational exhibits (1 Lowther Gardens, S.W. 7. 1s. 6d.). The two discourses were delivered in the large lecture theatre, on January 3 by Dr. J. D. Cockcroft on "The Cyclotron", and on January 4 by Mr. C. S. Wright on "Polar Geophysical Research". The number of firms exhibiting is slightly larger than last year, but the research and educational section is somewhat less. In the trade section the name of the firm and the number of the stand are given at the head of each page; and the index gives under each

instrument mentioned the pages on which descriptions of such instruments will be found. Some of the illustrations are not very informative, while others show internal details by cutting away enclosures, and a few give wiring diagrams.

Archaeological Investigations in Turkey

A REPORT of results of the continued excavations of the Neilson Expedition to Turkey of the University of Liverpool on the site at Mersin in Southern Turkey, records the discovery of the remains of a fortified city, of which the architectural structure is remarkable (*The Times*, January 3). The gateway is flanked by towers; and a defensive wall is pierced by a range of narrow windows. Piles of improvised missiles lie at hand. The whole city was destroyed by fire while still in occupation; and the contents of the buildings, which include a palace, are said to be complete, though much burned by fire and broken. These remains were encountered at a depth of twenty feet below those of the Hittite city brought to light by the expedition last year. They are assigned to a date at about 3600 B.C.

Earthquake near Japan

THE U.S. Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has made a preliminary determination of the epicentre of the earthquake of November 22, 1938, 1 h. 14.1 m. G.C.T., and finds it to be situated in latitude 37° N., longitude 142° E. This was made possible by reports from the seismological stations at Honolulu, Manila, Zikawei, Victoria, Georgetown, Fordham, Sitka and Philadelphia. This epicentre is under the bed of the ocean to the north-east of the main island of Japan, and is near the epicentres of the shocks of November 5 and 6, which were lat. 38° N., long. 141° E., and lat. 36° N., long. 144° E. respectively.

Earthquake in Belgium

THERE was an earthquake during the evening of December 30, with epicentre in the vicinity of Spixhe, near Spa, which caused the collapse of chimneys and moved furniture but caused no casualties. This recalls the earthquake of June 11, 1938, which probably had an epicentre somewhat to the north-west of the present one, and was felt in England, France, and Germany as well as in Belgium (*NATURE*, 141, 1090; 1938). The other epicentre near the present one was located in the International Seismological Summary as lat. 51° N., long. 6° E., which is to the north-north-east of the Spixhe shock and just inside the borders of Germany. Earthquakes occurred from the German epicentre on January 5, 1926, and January 14, 1928.

Announcements

WE regret to announce the deaths of Mr. Emile Mond, honorary treasurer of the Chemical Society and of the Faraday Society, on January 1, aged seventy-three years; and of Prof. Victor Grégoire, professor of botany in the University of Louvain, on December 12, aged sixty-eight years.

PROF. EJNAR HJERTZSPRUNG, director of the Observatory and professor of astrophysics in the University of Leyden, has been elected *correspondant* of the Section of Astronomy of the Paris Academy of Sciences in succession to the late Dr. W. W. Campbell.

AMONG the recent medal awards of the Royal Horticultural Society are the following: Victoria Medal of Honour to Dr. W. F. Bewley, Mr. H. R. Darlington, Mr. F. G. Preston, and Mr. G. Reuthe; Veitch Memorial Gold Medals to Mr. M. B. Crane and Miss I. Preston.

A CENTRE for aeronautical studies and research has recently been founded at Milan by the Italian Ministry of Aeronautics.

THE University of Porto Alegre, with the support of the Federal Government of Brazil, has decided to erect a hospital including a pathological institute.

THE Cornell University Medical College, New York, has received from the Jane Coffin Childs Fund for Medical Research the sum of 4,500 dollars for experimental investigations of leukaemia with special reference to extra-chromosomal factors. The research will be carried out by Drs. C. L. Opie and J. Furth, of the Department of Pathology.

THE Government Health Service of the Dutch East Indies has instituted an investigation among medical practitioners as to their experience with medicinal plants. This will be carried on at the same time that the Commission on the Commerce of Medicinal Herbs is conducting a botanical and pharmacological analysis and a series of technical experiments in the cultivation of such plants.

THE Hellenic Travellers' Club has arranged a tour on March 18–April 7 to sites of medical interest in Greece. At Epidaurus, Prof. G. E. Gaek will lecture on the cult of *Asclepius*, and visits will also be paid to Cos, where the school of Hippocrates flourished, Cnidos, Pergamos, the home of the school of Galen, Athens and Mycenae. Further information can be had from the Secretary, 3 Albany Courtyard, Piccadilly, W.1.

THE Royal Academy of Sciences of Turin announces that the thirty-first award of the Bressa Foundation Prize will be made during 1941. The prize, of the value of 9,000 lire, will be awarded to the man of science, either Italian or foreign, who, in the opinion of the Academy, shall have made the most notable and useful discovery or produced the most important work during the period 1937–41 in any of the following branches of science: physical and experimental science, natural sciences, pure and applied mathematics, chemistry, physiology, pathology, geology, history, geography and statistics. Authors who wish to have their work considered are invited to send copies, which must be printed, to the secretary of the Academy, Via Maria Vittoria 3, Turin, not later than January 31, 1941. R273

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 29.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Estimation of Vitamin A

EARLY in 1937, the results of biological and spectroscopic tests for the vitamin A content of a specimen of halibut liver oil and of a concentrate prepared from it were published in *NATURE*¹. Ten laboratories participated in this co-operative experiment. It was hoped that by enlisting so many groups of workers the uncertainty of the biological results, due to the error inherent in the biological technique, would be minimized, and that an authoritative pronouncement could be made on the magnitude of the value for the conversion factor relating the results obtained by spectrophotometric and biological methods. As a result, a value of 1,470 was reported for the halibut liver oil, whilst that for the concentrate was lower, lying between 1,000 and 1,200. Spectroscopic control carried out on the materials distributed for the feeding tests indicated a satisfactory degree of stability for the oil, but the concentrate deteriorated during the period occupied in the work by an amount sufficient to account for the lower value.

The value 1,470 then communicated as the conversion factor for the sample of halibut liver oil was a provisional one, since the results had not been subjected to statistical analysis. Since then, the statistical analysis has been completed by Dr. J. O. Irwin, of the London School of Hygiene and Tropical Medicine, who gives the final figure for the conversion factor for this specimen of halibut liver oil as 1,670. This result, therefore, agrees remarkably well with the value 1,600 provisionally adopted by the Second International Conference on Vitamin Standardization (1934).

The experiment did not, however, dispose of discrepant but well-accredited results obtained in the course of independent attempts to redetermine the conversion factor. One very important instance was that of the United States Pharmacopoeia reference cod liver oil, adopted as subsidiary international standard for vitamin A at the 1934 International Conference. The value reported in 1934 for this oil

for $E_{1\text{cm}}^{1\%}$ 328 m μ was 1.44, as determined from the average result of tests by four sets of individual workers, or 1.58 according to Morton and Edisbury (see ref. 2, Table IV, p. 30), who are responsible for the spectrophotometric estimations in the present experiment. The biological potency assigned to the oil at that time was 3,000 I.U. per gm., representing the average of results collected from nine different laboratories by Dr. E. M. Nelson. The individual values ranged from 2,400 to 3,725 I.U. per gm. (ref. 2, p. 38). The conversion factor for this oil at that time was therefore 2,080 or 1,900, according to the value accepted for the contemporary spectrophotometric estimation. Materials tested against this oil have also tended to show high conversion

factors of about 2,000; it seemed essential, therefore, that this oil should be subjected to another co-operative test.

A fresh sample of the oil was kindly contributed by the Committee of Revision of the U.S. Pharmacopoeia, and tests similar to those described for the previous experiment¹ were made. The same precautions were taken to secure uniformity in dilution, and spectroscopic criteria were used to check the stability of the solutions used for the biological experiments. A special dilution of the international β -carotene standard was prepared, as before, by the Department of Biological Standards of the National Institute for Medical Research. The dilution of the U.S.P. reference oil was made by Dr. R. A. Morton and Dr. J. R. Edisbury of the University of Liverpool, who also made all the spectrophotometric tests.

Ten laboratories took part in the biological tests. The stability of the solutions used for the biological tests was satisfactorily maintained throughout.

The biological values obtained by the individual laboratories were submitted for statistical examination to Dr. J. O. Irwin, who reported that they ranged from 1,334 to 3,270 I.U. of vitamin A per gm.; six of the ten values lay between 2,200 and 2,600 I.U. per gm. and the weighted mean was 2,619 I.U. per gm. The mean limits of error per experiment ($P = 0.99$) were 73 to 137 per cent.

The value of $E_{1\text{cm}}^{1\%}$ 328 m μ for the unsaponifiable fraction of this particular sample of the U.S.P. reference oil was 1.44. The conversion factor, as determined in this test, is therefore 1,820.

If the result of this experiment is accepted, and the present biological potency for the U.S.P. oil is taken as 2,619 I.U. per gm. instead of the accepted 3,000 I.U. per gm., it is clear that the biological value of all substances tested against the U.S.P. oil for as long as it has possessed this value should be only 2,619/3,000 of that reported, and the conversion factor for each of such substances should be subject to a similar diminution. Even when this correction is applied, the conversion factor, as in the present case, may still be high.

A calculation has been made by Dr. Irwin which shows that the difference between the logarithms of the conversion factor of 1,670 for the halibut liver oil, and of 1,820 for the U.S.P. oil is 2.1 times the standard error, and that the odds are about 30 to 1 against this result being a chance difference. Before a final decision can be reached it will probably be necessary to carry out a third co-operative experiment when a pure vitamin A ester becomes available. Meanwhile, there seems no other course open than to recommend the continuation of the provisional value 1,600 as the best compromise, and again to await further data.

Those who participated in the work were: A. L. Bacharach and E. Lester Smith, Glaxo Laboratories, Ltd., Greenford; R. G. Booth, British Cod Liver Oil Producers (Hull), Ltd.; W. A. Broom, Messrs. Boots Pure Drug Co., Ltd., Nottingham; H. M. Bruce and K. H. Coward, Pharmaceutical Society, London; A. D. Emmett, R. A. Brown and M. Sturtevant, Messrs. Parke, Davis and Co., Detroit Laboratories (communicated by J. A. Freeman); E. M. Hume, Lister Institute, London; J. O. Irwin, London School of Hygiene and Tropical Medicine; S. K. Kon, National Institute for Research in Dairying, Shinfield; T. Moore, Dunn Nutritional Laboratory, Cambridge; R. A. Morton and J. R. Edisbury, University, Liverpool; S. W. F. Underhill, Messrs. The British Drug Houses, Ltd., London; H. Wilkinson, Messrs. Lever Bros., Ltd., Port Sunlight.

E. M. HUME

(Secretary, Vitamin A Sub-Committee of Accessory Food Factors Committee, appointed by the Lister Institute and Medical Research Council).

Lister Institute,
London, S.W.1.
Dec., 15.

¹ NATURE, 130, 467 (1937).

² Med. Res. Council, Special Report Series No. 203 (1935).

A Rapid Visual Test for Vitamin A Deficiency

THE recovery of vision after blinding by a bright light depends, among other things, on a reformation of visual purple from vitamin A in the blood. Various instruments have been used to test this relationship, but have been severely criticized. In all such work, at least fifteen minutes have been needed for each test, and usually much longer.

A new apparatus has been devised to test vitamin A deficiency rapidly. After looking at a bright light of certain intensity for 30 seconds, the time needed to see a dim light of constant intensity is taken (in distinction to instruments which have complicated means for varying the intensity of the dim light). The range of recovery times is 3-50 seconds, an average test takes less than a minute, and two or three tests are made within five minutes of the subject entering the room. Up to forty persons an hour have been tested.

Treatment with vitamin A of 123 people having more than fifteen seconds recovery time (taken as deficient), showed a response in all cases but three, ending in a recovery time of ten seconds or less (taken as normal). Thirty other cases treated with an A-free oil showed no change on repeated tests.

A normal person beginning at eight seconds placed on an A-deficient diet gradually lengthened in recovery time until a time of twenty-seven seconds was reached. At this point haemeralopia, asialia and other symptoms of A-deficiency were present.

Normal recovery time on this apparatus is considered to be ten seconds or less, and over fifteen seconds is deficient. These somewhat arbitrary times were arrived at in the following way: (1) An early survey of a hundred people was plotted to show the number of cases at each recovery time. The form of this curve is the same with our present total of 1,200 cases. The mode is eight seconds, and there is a pronounced dip at 11 seconds. All values less than eleven seconds were therefore tentatively adopted as normal. (2) Large amounts of vitamin A have no

effect on recovery times already at ten or less; but recovery times at twelve or twenty or more, treated with vitamin A come to values of ten or less, depending on the individual.

In a survey of a thousand university students, 52 per cent were normal (3-10 sec.), 24 per cent border-line (11-15 sec.), and 24 per cent deficient (16 or more) with respect to vitamin A.

From these students, 753 case histories were obtained, and the following are some of the relationships found:

	Normal (per cent)	Border-line (per cent)	Deficient (per cent)
Cold within a month after test	54.5	64	71.5
Night blindness	7	18.	19
Dry skin	7	16	18

A total of 1,200 people have been tested and no relation has been found to sex, age, colour of eyes, wearing of glasses if usually worn, myopia, hypermetropia, astigmatism or fatigue. These and other factors are still being investigated. On the other hand, every deficient case has been found to have had a low intake of vitamin A (where calculated this has ranged from 500 to 2,000 I. U. daily).

Full details of the apparatus, and of these investigations, will be published elsewhere.

L. B. PERR.

Department of Biochemistry,
University of Alberta,
Edmonton.
Nov. 25.

Laccase, a Blue Copper-Protein Oxidase from the Latex of *Rhus succedanea*

IN 1883 Yoshida¹ discovered, in the latex of the Japanese lacquer tree (*Rhus vernicifera*), a thermolabile substance which was responsible for the darkening and hardening of the lacquer.

To Bertrand² we owe the first extensive study of this substance which he found in the latex of an Indo-Chinese lacquer tree (*Rhus succedanea*). He described this substance under the name of laccase, and showed it to be an enzyme capable of catalysing the oxidation of different polyphenols such as hydroquinone, pyrogallol and others. He has also shown that the darkening and hardening of latex is due to the catalytic oxidation by this oxidase of natural polyphenols, urushiol and laccol. This important discovery of Bertrand was confirmed and extended by other workers and more recently by Suminokura³ and Brooks⁴.

The laccase for our present study was obtained from the latex of *Rhus succedanea*. For the extraction and purification of the enzyme the latex is treated with acetone, the precipitate is dried, extracted with water and the enzyme is then purified by a method somewhat similar to that used by us for purification of polyphenol oxidase of mushrooms⁵.

The purified enzyme catalyses the oxidation of polyphenols and diamines, the oxidation of *p*-phenylenediamine being twice as fast as that of catechol. Monophenols such as *p*-oresol or tyrosine are not oxidized at all by purified laccase even when tested for ninety minutes. Both crude and partly purified enzymes catalyse the oxidation of ascorbic acid without the addition of a carrier such as catechol.

The purest enzyme preparation obtained has a strong blue colour. It is devoid of haematin, iron and

manganese, and contains 0.154 per cent copper. The colour of laccase solution containing 0.015 mgm. copper per c.c. is of the same intensity as a 7 per cent copper sulphate solution. The colour disappears reversibly on the addition of a very small amount of substrate such as ascorbic acid or hydroquinone. It also disappears on boiling the enzyme or treating it with cyanide and diethyl-dithio-carbamate.

The activities of different preparations are proportional to their copper contents. All this shows that laccase is a copper-protein compound belonging to the same group of enzymes as the polyphenol oxidase of potatoes¹ and of mushrooms². If the polyphenol oxidase of mushrooms containing 0.3 per cent copper is 90–100 per cent pure, the laccase preparation containing 0.154 per cent copper would be 45–50 per cent pure. This laccase preparation, however, contains 55 per cent of a polysaccharide and only 6.45 per cent nitrogen, which corresponds to about 45 per cent protein. Assuming now that the polysaccharide is an impurity not connected with the enzyme and the copper is bound only to the protein, the copper content of the laccase protein would be about 0.34 per cent, which is the same as the copper content of crystalline haemocyanin³. If one allows for the polysaccharide content of our purest preparation, the Q_{01} of pure laccase would appear to be about 40,000 with *p*-phenylenediamine as substrate at 20° C.

The activity of laccase is strongly inhibited by potassium cyanide, hydrogen sulphide, sodium oxide and diethyl-dithio-carbamate but not by carbon monoxide, and this holds true whether catechol, *p*-phenylenediamine or ascorbic acid are used as substrates.

Although laccase belongs to the group of copper-protein enzymes, it differs in the following respects from the polyphenol oxidase of cultivated mushrooms (*Psilocybe campestris*):

(1) Laccase is distinctly blue while polyphenol oxidase is yellowish or colourless.

(2) Laccase oxidizes *p*-phenylenediamine better than catechol, while polyphenol oxidase scarcely attacks it.

(3) Laccase, when pure, does not oxidize *p*-cresol at all, while polyphenol oxidase in this reaction shows a distinct lag period, which, as we have shown, becomes more protracted on gradual purification of this enzyme⁴.

(4) Crude laccase preparation oxidizes ascorbic acid directly; this activity decreases on purification and can partly be restored by the addition of catalytic amount of *p*-phenylenediamine but not of catechol. Polyphenol oxidase, on the other hand, whether crude or pure, oxidizes ascorbic acid only through a carrier like catechol. The Q_{01} of this latter reaction using only 0.02 mgm. catechol is still very large (540,000)⁵.

(5) Laccase is not poisoned by carbon monoxide, while polyphenol oxidase, as we have shown, undergoes a very strong, although light-insensitive, inhibition by carbon monoxide⁶.

(6) The activity of laccase ($Q_{01} = 40,000$) is of the same order of magnitude as that given for potato oxidase¹. Both enzymes show only a twentieth of the activity of the polyphenol oxidase from cultivated mushrooms. This is clearly demonstrated especially when the activities of laccase and mushroom oxidase are estimated in the same way.

It may be mentioned that the purification of polyphenol oxidase from a wild mushroom (*Lactarius vellereus*) gave a yellowish preparation containing

0.2 per cent copper and having Q_{01} of about 250,000 for catechol and of only 1,640 for *p*-phenylenediamine.

The results of this communication, apart from the fact that they reveal the nature and properties of laccase, are interesting in some other respects. They dispose of the criticism of our work on the polyphenol oxidase of mushrooms made by Kubowitz⁷ who, without justification, assumes that the properties of different plant phenol oxidases must be the same as those of the potato oxidase. These results also serve as a warning against generalizations based on an incomplete knowledge of the subject and against the tendency of ascribing to one enzyme the properties of another enzyme in the same class, contrary to all the available evidence.

D. KEILIN.
T. MANN.

Molteno Institute,
University of Cambridge.
Dec. 7.

¹ Yoshida, H., *J. Chem. Soc.*, 48, 472 (1883).

² Bertrand, G., *C.R.*, 118, 1215 (1904).

³ Sumihokura, K., *Biochem. Z.*, 224, 292 (1930); *Bull. Chem. Soc. Japan*, 11, 259 (1938).

⁴ Brooks, G., "Laque d'Indochrome", *Actualité scientifiques et industrielles*, No 94, 1–100 (1934).

⁵ Keilin, D., and Mann, T., *Proc. Roy. Soc. B*, 135, 187 (1938).

⁶ Kubowitz, F., *Biochem. Z.*, 302, 231 (1937).

⁷ Mann, T., and Keilin, D., *NATURE*, 142, 148 (1938).

⁸ Keilin, D., *Proc. Roy. Soc. B*, 134, 206 (1938).

⁹ Kubowitz, F., *Biochem. Z.*, 299, 32 (1938).

The Sympathetic Character of the Nucleus Supraopticus

In a recent publication dealing with the question of whether nerve fibre terminals or pituitary cells in the pars nervosa of the pituitary secrete the hormones pitocin and pitressin¹, I quoted Ranson, Kabat and Magoun² as holding the view that the nucleus supraopticus of the hypothalamus was sympathetic in character. I was under the impression that the hypothalamic sympathetic centre, which extends to the chiasm, also included the nucleus supraopticus. On re-reading their work, it was found that a small paragraph had been overlooked in which it is definitely stated that there was no evidence that the nucleus supraopticus was included in this sympathetic centre.

I apologize to these authors for this error and retract the above-mentioned quotation. However, other evidence quoted (Kappers³) indicates that the nucleus supraopticus is sympathetic. Crouch and Elliott⁴ found that sympathetic reactions were regulated by the hypothalamus as a whole; but better responses were obtained from anterior and lateral nuclei. Because of this, I think that the nerve terminals of the hypothalamohypophyseal tract are either adrenergic or cholinergic, as are the terminals of other autonomic fibres, and do not secrete the characteristic nervous hormones.

MERVYN GRIFFITHS.

Montreal Neurological Institute,
3801 University Street,
Montreal.
Dec. 3.

¹ Griffiths, *Proc. Linn. Soc. N.S.W.*, 62, pts. 3–4, 81 (1938).

² Ranson, Kabat and Magoun, *Arch. Neurol. and Psychiat.*, 33, 457 (1935).

³ Kappers, "Three Lectures on Neurobiology and other Subjects" (William Heinemann (Medical Books), Ltd., 1938).

⁴ Crouch and Elliott, *Am. J. Physiol.*, 115, 245 (1936).

Heteroauxin Production by Efficient and Inefficient Strains of *Rhizobia*

It has been suggested by Thimann¹, Link, Wilcox and Link², and Link³ that β -indole-acetic acid (heteroauxin) is the agent partially or entirely responsible for the formation of nodules on the roots of leguminous plants. Thimann¹ advances the hypothesis that the root nodule bacteria convert tryptophane into heteroauxin, (a) by stimulating elongation of a lateral root and (b) by arresting root elongation through continued auxin production, resulting in the formation of a nodule. If this condition exists, there may be differences in the rate of formation and in total amounts of heteroauxin derived from tryptophane, between efficient and inefficient strains of *Rhizobia*.^{*} (Efficient: *Rhizobia* which infect the host plant and benefit the latter by the symbiosis; inefficient: *Rhizobia* which infect the host plant but fail to aid in fixing atmospheric nitrogen.) Nodules produced by efficient strains are generally characterized as being large and usually located on the crown of the tap-root, indicating early invasion, while inefficient strains produce very small nodules which are distributed over the secondary root system, indicative of relatively late invasion.

The purpose of these investigations was to determine whether or not early or late invasion could be correlated with rate and amount of production of β -indole-acetic acid. The substrate upon which the *Rhizobia* were grown consisted of mannitol 1.0 per cent, K_2HPO_4 0.05 per cent, $MgSO_4$ 0.02 per cent, $NaCl$ 0.01 per cent, $CaCO_3$ 0.1 per cent, KNO_3 0.05 per cent and tryptophane ('Pfanstiehl') 0.05 per cent. In contrast to Chen's medium⁴, in which yeast extract was the source of nitrogen, the above medium contained inorganic nitrogen. No β -indole-acetic acid could be detected in uninoculated controls. Neither could heteroauxin be detected in ether extracts of cultures inoculated in the basal media (same as above with tryptophane omitted), indicating that the bacteria were unable to synthesize the auxin when potassium nitrate was used as a nitrogen source and mannitol as a carbon source.

The basal medium was sterilized at 15 lb. pressure for 15 minutes and a solution of tryptophane, sterilized by filtration, added aseptically. Preliminary tests in which 'tryptone' ('Bacto') or peptone ('Bacto') plus 'tryptone' was substituted for tryptophane, yielded data similar to those in the accompanying table, with the exception that the uninoculated controls frequently yielded positive tests for heteroauxin. Therefore, the medium cited above was used exclusively.

FINAL CONCENTRATION OF β -INDOLE-ACETIC ACID IN 5 ML. MEDIUM AFTER FOUR WEEKS (AVERAGE OF FOUR EXPERIMENTS).

	Efficient	Inefficient	
<i>Rh. meliloti</i>	1: 75,000	1: 10,000	
<i>Rh. trifolii</i>	1: 42,000 (R)	1: 75,000	
<i>Rh. leguminosarum</i>	1: 42,000	1: 45,000 (R)	
<i>Rh. phaseoli</i>	1: 52,000	1: 42,000 (R)	
<i>B. radiobacter</i>			1: 10,000 (24 hr.)
Controls (uninoculated)	0	0	

(R) indicates cultures which brought about a rapid conversion.

Cultures were incubated at room temperature for four or five weeks. Presence of heteroauxin was first detected by the *Avena* technique, but later a colorimetric method⁵ was employed to test for indole-acetic acid. Cultures were tested three times weekly, during the course of each experiment, by withdrawing aliquots aseptically. Subcultures into litmus milk at periodic intervals failed to reveal any contamination. The strains studied were *Rh. meliloti* cultures

107 (efficient) and 120 (inefficient), *Rh. trifolii* 202 (inefficient) and 209 (efficient), *Rh. leguminosarum* 317 (efficient) and 333 (inefficient) and *Rh. phaseoli* 403 (inefficient) and 414 (efficient)*.

B. radiobacter, commonly found in the root nodules of the Leguminosae, transformed tryptophane into β -indole-acetic acid at a more rapid rate than the *Rhizobia*, yet this organism does not produce nodules on the roots of legumes.

From the data cited, there is no apparent correlation between the rate and amount of indole-acetic acid derived from tryptophane and the ability to fix atmospheric nitrogen by the strains of *Rhizobia* studied. In fact, there is a tendency for the inefficient to produce auxin more rapidly than the efficient strains. Chen⁴ reports that ineffective strains in most of his experiments produced less growth substance than effective ones. He used *Rh. trifolii* only, and our data substantiate his in this respect but not when *Rhizobia* of other cross inoculation groups were studied. The fact that *B. radiobacter* likewise produces heteroauxin further complicates any interpretation of the data. What significance, if any, can be attached to the production of β -indole-acetic acid by *Rhizobia* in the light of the behaviour of *B. radiobacter*?

CARL E. GEORGI.

ALBERT E. BEGUIN.

Dept. of Bacteriology,
University of Nebraska.
Nov. 18.

* Culture numbers refer to the University of Wisconsin strains obtained originally through the courtesy of Messrs. Series and Baldwin.

¹ Thimann, K. V., *Proc. Nat. Acad. Sci.*, **22**, 511-514 (1925).

² Link, G. K. K., Wilcox, H. W., and Link, A. DoB., *Bot. Gaz.*, **96**, 816-867 (1937).

³ Link, G. K. K., *NATURE*, **140**, 507 (1937).

⁴ Chen, H. K., *NATURE*, **140**, 753 (1938).

⁵ Abderhalden, E., *Biochem. Handbuch*, **4**, 914 (1911).

Kopf, F., and Kostermans, D. G. F. R., *Hoppe-Seyler Z. phys. Chem.*, **223**, 113-121 (1934).

Fossil Man-Apes of South Africa

By invitation from Dr. Robert Broom, of the Transvaal Museum, Pretoria, and from Prof. Raymond A. Dart, of the Medical School, University of the Witwatersrand, Johannesburg, we visited South Africa in July and August last, and were given every facility for the study of the original fossils described as *Australopithecus africanus* Dart, 1925¹, *Australopithecus* (later *Plesianthropus*) *transvaalensis* Broom, 1936², and *Paranthropus robustus* Broom, 1938³, all probably of Pleistocene age.

Our report on the dentition and dental arches of the South African fossil man-apes has recently been completed and sent to the Pretoria Museum, but the importance of these 'near-men' in future discussions of the origin of man seems to warrant the present brief statement of our principal results.

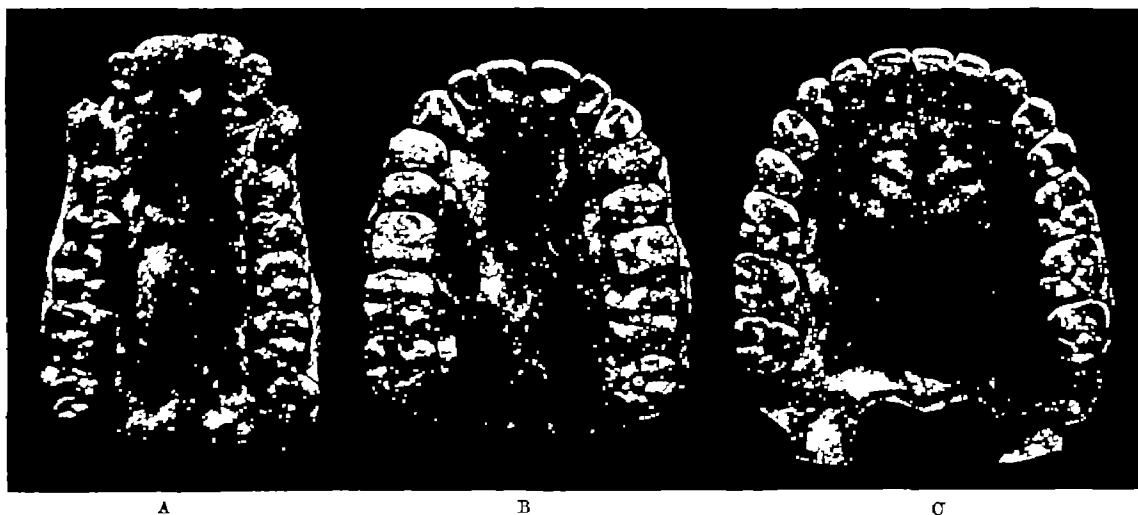
The dentition of the adult forms described by Broom presents many transitional or annectant conditions between the pithecoïd and human stages. The upper canine tooth in a supposed female specimen referred to *Plesianthropus transvaalensis* has a smaller transverse diameter than the first upper premolar, and is altogether more human than ape-like. Although the upper canine crowns are broken off in the type specimen, the roots prove that these teeth were much smaller than those of apes. A well-preserved lower canine found in the same cave (at Sterkfontein) is remarkably small in comparison with those of typical modern apes; its crown has a

relatively low tip. This form of canine, which is sometimes nearly approached in certain female chimpanzees and orangs, would require but little additional modification to attain the human status.

The first upper premolar of *Plesianthropus* differs from that of typical apes in having a nearly symmetrical convex outer face and a generally human appearance; however, its buccal root remains distinct from the lingual, as in apes.

a gradual shift from the frugivorous food habits of primitive dryopithecine apes to the omnivorous habits of early man.

The facts and considerations cited in our fuller report can scarcely leave a well-founded doubt that the Pleistocene man-apes were survivors of the diversified *Dryopithecus* stock of the late Tertiary, which ranged from Spain to India and southward to East Africa, and that they were, in both a structural



RESTORED UPPER DENTAL ARCHES OF (A) *Sivapithecus sivalensis*, (B) *Plesianthropus transvaalensis*, (C) HEIDELBERG. (C) RESTORED BY PROF. J. H. MCGREGOR TO FIT THE KNOWN LOWER DENTAL ARCH.

The first lower premolar of *Paranthropus* has a rounded or ovoid crown, not unlike that of *Sinanthropus* and far advanced beyond the primitive condition in the lower Miocene *Proconsul*; here the first lower premolar has a compressed crown, the outer face shearing against the inner face of the upper canine. Transitional stages leading to the almost human first premolar of *Plesianthropus* are seen in the Siwaliks forms *Sivapithecus sivalensis* and *S. indicus*. With regard to its second lower premolar, *Plesianthropus* is intermediate between *Sivapithecus* and *Sinanthropus*.

The first and second upper molars of *Plesianthropus* are of the four-cusped type common to apes and man, but m^1 in the South African genera is very large, and even m^2 is much larger than in most men; moreover, m^1 is the smallest of the three. In the lower molars the length increases as we pass from m_1 to m_2 , as it does in primitive apes, whereas in man m_2 is usually shorter anteroposteriorly than m_1 . The lower molars of *Plesianthropus* exhibit a modified form of the five-cusped '*Dryopithecus* pattern'; but the principal grooves tend to arrange themselves as in the 'plus pattern' of typical man; cusp 6, which is barely indicated in some apes, is here prominent, as it is in some men.

A critical consideration of the evidence has led to the reconstruction of the upper dental arch reproduced in the accompanying figure. Its sides were slightly divergent posteriorly and it was well advanced in the human direction.

The crowns of the lower grinding teeth of the South African man-apes when well worn present nearly flat surfaces, as in man, whereas those of apes show steep elevations, especially on the inner side. These transitional conditions suggest that there was

and a genetic sense, the cousins of the contemporary human branch. Their numerous transitional conditions tend strongly to connect the families of apes and men at no very distant geological date (perhaps lower Pliocene). They seem to give no support to the idea of the separate existence of the human stock in early Tertiary times.

WILLIAM K. GREGORY.

MILO HELLMAN.

American Museum of Natural History,
New York, N.Y.

Dec. 3.

¹ NATURE, 115, 196-199 (Feb. 7, 1925).

² NATURE, 123, 436-438 (Sept. 19, 1936).

³ NATURE, 142, 377-379 (August 27, 1938).

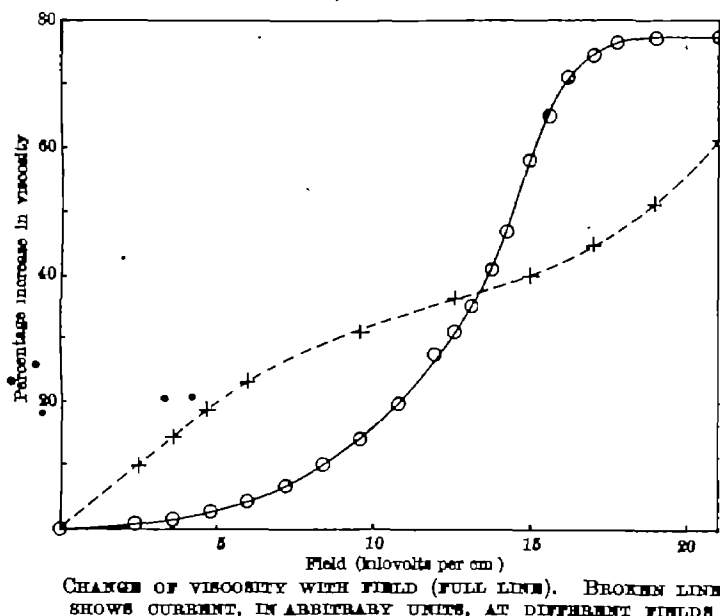
Effect of an Electric Field on the Viscosity of Liquids

FOR the past three years we have been working on the effect of an electric field on the viscosity of liquids. As the subject is now attracting attention, we think it will be well to give a preliminary account of our chief results. Experiments have been carried out with a method that permits a high degree of accuracy, with fields both transverse to and parallel to the direction of flow. The transverse field was applied with the liquid running in a channel of rectangular cross-section, the distance between the opposite charged sides, which were parallel to a high degree of accuracy, being about 0.2 mm.

The liquids used may be classified into those possessing no dipole moment, and those with a dipole moment. With non-polar liquids there is no effect. For example, with carbon disulphide and a transverse

field of 40,000 volts/cm., we have shown that any change in viscosity must be less than 1 part in 5,000. Other substances for which no effect has been established are benzene, chlorobenzene and various alcohols.

A marked effect, which presents several striking features, has been established with ten polar liquids (ether, acetonitrile, acetone, nitromethane, chloroform, and methyl, ethyl, propyl, butyl and amyl acetates). The viscosity increases with the field, but shows a saturation effect. A typical curve of the relation between field and change of viscosity is reproduced herewith for acetonitrile. The viscosity increases at first in a way roughly proportional to the square of the field, but later approaches a constant value which we call η_{∞} . In the case illustrated the limiting increase of viscosity is nearly 80 per cent.



With any one polar liquid the scale of the increase, determined by the value of η_{∞} , depends markedly on the purity, as measured by the conductivity k of the liquid. Repeated distillation diminishes both k and η_{∞} , and it has been established that η_{∞} is proportional to k . For example, with acetonitrile the limiting increases of viscosity are 115 per cent and 27 per cent for conductivities of 2.58×10^{-6} and 0.578×10^{-6} ohm⁻¹ cm.⁻¹ respectively.

In transverse alternating fields, the full static effect is obtained up to frequencies of about 400 ~. With higher frequencies, the effect decreases, and at frequencies of the order of 2,000 ~ there is no change of viscosity. The cut-off frequency increases as the temperature rises. No effect has been obtained in longitudinal fields of the same order.

An interesting effect which has been established is that the current through these badly conducting polar liquids (k of the order 10^{-6} ohm⁻¹ cm.⁻¹) does not obey Ohm's law. The current has certainly ceased to be proportional to the potential difference at fields of the order of 2,500 volts/cm., and tends towards a saturation effect. At higher fields there is a rapid rise in current, the whole curve of current against voltage being reminiscent of that for an ionized gas. The broken curve reproduced is typical.

The implications of these results will be discussed in a paper which awaits the completion of confirmatory results with a channel of different width.

E. N. DA C. ANDRADE.

C. DODD.

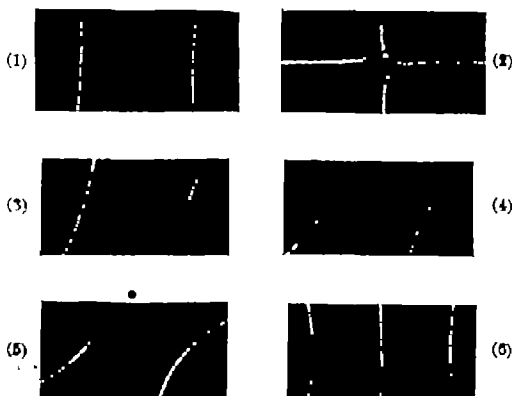
Physics Laboratory,
University College,
London.
Dec. 2.

Fundamental Vibration of a Rectangular Plate

THE *higher overtones* of vibrating plates sometimes combine when it so happens that the periods of two or more of them are very nearly equal. This phenomenon, which is of academic rather than of applied interest, has been fully studied for a free circular plate¹.

That the *graver tones* of the transverse vibrations may occasionally combine, would appear to be of importance in engineering resonance problems; the rectangular plate is a case in point. Two familiar sand nodal figures are shown in Figs. 1 and 2, of which the first is fundamental to a narrow, and the second is fundamental to a wide free rectangular plate. The frequencies for the particular brass plate employed were very nearly equal, 558 and 548.8 c./sec. respectively. By filing the longer side of the plate, the two periods were adjusted to equality with the aid of a valve oscillator. This resulted in a profound change in the form of the vibrating surface (see Fig. 4), the former nodal systems being no longer obtainable. A pattern which is the mirror image of Fig. 4 can also be obtained. The sharpness of resonance, which is an inverse measure of the 'damping capacity' of engineering practice, is considerable. Thus a change of only 1 c./sec. one way or the other in the tone, produced the modified nodal patterns of Figs. 3 and 5.

That these curved nodal lines are due, neither to a want of uniformity in the plate, nor to absence of



freedom in the vibration, is proved by the fact that as soon as the same plate is excited in another mode (see Fig. 6), a characteristic single nodal pattern is

obtained. The ratio of length to breadth in Fig. 4 is 1.93. I estimate that a combination between the nodal systems of Figs. 2 and 6 should occur when this ratio is about 3.9.

MARY D. WALLER.

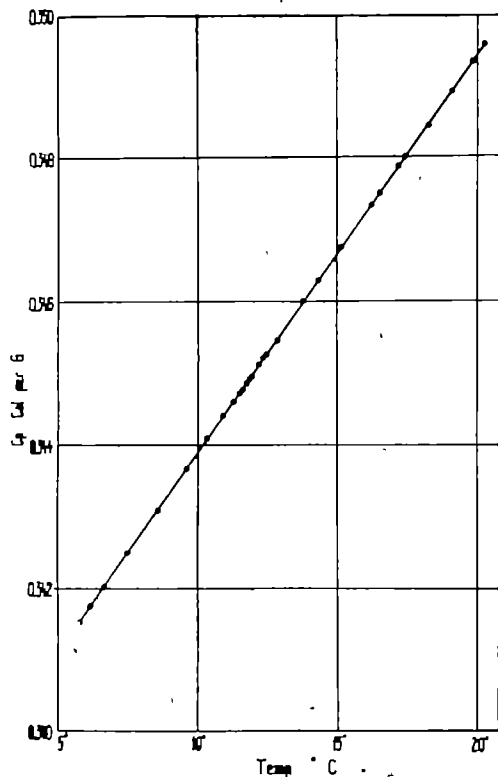
Physics Laboratory,
London (R.F.H.) School of Medicine for Women,
8, Hunter St., London, W.C.1.

Dec. 5.

¹ Waller, M. D., *Proc. Phys. Soc.*, **50**, 77 (1938).

Relation between Specific Heat and Temperature for Nitrobenzene

THEORETICAL considerations lead to the conclusion that traces of impurities can have an influence on the dielectric constant and density of a substance, but the changes of energy are only very slightly affected by them. For these reasons, the relation between specific heat and temperature for nitrobenzene has been investigated, with special attention to the neighbourhood of the solidification point of this substance.



This work is analogous to that carried out at the Kamerlingh Onnes Laboratory in Leyden on helium. It was then found that at the transition point of helium the change of density was 0.3 per cent, that of the dielectric constant 0.1 per cent, but the change of specific heat was as much as 79 per cent in certain temperature limits.

Two samples of nitrobenzene were used. One was purified by Dr. W. Keesel, of the Joseph Pilsudski University in Warsaw, the second by myself. The apparatus was similar to that used by Prof. W. H.

Keesom and Dr. Olusius¹ in Leyden. Before measurement, the nitrobenzene was distilled directly into the calorimeter. The energy increments were made small so as to be able to observe the possible transition point.

The experimental results show that the change of the specific heat of nitrobenzene with temperature is linear and this relation can be represented by the following equation:

$$C = 0.33830 + 0.000556 t.$$

It should be emphasized that observations in the neighbourhood of 9.5° C. were made with especial care, the points of the curve being 0.3° C. from each other, all lying on a straight line. The results obtained are in perfect agreement with those of other authors², especially with the data of Williams³ and Daniels⁴.

The relation of the refractive index to temperature and the heating curve were also investigated in the temperature limits 5.7–20° C., but no anomalous behaviour was observed.

J. MAZUR.

Physical Laboratory,
Polytechnic Institute,
Warsaw.
Nov. 16.

¹ Keesom, W. H., and Olusius, K., *Comm. Leyden*, No. 219.

² Parks, G. S., and Todd, S. S., *J. Chem. Phys.*, **2**, 440 (1934).

³ Williams, J., and Daniels, F., *J. Amer. Chem. Soc.*, **46**, 903 (1924).

After-Image Phenomena

If in a dark room a light be attached to a scale, and a point three feet on the right is marked with a peg and the light be looked at with one or both eyes for one or two seconds from a distance of ten feet and then the eyes be directed at the peg, it will be noticed that the negative after-image of the light is seen on the peg but the positive after-image has rapidly passed it to the right. The eyes being firmly directed towards the peg, it will be noticed that the positive after-image comes rapidly back towards the peg.

The first part of the experiment I have described before; it is evidently due to the contraction of the eye muscles pressing on the eye and moving the photo-chemical fluid, thus causing a separation of the positive and negative after-images. The second part of the experiment appears to be due to the cessation of the pressure on the eye causing the photo-chemical fluid to flow in the opposite direction. It should be noted that the pressure is in the opposite direction to the movement of the image; thus when the pressure is to the left, the image moves to the right, corresponding to the new position of the fluid in the retina.

F. EDWARDS-GRADIN.

45 Dollis Hill Avenue,
London, N.W.2.
Dec. 12.

Ultra-Violet Spectrum of Thiophosgene

We have tried to solve the problem of the fundamental vibrations of thiophosgene by analysing one of the three band systems found by one of us¹ previously in the ultra-violet spectrum of the vapour. The first system is composed of more than five hundred bands distributed between 5712 and 3989 Å. at ordinary temperature. A second and a third

system appear between 3282 and 2710, and beyond 2710 Å. respectively. Their complete analysis is in progress.

The main feature of the first system, observed when the dispersion is sufficiently high, is the fact that each band is resolved into two or sometimes three components. It is easy to see that we are dealing with isotope effects originating from the Cl atoms. As a matter of fact, the same phenomenon has already been observed by one of us² in the case of phosgene and has been assigned to the above cause through direct experiments by W. Kuhn³.

The following formula enables us to calculate all the bands of the system in satisfactory agreement with the observed frequencies:

$$\nu = 17374 + 914\nu_1' - 3\nu_1'' + 240\nu_2' + 400\nu_2'' - \nu_3'' - 1148\nu_4' - 537\nu_4''$$

Thus the absorption spectrum of thiophosgene is characterized by five fundamental frequencies: 1148 and 537 cm^{-1} for the normal molecule and 914, 240, 400 cm^{-1} for the activated state.

As the molecule belongs to the symmetry group C_{2v} , it is possible to assign these values to the various possible vibrations in the following way:

$$\nu_1'' = 1148, \nu_1' = 537, \nu_2' = 914, \nu_2'' = 240, \nu_3' = 400$$

The nomenclature is identical with that used by Bailey and Hale⁴ in the case of phosgene.

It is worth mentioning that our analysis was made at a time when no data were available for the Raman or infra-red vibration frequencies of the thiophosgene molecule. Our formula has been derived from the measurements by determining the distribution of intensities, considering quantitatively the isotope effect and

by applying the rules of Herzberg and Teller⁵. It is only recently that the Raman spectrum of liquid thiophosgene has been measured, namely, by H. W. Thompson⁶. His data confirm our results for the normal molecule both with regard to magnitude and assignment: $\nu_1' = 1121$ and $\nu_2'' = 497$. The slight difference may be due partly to the fact that our figures refer to the gaseous and not to the liquid state of the thiophosgene molecule.

It is further of interest that even the values of $\nu_2' = 287$ and $\nu_2'' = 363$ given by H. W. Thompson are not very different from our figures for ν_2' and ν_2'' , although these latter belong to the excited and not to the ground state as in Thompson's experiments. This coincidence is obviously due to the fact that the electron excitation is located in the C-S bond. Incidentally, with the elucidation of the thiophosgene spectrum, our experiments provide, as results of more general interest, a check on the validity of the Herzberg-Teller theory and a justification for the use of the isotope effects in the study of complex spectra.

Details of our experiments will be published elsewhere.

VICTOR HENRI.

JULES DUCHESNE.

Institute of Physical Chemistry,
University, Liège.
Dec. 3.

¹ Henri, V., "Structure des Molécules", 90 (1925).

² Henri, V., and Howell, O., *Proc. Roy. Soc., A*, 123, 190 (1930).

³ Kuhn, W., and Martin, H., *Z. phys. Chem.*, 81, 93 (1933).

⁴ Duchesne, J., *Thèse Liège*, 1937.

⁵ Bailey and Hale, *Phil. Mag.*, 26, 98 (1938).

⁶ Herzberg and Teller, *Z. phys. Chem.*, 81, 410 (1933).

⁷ Thompson, H. W., *J. Chem. Phys.*, (11), 6, 748 (1938).

Points from Foregoing Letters

STATISTICAL analysis of the results obtained in ten laboratories give a value of 1,670 for the conversion factor for calculating from spectrophotometric observations the biological effect of halibut liver oil (containing vitamin A); therefore Miss E. M. Hume considers that the conversion factor of 1,600 provisionally adopted by the Second International Conference on Vitamin Standardization in 1934 should be retained, although marked discrepancies have been observed in the United States, in connexion with the United States Pharmacopoeia reference cod liver oil, which gives a higher conversion factor (about 2600).

The time of recovery of vision after looking at a bright light has been determined by Dr. L. B. Pett for 1,200 people by means of a new apparatus and found to depend upon the amount of vitamin A taken with the food. The author also gives a table showing a certain correlation between recovery time in the visual test on one hand and dry skin, night blindness and liability to colds on the other.

Laccase, an oxidizing enzyme found in the latex of *Rhus succedanea*, is found by Prof. D. Keilin and Dr. T. Mann to be a copper-protein compound belonging to the same group as the polyphenol oxidase of potatoes and mushrooms, but differing in its blue colour and other respects; for example, it oxidizes ascorbic acid directly, does not oxidize *p*-cresol and is not poisoned by carbon monoxide.

Dr. O. E. Georgi and A. E. Beguin find that there is no correlation between the amount of indole-acetic

acid (heteroauxin) produced in synthetic media, in presence of tryptophane, by various strains of *Rhizobia*, and the ability of these strains to induce the formation of nodules on the roots of leguminous plants.

From a study of the dentition and dental arches of the South African fossil man-apes, Prof. W. K. Gregory and Dr. M. Hallman conclude that these Pleistocene man-apes were derived from apes at no very distant geologic date, perhaps Lower Pliocene, and that the evidence does not indicate the existence of human stock in early Tertiary times.

A graph showing the change in viscosity of acetonitrile under the influence of an electric field, is submitted by Prof. E. N. da C. Andrade and O. Dodd. Similar results were obtained with ether, acetone and other polar liquids; with non-polar liquids there is no effect.

Nodal figures obtained with rectangular brass plates, showing that the *groover tones* of the transverse vibrations may occasionally combine, are submitted by Miss Mary D. Waller.

The change in the specific heat of specially purified nitrobenzene with temperature is found by Dr. J. Masur to be linear over the range 5°–20° C.

The ultra-violet spectrum of thiophosgene has been investigated by Prof. V. Henri and Dr. J. Duchesne. The vibration frequencies calculated for the normal molecule agree with those since published by H. W. Thompson, derived from a study of the Raman spectrum.

Research Items

Kazak Social Structure

MR. ALFRED E. HUDSON has examined the nature of certain features of Turco-Mongol social structure, investigating the processes which appear to have been active in their development ("Kazak Social Structure", *Yale University Publications in Anthropology*, No. 20. Yale Univ. Press, and Humphrey Milford, 1938. Pp. 109. Price 1.50 dollars). Most of the material utilized relates to the middle nineteenth century, immediately before the Russian conquest of Central Asia; but the author also bases his work on investigations in the field in 1936. The Kazak, or Kirghiz, are a nomad stock-herding people, though now becoming sedentary. They inhabit the steppe country lying between the Caspian and the Altai Mountains, and number, according to the 1926 census, 3,959,000. They are divided into a large number of tribes, sub-tribes, gentes and branches, of which the structure and relation one to another are not clear. As the result of this investigation, after consideration of the various aspects of Kazak social life into which they enter, it would appear that there is a constant tendency towards the division of existing groups by branching, and at the same time a movement towards the formation of larger groups from the smaller by fusion. Although increasing numbers was the underlying cause of fission, the immediate causes were various. New economic units arose, for example, from the custom of giving a son a share of his father's cattle, favouring the centrifugal tendency. In the formation of larger units, groups of individuals, who belonged to other gentes, were absorbed, or subordinate or vassal gentes might be formed, leading to a symbiosis, rather than a political union. Political amalgamation frequently cut across genealogical lines. While some unions were for mutual protection, others were the result of force. In this third type it is difficult to distinguish between voluntary and involuntary amalgamation. The prestige of a leader acted as a magnet. In practice the solidarity of the blood-group was subservient to the domination of the wealthy and powerful individual. The personal dependence of the weak on the strong and wealthy was more effective than the responsibility of the members of the blood group for one another.

Petroglyphs and Tuareg Origins

In 1926, the Hon. Francis Rodd directed attention to apparent similarities between certain rock drawings in the Aïr mountains of the southern Sahara and the pictures of Libyans in Egyptian tomb decorations, etc., of the Nineteenth and Twentieth Dynasties. The question of whether the Tamahu, and Tehenu of the Egyptian records were related to, if not the actual ancestors of, the Tuareg, was discussed by Orio Bates. Mr. Rodd now points out (*J. Roy. Anthropol. Inst.*, 68; 1938) that the human figures which appear in these petroglyphs can be divided into categories, according to the method of portrayal. Four types can be distinguished: (1) The 'hour-glass' group, which recently has become explicable as represented in the archaic leather dress of the 'wild

men, of the Ahaggar and Aïr, who live remotely in the fastnesses of these mountains, possibly remnants of a pre-Tuareg, non-negroid people; (2) the 'demon' or 'imp' figures, having nothing in common with the other groups except hair decoration; (3) decorated figures, with an elaborate dress, in which an attempt is made to portray a patterned or chequered garment with a yoke or ornament at the neck, and having certain analogies in Tehenu Libyans of the Egyptian tombs; and (4) the 'riding-breeches' group. Nos. 3 and 4 appear to be contemporary, though their heads are strikingly different in shape. It has been suggested that the 'riding-breeches' type represents the women of group 3. Neither type shows the mouth, which may be an attempt to represent the Tuareg veil, although the Egyptian Libyans have the mouth fully represented. Tentatively it is concluded that group 2 may be an aboriginal pastoral, or hunting people, slaves or subjects of group 1, that is if they are their contemporaries. Group 3 may be the Libyans of the Egyptian tombs. They wear feathers in their hair, with the Libyan lock on each side of the head. They possess spears and javelins, round shields and horses. Group 4 may be women or men. If the latter they are of a different race from Group 3; if they are women, they are the women of group 3, in which event they ought to be Amazons, as they wear feathers in their hair, one Libyan lock and possess spears, javelins, round shields, and horses. If group 3 represent the ancestors of the Tuareg, it shows the survival of the same costume over a very long period, and makes the migration of the Tuareg to Aïr much earlier than has been thought.

Antirabic Immunization

I. J. Kligler and H. Bernkopf (*Brit. J. Exp. Path.*, 19, 378) report experiments showing that intraperitoneal injection of formalized tissue cultures of rabies virus has considerable immunising capacity for mice. Immunity to intracerebral infection was incomplete, and about 42 per cent showed no immunity after five to seven injections of the vaccine. Immunity was established more readily by intraperitoneal or subcutaneous infection. Immunized mice which survived an intraperitoneal infection were found to possess a greater degree of immunity than untreated mice which survived infection. Primary treatment with inactive virus affected in a marked degree the immunity of the mice to an intracerebral infection. Mice which received diluted vaccine (1:10) or fewer doses possessed a lower degree of immunity than the others, although they all survived intraperitoneal or subcutaneous infection with fresh brain virus. Only half the mice which survived intraperitoneal infection without previous vaccination proved immune to intracerebral infection, whereas 84 per cent of previously immunized mice were found to be immune. Intraperitoneal injection of a single dose of a rabies virus culture which had a very low virulence for mice conferred on the treated mice a high degree of immunity against a subsequent intracerebral infection with test-brain virus.

Absorption of Sulfanilamide

E. K. Marshall, jun., and W. C. Cutting (*Bull. Johns Hopkins Hosp.*, 63, 328; 1938), of the Department of Pharmacology and Experimental Therapeutics, Johns Hopkins University, made the following studies of the absorption and excretion of sulfanilamide in the mouse and rat. Blood concentration curves were determined in these animals after administering sulfanilamide in different doses, in different vehicles and by different routes. The percentage excretion of the drug in eight hours by the kidney was determined, as well as the amount remaining unabsorbed in one hour in the intestinal tract. From the data obtained, it was concluded that the excretion was more rapid in the mouse than in the dog, rat or man. No significant difference was found when sulfanilamide was administered by different routes or in different vehicles. When large doses were given the maximum concentration in the blood of the rat was much lower than in the mouse.

The Glasshouse Leaf-Hopper

MR. G. FOX WILSON has collected much information about the glasshouse leaf-hopper, *Erythroneura (Zygina) pallidifrons*, in a recent short paper (*J. Roy. Hort. Soc.*, 63, Pt. 10, Oct. 1938). The pest appears to have assumed serious proportions, and causes widespread damage to the leaves of many glasshouse plants. *E. pallidifrons* has been known for many years, but was first erroneously named *Zygina parvula*. Taxonomy, life-history, methods of feeding, and host range, are discussed in the paper, and control measures have also been investigated. Eradication is difficult, but the use of nicotine-soap wash offers the greatest possibility of success. The use of darris, pyrethrum extract or eucalyptus oil, and also fumigation with nicotine vapour or hydrocyanic acid gas, are alike in their inadequate control of the pest. An infestation may often be checked by removing the lower leaves of plants which are attacked, crushing the larvae under the upper leaves, and removing weeds, particularly chickweed, which harbour the insect.

Pathogenic Yeasts

THE non-sporing yeast *Mycotorula albicans* is frequently associated with other fungi in various diseases of human skin. Its distribution as a parasite is apparently widespread, and Messrs. P. Redaelli, T. Castelli and R. Ciferri have shown (*Mycopathologia*, 1, Fasc. 3, Sept. 1938) that it can be isolated from various Italian home-made bread yeasts. It does, in fact, perform the alcoholic fermentation of a leavening agent. There would seem little danger to human beings from eating bread baked with such mixed yeast, but as a source of infection it cannot be overlooked. Another non-sporing yeast, *Blastodendron Krausii*, has also been isolated from the same kind of yeast. It also can accomplish alcoholic fermentation of glucose, levulose and maltose; but as yet is not a proved parasite of human beings.

Agaricaceae of Hokkaido, Japan

THE second part of a very detailed study, by Sanshi Imai, of the gilled fungi of Hokkaido, Japan, has recently appeared (*J. Fac. of Agriculture, Hokkaido Imperial University*, 43, Pt. 2, pp. 179-378, Aug. 1938). The first part, which was noticed in

these columns (*NATURE*, 141, 1105; 1938) was published in March of this year. This second part completes the account of Agaricaceae, and raises the number of new species to forty. 348 kinds have, in all, been described critically. 238 of these are already known in Europe and North America; 49 species have previously appeared in Europe only, and 23 in North America. 43 species are indigenous in eastern Asia, and 196 species are new to Japan. Many fungi in Hokkaido are intermediate between European and North American species, thus giving additional confirmation of an ecological connexion with both regions. Edible and poisonous species are enumerated, but the account is of international value for its critical nature and its proposals for further subdivisions in existing classifications.

Mould Fungi of the Soil

DR. MARIE E. CAMPBELL has made a detailed study of Mucorales in the soil (*Trans. Roy. Soc. Edin.*, 59, Pt. 2, 411-436; 1937-1938). Twenty-three species of this group of mould fungi have been isolated from seven samples of soil, and some conclusions of general mycological interest have been reached. Twenty of the species were heterothallic, and the remaining three homothallic. A hybridization, though somewhat imperfect, has occurred between the negative form of *Abisidia cylindrospora* and the positive form of *Rhizopus nigricans*, thus adding possible interthallic crosses as another taxonomic difficulty to those already overwhelming the mycologist. Positive forms of the Mucorales are, in general, distributed more widely in soil than the negative strains, and there are indications that moorland and peaty soils contain fewer species of these fungi than cultivated fields. Many other details of culture, of spore longevity, of structure, of the effect of soil reaction and other factors, are given in the paper, which is further elucidated by fifteen text-figures and three excellent plates.

Thorough Cultivation of Soil

IN most countries, and especially in Great Britain, farmers have a traditional belief in the necessity and virtue of thorough cultivation. Although it is self-evident that some cultivation is needed to secure a satisfactory tilth, it is not certain that additional and deeper workings of the soil are as valuable as has been generally thought. At the present day when cultivation is one of the heaviest expenses on the farm, the question clearly needs reconsideration, and Dr. B. A. Keen has recently given some interesting results of investigations on the subject (*J. Min. Agric.*, 45, 645; 1938). Experiments carried out over a number of years on heavy land showed that deep ploughing or subsoiling was of little or no benefit to a sugar beet crop, while extra ploughings, though they produced some small increase in the yield of the potatoes and sugar beet, were also uneconomic operations. Similarly, intensive inter-row cultivation of root crops, hitherto regarded as desirable, proved a waste of labour on both heavy and light land. The practice of rolling and harrowing cereals, on the other hand, was supported by experimental evidence. Rotary cultivation received special attention, comparison being made between plots prepared by the plough, the grubber and the rototiller. Germination tended to be quicker on the loose seed bed from the rototiller, but subsequent growth and yield were

very similar on all three sets of plots. If time presses, therefore, the quicker and cheaper process of grubbing can safely be substituted for ploughing, but the practice should not be continued for several years in succession, as weeds are liable to increase rapidly. The conclusion that, beyond a certain minimum, cultivation has little influence on crop yield has also been reached from experiments carried out on different soils and under different climatic conditions, but still further work is needed to determine if the results are of general application, or are typical of certain types of soil and climate only.

Helium Ratios of the Quincy Granite

It is well known that the helium ratios of acid rocks, especially if coarse-grained, are usually much smaller than those of fine-grained basic rocks of the same geological age. A systematic programme of research to discover the source of these anomalies is being carried out by N. B. Keevil, and a report of his results on the Quincy granite and its minerals has recently appeared (*Amer. J. Sci.*, 406-416, Dec. 1938). The 'ages' computed from determinations of the helium, uranium and thorium contents are: quartz, 86 ± 5 ; riebeckite and aegirine, 86 ± 5 ; and alkali feldspar, 49 ± 3 million years. The weighted 'age' calculated from these data and the mineral composition is in agreement with the 'age' determined from the granite itself—62 million years. A similar low 'age' for a Pre-Cambrian labradorite from the Adirondacks (101 ± 10 million years) suggests that leakage from feldspars may be prevalent. Judging from the high degree of alteration of the Quincy feldspar, the loss of helium in this case is ascribed to excessive crystal imperfections. Though the concentrations of helium and radioactivity in the riebeckite and aegirine are five times as high as in the other minerals, a relatively high 'age' was obtained, indicating that there has been no tendency for helium to diffuse towards a uniform concentration during the history of the rock. Further experiments are in progress to show whether low helium 'ages' may be due to leakage from feldspar, and whether the most reliable results on rocks are to be obtained from quartz and the ferromagnesian minerals.

Geochemical Data of Southern Africa

DR. A. L. HALL has made a very valuable compilation of chemical analyses of rocks, minerals, ores, coals, soils and natural waters from Southern Africa. Geologists and others will welcome its publication by the Geological Survey of South Africa (*Mem.* 32, p. 868; 1938), particularly as the 5,983 analyses have been drawn from a widely scattered literature. Part 1 deals with material occurring within the Union of South Africa and South West Africa, while Part 2 covers the Rhodesias, Kenya Colony, Tanganyika Territory, Uganda, Nyasaland, the Belgian Congo, Madagascar, Mozambique, etc. The rocks analysed have been roughly classified as acid, intermediate, alkali, basic and ultrabasic, sedimentary and metamorphic, and as differences of opinion on matters of classification may introduce difficulties in running down particular analyses, a detailed index is provided. It is very convenient to have in one volume all the analyses (up to the beginning of 1936) of such petrologically important provinces as those of the Bushveld, the kimberlite pipes, the Karroo dolerites and lavas, the rift valleys, and other alkali-

complexes. In this and other geochemical fields the volume will be of service in indicating where further chemical investigation is desirable, in preventing overlapping of analytical effort, and as a guide to the sources of information.

Tri-alkyl Derivatives of Lead

F. Hein and A. Klein have recently described a greatly improved method of preparing lead tri-ethyl and lead tri-methyl (*Ber. deutsch. chem. Gesells.*, Nov. 1938). The electrolytic method described by Midgley, Hochwalt and Calingaert in 1923 gives very low yields. This is due to the solvent action of alcohol on the product, which becomes transferred to the oxidizing action at the anode. By substituting 2N caustic alkali for alcohol a greatly improved yield results as the lead tri-ethyl is insoluble in water. Moreover an alkaline solution of lead tri-ethyl chloride can be used as electrolyte instead of previously isolating the hydroxide. The product separates in an almost pure condition at the lead cathode, but when pure water was substituted for alkali only lead and hydrocarbons were formed at the cathode. The appearance of troublesome by-products at the anode and the very slow formation of oily drops near the cathode before the application of the current led ultimately to the discovery that the tri-ethyl lead can be obtained easily, rapidly and almost quantitatively by a purely chemical method, namely, by reducing the alkaline solution of lead tri-ethyl chloride by metallic aluminium, lead or zinc at the temperature of the water-bath. After drying the oil with sodium sulphate it was analytically pure. When tin was substituted for aluminium, lead or zinc, an unstable substance, presumably lead di-ethyl from its scarlet colour, was formed but not isolated. No data are given as to the molecular complexity of the compound which was found by Midgley, Hochwalt and Calingaert to associate to the dimeric form in benzene except in dilute solutions.

Photochemical Theory of Vision

No. 583 of Messrs. Hermann's Series of *Actualités Scientifiques et Industrielles* (Paris) is the fourth of the biophysical series, and is entitled "La Base chimique et structurale de la Vision". It is written by Selig Hecht, professor of biophysics in Columbia University. It brings together a large amount of quantitative work which has been done on human and other eyes during the last ten years and shows that it is consistent with a simple photochemical theory of vision. According to this theory, there is initially in each cell of the retina a quantity a of a substance sensitive to light, and if light of intensity I has acted on it for t seconds and has converted x of the substance into photoproducts, which may combine with themselves or with other products to re-form the original sensitive material, the rate at which x increases with time under the action of light I is equal to $k_1 I(a-x)^m - k_2 x^n$ where k_1 and k_2 are constants, and m and n are 1 or 2 according to whether the reactions are mono- or bi-molecular. Curves are given showing how the least increment of intensity of light detectable under various conditions depends on I for each of the possible values of m and n and for both rods and cones of the retina, and the author shows how recent observations enable the values of m and n to be determined.

Scattering of Wireless Waves in the Ionosphere

By T. L. Eckersley, F.R.S.

THE purpose of this note is to direct attention to the real nature of the scattering of wireless waves in the ionosphere.* Particulars have been given in several papers (see references), but their significance does not seem to have been generally realized.

The essential facts are as follows:

(1). The echo pattern received on a linear time base near a high-power pulse transmitter on a frequency above the critical frequency is practically without exception of the type given in Fig. 1, in which the ground pulse *G* is followed by echoes at *P* which occur momentarily at apparent equivalent heights of 80–300 km., and a more distant irregular scatter group *S*. This group, while continually changing in detail, forms a permanent system of

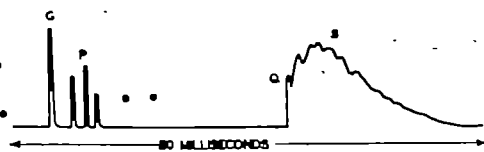


Fig. 1.

echoes, having a well-defined leading edge *Q* with an equivalent height between approximately 600 km. and 2,500 km. and extending until it is finally lost in the background noise. It is this group which forms the

*We are not here concerned with the 'broadening' of *F* echoes often observed at night.

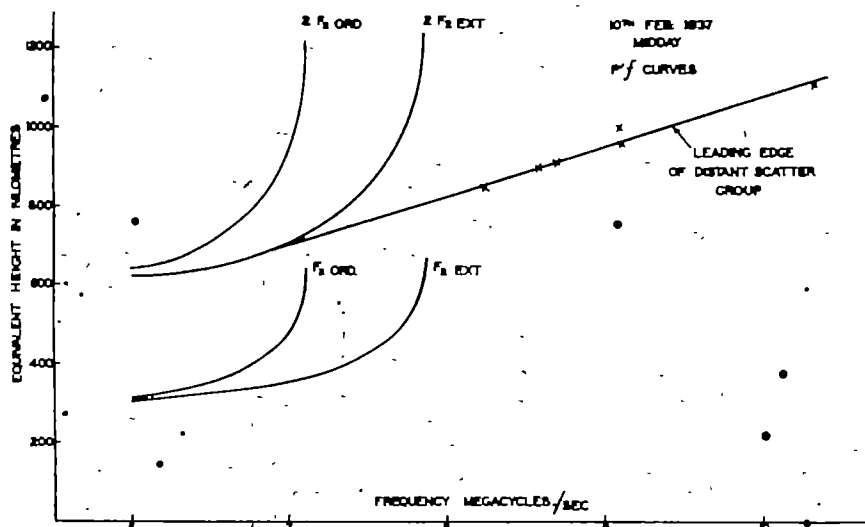


Fig. 2.

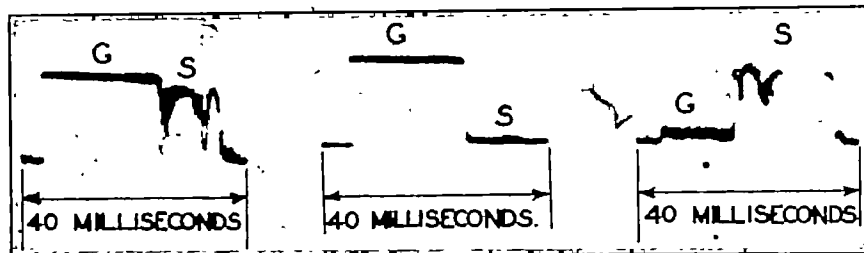


Fig. 3.

(a) GROUND SIGNAL, *G*; (b) GROUND SIGNAL MAXIMUM; SCATTER, *S*. (c) GROUND SIGNAL SUPPRESSED; SCATTER SUPPRESSED; SCATTER MAXIMUM.

echoes of apparently great equivalent height which have been recorded by other workers.

(2) Spaced-frame experiments, which determine the direction of arrival of the echoes, show that the echoes in the scatter group *S* are never reflected vertically when the frequency is above the critical frequency, so that the delays of these echoes on the ground pulse do not represent equivalent vertical heights.

(3) The apparent equivalent height of the leading edge *Q* is a function of the frequency, and a typical curve is shown in Fig. 2. As the frequency is reduced, so that it approaches the critical frequency at vertical incidence, this equivalent height approaches that of the second order *F*₂ reflection, and the direction approaches the vertical. Thus the maximum equivalent height at which the scatter echoes are received vertically is associated with the second order *F*₂ reflection.

(4) If a beam transmitter is used, energy is scattered back from the direction in which the beam is pointing. This effect was explained by Mr. Tremellen in 1927, and we have verified it by numerous experiments since. Instead of using special high-power pulse transmissions to observe

the scatter, as in Fig. 1, use can be made of commercial morse transmitters by choosing times when they are sending regularly spaced dots. Fig. 3 shows a set of photographs of such a morse dot observed on a linear time base when the speed was 25 cycles per sec. The transmitter was situated at Ongar, Essex, and had a beam directed on Salisbury, in South Africa. The frequency was 19.5 Mc./sec., and so was well above the critical frequency. The receiver was an Adcock direction finder situated only a few kilometres to the east at Chelmsford, and a strong ground signal was received from a direction nearly at right angles to the

direction of the beam. In (a) the scattered signal can be seen overlapping the ground signal and extending beyond it. This scatter was found to be strongest when the ground signal was suppressed as in (c), and was itself suppressed, nearly at right angles to this direction, as in (b), at the maximum of the ground signal, when the goniometer indicated an almost southerly direction.

(5) The distant scatter group *S* disappears when the frequency is so high that the ray which leaves the earth tangentially escapes through the *F* layer.

These five facts can only be explained in one way. Rays of frequency considerably greater than the critical frequency follow an oblique path, passing through the *E* layer on their upward path at *A*, and on their downward path at *B* after reflection at the *F* layer, as in Fig. 4. Experimental evidence⁵ shows that the *H* layer is always full of irregular scattering clouds. Signals received at or near the transmitter are those which have been scattered back along their original outward path at *A*, giving rise to echoes of the type *P*, and at *B*, producing the distant

scatter group *S* shown in Fig. 1. The results given in (5) above prove that there are no scattering clouds in the *F* layer similar to those in the *E* layer.

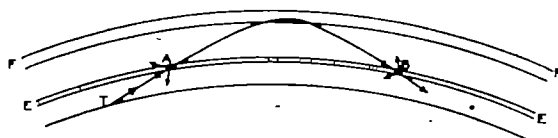


Fig. 4.

All these results are based on very numerous observations carried out over a number of years.

⁵ *J. Inst. Elect. Eng.*, "An Investigation of Short Waves", 67, 905-97, (1929).

⁶ *J. Inst. Elect. Eng.*, "Studies in Radio Transmission", 71, 430-43 (1933).

⁷ *Marconi Review*, "Scattering, Polarization Effects and Accuracy of S.W. Direction Finding", No. 53 (March-April, 1935) and No. 55 (July-August, 1935).

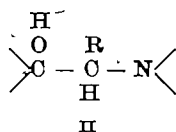
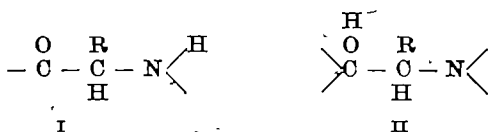
⁸ "Gesammelte Vorträge der Hauptversammlung 1937 der Lilienthal-Gesellschaft für Luftfahrtforschung", pp. 522-539.

⁹ *NATURE*, 140, 845 (1937).

Structure of Proteins

DESPITE the cold weather and the proximity of Christmas, some hundred and thirty people attended a meeting of the Physical Society on December 20 at which Dr. Irving Langmuir delivered an address on the structure of proteins. He began by enumerating the facts which pure chemistry had succeeded in accumulating about these substances, which play such an important part in living Nature. By the union of two amino acids, with the elimination of a molecule of water, the polypeptide unit is built up. Chemically, this has two valence bonds free, one at each end, and thus seems adapted solely for the formation of chain compounds. If proteins are indeed chain compounds, it would be difficult to understand why they have apparently definite molecular weights (often multiples of 18,000), or why the molecule behaves approximately as a spherical one.

A few years ago, Dr. Dorothy Wrinch suggested that, instead of the polypeptide unit (I),



where *R* is one of a number of radicals, the unit might really be (II), which differs from it only in the position of a proton within the molecule. It has, however, four free valency bonds, which (being attached to nitrogen or carbon atoms) make angles of 109° with each other. Investigation of the spatial arrangements possible with such a unit shows that they can form closed 'cages', the plane sides of which are constructed of a lacework of hexagons. The discrete molecular weights (and indeed the ratios of these) thus receive a natural explanation, as does the approximately spherical shape of the molecule.

One cage in particular contains 288 amino-acid residues, which is equal to the number determined by physico-chemical methods in the case of egg

albumin, within the limits of accuracy of these methods. In this particular case, the cage is a truncated tetrahedron which does not differ greatly from an octahedron.

Now proteins can be 'denatured' by various mild treatments (shaking for three or four minutes, or heating to 85° C. for one or two minutes are sufficient in some cases) and then show markedly different properties from native proteins, but no change in molecular weight. It is suggested that these denatured proteins are in fact composed of the polypeptides which the chemist had discovered, since the treatment which he necessarily applies in order to make investigations would be sufficient to cause the change. The ease of denaturation, and the great alteration in properties, both follow naturally from this hypothesis, taken in conjunction with the 'cyclo' hypothesis adopted for native proteins.

A particularly interesting fact which receives explanation by these theories is the insolubility in water of mono-molecular layers of proteins formed from soluble native proteins. The explanation lies in the positions of the side chains *R*, which in the cage structure are arranged around the edges of the hexagonal lacunae composing the plane sides of the cage, whereas in a mono-molecular layer, the cage is developed into a plane. When *R* is hydrophobe, the mono-molecular layer is formed with these radicals projecting; in the 'cage' they project into the interior and are thus marked.

The last part of the lecture was devoted to the X-ray evidence, which is most complete in the case of insulin, since as shown by Crowfoot, this particular protein has but one molecule per unit cell, and the results are therefore more easily interpreted than would be the case with most proteins.

Dr. Langmuir stressed the point that the X-ray data, like many of the other facts explained by the theory, such as the appearance of α - but no β -amino acids, were not used as data in constructing it originally; nevertheless, the results of the X-ray

investigation, in Dr. Langmuir's view, confirm many features of the structure to which the theory had led.

In the discussion which followed the address, Dr. Wrinch explained that the method used by Langmuir and Wrinch in interpreting the vector maps was a geometrical formulation of the classical picture of a crystal as a set of discrete units. Prof. J. D. Bernal uttered a word of caution against supposing that the theory was proved. He thought that certain features

must be true, and others were possibly true, but in his view the X-ray data fail to confirm the proposed structure. He had had a vector map calculated for the latter, and found that it differed very markedly from that obtained experimentally. Prof. E. H. Neville showed the care that is needed in interpreting a vector map, by a simple example in which a map constructed from a given set of points appeared at first sight to correspond to quite a different type of distribution.

Studies in Galactic Structure

IN *Bulletin of the Astronomical Institutes of the Netherlands*, No. 308, J. H. Oort investigates the structure of the galactic system from counts of faint stars in medium and high galactic latitudes combined with absorption data from Hubble's counts of extra-galactic nebulae. Data for the star density were derived from Kapteyn's Selected Areas; the amount of absorption to be used for each selected area was estimated from nebular counts in neighbouring fields.

Assuming tentatively that the absorption occurs in front of the stars studied, the investigation leads to a picture of the galactic system differing somewhat from the prevalent conception: broadly, the sun appears to be situated in a region of relatively low star density surrounded in all galactic longitudes by extensive regions where the density is at least twice as high.

The structural features indicated are large-scale phenomena, extending on both sides of the galactic plane to distances of 500 or 700 parsecs (say 1600–2300 light years) from this plane. The analogy between this structure and the spiral structure of strongly flattened extra-galactic systems is discussed; but the data are insufficient to define the course of the spiral arms, although the sun apparently lies between two arms. At greater distances from the galactic plane, the unevenness in density distribution disappears; at levels between 800 and 1800 parsecs the equidensity surfaces are satisfactorily represented by planes inclined at angles of about 10° to the galactic plane, implying an increase of density in the direction of the galactic centre by a factor 1.38 per 1000 parsecs. The derived longitude of the centre is $324^\circ \pm 3^\circ$ (region of Scorpio-Sagittarius), in excellent agreement with the longitude derived from

the effects of differential rotation or from the distribution of globular clusters and planetary nebulae. As regards selective absorption, the evidence from colour-excess data in the Kapteyn Areas points to a strong galactic concentration of the absorbing clouds, and indicates that the greater part of the absorption derived from Hubble's counts of nebulae must have occurred relatively close to the galactic plane.

From the time of Sir William Herschel, the dark patches and lanes, more or less devoid of stars, in the Milky Way have been an attractive problem for astronomers. It is now known that these dark areas must be due chiefly to clouds of cosmic dust. In Publication No. 48 of the Kapteyn Astronomical Laboratory at Groningen, an estimate is made by B. Hiemstra of the distances of some absorption clouds in areas 2, 5, 9 and 24 of Kapteyn's Selected Areas.

From a statistical study of proper motions and apparent magnitudes of the stars in the absorbing regions and in the surrounding rich areas, the author is able to derive limits for the distance and absorption effect of the clouds, assuming them to be of infinitesimal thickness compared with their distance. The results range as follows: Area 5 contains a cloud absorbing 0.8^m – 1.5^m at a distance less than 300–400 parsecs. Area 2 contains a cloud absorbing at least 0.5^m at a distance of 600–1200 parsecs. In area 9, lying east of the North America Nebula, the absorption reaches 2.0^m at a distance of 600–650 parsecs. The plates used in the investigation were taken at the Radcliffe Observatory, Oxford, with the 24-inch refractor, which was recently presented to the University of London Observatory at Mill Hill. Usually the pairs of plates were taken about fifteen years apart.

Education for Citizenship

PREPARATION for and training in citizenship are recognised by an increasing number of people in Great Britain as of vital national importance and as calling urgently for the development and extended application of effective techniques. There is much to interest them in "Forums for Young People", a pamphlet recently issued by the United States Office of Education (Washington, D.C., Superintendent of Documents, 15 cents). This is a study of problems and plans involved in providing organized series of free discussions of public affairs for high school and college students and for other young people. For two years, the Commissioner of Education has conducted, with the help of very

substantial Federal grants, a vigorous propaganda for the organization of public affairs forums throughout the States, and the resulting experiments have provided ample material for this study, the publication of which, will, he hopes, "contribute to the thinking of the teaching profession and of laymen on this problem of finding ways and means to make secondary and higher education meet its civic responsibilities". It begins with an admirably lucid discussion of pros and cons. The point of view taken is that the most important purpose of education in our time is the training of the mind to deal intelligently with the undecided issues which face mankind. Subsequent chapters describe: types of forum

programmes for high schools, forum plans for colleges and universities, forum plans for youth on community-wide basis and "guide-posts to organisation".

Some of the problems of "Forums for Young People" were discussed at the Secondary School Conference held by the Association for Education in Citizenship last year at Morley College, London. A report of the proceedings at this conference appeared in the July number of the *Citizen*. The conference covered a wider field, including consideration of the part played by character and purpose in the making of good citizens, and the efficacy of various out-of-school activities such as scouting, classes in first-aid, and camping as means for stimulating emotion and imagination and harnessing them to action in the service of the community so as to overcome "that apathy which is the besetting weakness of democracy". With the view of keeping in touch with one another the now considerable number of schools where systematic efforts are made to foster the development of a spirit of community service a "Schools Community Service Group" has been constituted within the Association with headquarters at

The Downs School, Colwall, Malvern, with Mr. W. F. Hoyland as honorary secretary. The chief subjects dealt with by the group are: manual work on the school estate, help at physical training and play centres, boys' clubs and school missions, visits to factories, housing estates, etc., work camps in the holidays, for example, helping unemployed men on their allotments, school expeditions abroad.

In the same number of the *Citizen* is an article of outstanding interest by Prof. René Maheu of the Institut Français du Royaume-Uni on the teaching of philosophy in French secondary schools. The philosophy teachers are, it appears, allowed the greatest freedom both as to method and as to subject, and most of them concentrate on instruction "not so much in facts or ideas as in the sovereign art of passing judgment". They seek to equip their pupils with the techniques of self-knowledge and of objective thinking. To them is available the sole opportunity given to secondary school teachers of "effectively helping their pupils to decide for themselves with their own reasoning powers, the use they are to make of their freedom as citizens".

The Differential Analyser in Electrical Engineering

IN recent years, there has been a considerable development in the design and use of mechanical and electrical instruments for carrying out calculations of various kinds. These calculations can be divided into two main groups: first, there are those which consist of the four processes of arithmetic (addition, subtraction, multiplication and division) combined in any way, and secondly there are those which involve the further ideas of the calculus. For the latter group of calculations, the solution of differential equations is one of special importance both in pure and in applied science, as in both fields there arise many kinds of differential equations which have no formal solution or none convenient for numerical evaluation, but for which quantitative information about the behaviour of the solution is required.

In a paper by Prof. D. R. Hartree and Mr. J. K. Nuttall on the differential analyser and its applications in electrical engineering (*J. Inst. Elec. Engineers*, No. 503), a description is given of the differential analyser, and it is shown that the solutions of non-linear differential equations can be readily obtained by its use. Although it is possible to evaluate the solutions of such equations numerically and sometimes graphical methods can be employed, yet except for simple equations, numerical methods are laborious and lengthy, and graphical methods are limited in scope and accuracy and are also laborious to carry out on a large scale. The general idea of such a machine was due to Lord Kelvin. The practical realization of the idea is due to Dr. V. Bush, of the Massachusetts Institute of Technology, where the first machine of this kind was designed and constructed. A similar machine built by the Metropolitan-Vickers Electrical Co., Ltd., is installed at the University of Manchester and there is another at the University of Pennsylvania.

Immediately following the paper describing the

differential analyser, there is an excellent account of the practical application of it to study the transients on a distortionless transmission line, by Prof. Hartree and Dr. Porter. The ever-increasing volume of technical literature on lightning and its effects on transmission lines and terminal equipment provides evidence of the attention now being paid by engineers to this problem. It is now known that the severity of a transient occurring at a line terminal may be lessened by flattening the front of the wave, by means of wave modifiers or surge absorbers or by reducing its amplitude by means of 'arresters' of various types. The principal features of the majority of arresters of the 'spillover' type is that their action depends on the use of a material having a non-linear current-voltage characteristic.

This paper describes the solution of the problem of evaluating the history of a transient on a finite line with such a non-linear impedance at one or both ends. The behaviour of a transient on a finite distortionless line can be described in terms of two travelling-wave systems propagated in opposite directions along the line. The voltages in these two waves satisfy two ordinary differential equations depending on the terminal conditions, and involving a relation between the voltage at two times differing by the time of travel of a wave from one end of the line to the other and back. Equations of this type can be handled mechanically by means of the differential analyser, and the use of the differential analyser does not require that the terminal impedances should have linear characteristics. The authors apply the instrument to a line with a capacitance at one end and a non-linear resistance (lightning arrester) at the other. Specimens of machine solutions, both with a linear and a non-linear resistance at the far end, are given and discussed, and compared with oscillograms taken on an actual line.

Electric Power Supply in India

AT the annual meeting of the National Academy of Sciences, India, held on March 5, a symposium was arranged on the subject of India's power supply. In opening the discussion, Prof. M. N. Saha said that no subject could at the present moment be of greater importance than that of a cheap and abundant power supply. The whole industrial efficiency of a nation depends on it. He pointed out that there are countries in the world that have developed all their power resources—Norway, United States, England and Germany; but India, China and Abyssinia are still dependent on a medieval economy. In Norway, the total output per head per annum is nearly 1,800 units. In England and Germany the power is mainly derived from coal, but the output per head is probably nearly the same. In India the output cannot exceed 90 units, of which about 60 is from human labour, 10 from animal power and 20 from steam and electrical power combined.

If the problems of poverty and unemployment in India are to be solved, the power resources of the country must be organized so as to bring them to the level of Europe, America and Japan. Dr. Tandon said that the sponsors of the Ganges canal project would have done better service to the country if, instead of trying to capture the public imagination by the ideal of rural electrification, they had concentrated the load near the generating stations for the development of the heavy chemical industries.

Pandit J. Nehru, in summing up the discussion, said that everyone saw the necessity of establishing a power research and survey institute. But democratic Governments are greatly burdened by their ordinary routine work, and complaints from innumerable persons who now have access to them. The first things they do are naturally those demanded by hundreds of thousands of people, and so they have no time to listen to the counsels of a few dozen, however great their reputation may be. The expert man of science is not always a helpful person. He does not realize that things which have to be put before the Government must be definite and that the proposals must fit in with the realities of the situation. He asked the Academy to draw up definite proposals for benefitting the nation, and not vague aspirations as to what should or might be done.

At a subsequent meeting on March 29, Prof. Saha moved a series of resolutions which were unanimously carried. The Government is requested to appoint a committee of legal and scientific experts, and representatives of industry, to study the present Electricity Act and to recommend the necessary legislation required to nationalize the generation and distribution of electricity with the view of making the supply of electrical power in the country cheap and abundant. The second resolution requests the Government to select a body of graduates in physics and electrical and chemical engineering, and to send them to study the methods adopted in countries such as England, the U.S.S.R. and Switzerland. The third resolution is a request that a permanent body called the "Power Survey and Research Institute" be appointed. Finally, the National Academy noted with regret that the Government of the United Provinces, when appointing an Electricity Committee, did not consider it necessary to ask the Academy to nominate a specialist to serve on the Committee.

Science News a Century Ago

Invention of Daguerrotype

ON January 7, 1839, Arago described to the Paris Academy of Sciences the invention of Louis Jacques Mande Daguerre (1789–1851) for the photographic process of taking pictures on metal plates. Writing from Paris, a correspondent of the *Athenaeum* said, "So universal an interest was excited here by the paper read by M. Arago, that I called on M. Daguerre to possess myself, as far as was permissible, of the facts of this very extraordinary discovery. . . . Of course, I can as yet give no precise details as M. Daguerre naturally objects to impart them to anyone, till he has received definite answer from the Government, with whom he is in treaty for the sale of his secret. I should add that the discovery is authenticated past the power of question by the testimonials of such men as Biot, von Humboldt and M. Arago. His earlier sketches of four years ago have a slight haziness; some of his last works have the force of Rembrandt's etchings." Of the various subjects of Daguerre pictures, the correspondent mentioned the Quays of Paris, the Louvre and Notre Dame, the picture of the last having been taken in the rain.

Daguerre had begun life as an inland revenue officer, then became a stage painter, and in 1822, in conjunction with M. Bouton, opened the Diorama in Paris, which for seventeen years was a great attraction. For many years he endeavoured to produce permanent pictures by the action of sunlight, and collaborated with Nicéphore Niepce (1765–1833). Daguerre's pictures were produced on plates of silver covered with a film of iodide. After exposure, the plates were developed by means of mercury vapour and fixed in a bath of hyposulphite of soda.

Parallax of α Centauri

ON January 9, 1839, the discovery of the parallax of α Centauri was communicated to the Royal Astronomical Society by Thomas Henderson (1798–1844), the first Astronomer Royal for Scotland, to which office he had been appointed in 1834, a year after his return from the Cape of Good Hope. "With a view," said Miss Clerke, "to correcting the declination of the lustrous double star α Centauri . . . he effected a number of successive determinations of its position, and on being informed of its very considerable proper motion ($3.6''$) annually he resolved to examine the observations already made for possible traces of parallactic displacement. This was done on his return to Scotland. . . . From the declination measurements made at the Cape and duly reduced, a parallax of about one second of arc clearly emerged . . . but, by perhaps an excess of caution, was withheld from publication until fuller certainty was afforded by the concurrent testimony of Lieutenant Meadows' determinations of the same star's right ascension. When at last, January 9, 1839, Henderson communicated his discovery to the Astronomical Society, he could no longer claim the priority which was his due. Bessel had anticipated him with the parallax of 61 Cygni by just two months."

William MacMichael (1784–1839)

DR. WILLIAM MACMICHAEL, an eminent London physician, who died on January 10, 1839, was born at Bridgnorth in Shropshire in 1784, the son of a

banker. He was educated at the local grammar school and Christ Church, Oxford, where he qualified in 1808. Appointed Radcliffe travelling fellow in 1811, he visited Russia, Turkey, the Balkan States and Palestine, and in 1817 and 1818 recorded his experiences of the journey. In 1818 he settled in London and four years later was appointed physician to the Middlesex Hospital. In 1829 he was made physician extraordinary to the King. At the Royal College of Physicians, of which he was elected fellow in 1818, he held the office of censor in 1822 and 1832 and of registrar in 1824. MacMichael is best known as the author of "The Gold Headed Cane" which was published anonymously in 1827 and contained the lives of Radcliffe, Mead, Askew, Pitcairn and Baillie, the successive owners of the cane, now in possession of the Royal College of Physicians. He was also the author of "Lives of British Physicians" (1830), also published anonymously and written in the same delightful style as the previous work, as well as of unimportant books on scarlet fever (1822) and cholera (1831).

Magnetical Observations

In its report of the meeting of the Royal Society held on January 10, 1939, the *Athenaeum* included the report to the Council by the Joint Committee of Physics and Meteorology appointed to consider the propriety of recommending the establishment of fixed magnetic observatories and the equipment of a naval expedition for observations in the Antarctic. The report, signed by Sir John Herschel, was approved, and Herschel, together with Sabine and Wheatstone, were requested to wait on Lord Melbourne. After reading the report, Lord Melbourne stated that he would urge Her Majesty's Government to adopt measures for carrying the resolution of the Council into immediate effect.

University Events

CAMBRIDGE.—The International Wool Publicity and Research Secretariat is supporting in the University a research studentship at the School of Biochemistry, and on the conclusion of the present holder's tenure it will consider providing for a further tenure appointment to which will be made by the University. The present holder is R. L. M. Synge, of Trinity College.

L. C. Young, of Trinity College, has been approved for the degree of Sc.D.

Dr. W. Feldberg has been appointed University lecturer in physiology.

The subject proposed for the Adams Prize for the period 1939-40 is "The Theory of Numbers". This phrase may be interpreted in the widest sense and as including, for example, the additive, algebraic, analytic and geometric theories.

READING.—Prof. F. J. Cole, professor of zoology since 1908, is resigning from the chair in September. Prof. Cole's researches have dealt chiefly with comparative anatomy and the history of zoology. From 1895 until 1906 he was lecturer in zoology in the University of Liverpool.

Societies and Academies

London

Royal Society (Proc., A, 169, 1-148; 1938).

SIR WILLIAM BRAGG: Presidential address.

J. L. LIXIUS and A. J. ALLMAND: The simultaneous sorption of carbon bisulphide and water vapour by activated charcoals.

R. F. BARROW and W. JEVONS: The band spectrum of silicon monosulphide and its relation to the band spectra of similar molecules.

R. W. SILLARS: The behaviour of polar molecules in solid paraffin wax.

J. SAYERS: Ionic recombination in air.

P. WEISS: (1) On the Hamilton-Jacobi theory and quantization of a dynamical continuum. (2) On the Hamilton-Jacobi theory and quantization of generalized electrodynamics.

E. A. GÜGGENHEIM: The statistical mechanics of co-operative assemblies.

Edinburgh

Royal Society of Edinburgh, December 5.

A. R. GLEN: The Oxford University Arctic Expedition to North East Land, 1935-1936. The north coast of the island was mapped in detail, while reconnaissance surveys were made of the east and south coasts. The ionosphere research carried off at the base in Brandy Bay yielded results of considerable value to the further development of world wireless communications, while measurements of the atmospheric ozone and observations on the aurora were successfully made. The geology and biology of North East Land were studied in some detail. Finally, at two stations established on the inland ice a comprehensive programme of glaciological and meteorological research was completed.

VERA FREYER: Structure and function of the alimentary canal of some tectibranch molluscs, with a note on excretion. The morphology, minute structure and functioning of the gut of four species of tectibranch molluscs has been described. Food, sensed by cephalic sense organs and raked in by the radula, is crushed by calcareous plates in the gizzard and exposed to enzymes from the salivary and digestive glands. Digestion of carbohydrates, proteins and fats occurs, soluble products and minute particles being passed through the stomach to the liver for absorption and further digestion. Indigestible food from the digestive gland is excreted via the anus and the kidney in different proportions in bivalves and gastropods.

MRS. E. M. BEATTIE: Investigation of visual threshold values. The main object of the work was the determination of the effect of fatigue, under certain conditions, on the magnitude of the threshold value. The time of fatigue by a light of given intensity was varied, and it was found that the apparent intensity, as measured by the critical frequency of flicker, of another light, also of constant intensity, was markedly increased by increase of the time of fatigue. The same condition holds when an interval of time elapses between the cessation of fatigue and observation of the second light, but the effect is smaller.

Paris

Academy of Sciences (*C.R.*, 207, 1137-1268, Dec. 12, 1938).

G. BERTRAND: Quantity of zinc in sea water. Samples of water off the coasts of France and of the Dead Sea have been examined by a chemical method (determination as calcium zincate); the figures obtained are 3-4 mgm. and 4.37 mgm. zinc per litre respectively.

L. BLARINGHEM and K. C. CHIN: New cases of xenia in wheat hybrids (*Triticum monochorum*, *T. aestivum* and *T. vulgare*).

E. ROUBAUD, J. COLAS-BELOUVE and G. J. STEFANOPOULO: Behaviour of yellow fever virus in the mosquito *Aedes geniculatus*. Transmission of the fever occurs when the mosquitoes are kept at 30-35° C., but not when they are at 20-22° C.

V. VOLTERBA and V. A. KOSTIZIN: Remarks on the toxic action of the medium, *à propos* a note by M. Regnier and Mlle. Lambin [Development of *Staphylococcus aureus* and *Bacillus coli* in a liquid medium].

P. LEJAY: Gravimetric map of the Philippines.

P. LÉVY: Brownian movement and geometric schemes.

O. PAUC: Contribution to the problem of M. Fréchet relating to the investigation of a derivable parametrization for curves with a tangent at every point.

M. BRELOT: Closed ensembles.

A. DVOŘÁK: Semi-convergence of series, and in particular of Dirichlet series.

M. GODEFROY and H. PONCIN: The idea of stability.

A. FOCH and G. CHASTINE: Chromo-photography and gyrotory flow.

V. VOLKOVICH: Some properties of vertical trajectories in plane problems of convection.

L. MALAVARD: Correction of air-flow for an elliptic channel.

J. SOLOMON: Quantum theory of gravitation.

J. GÉHÉNIAT: Wave mechanics of the heavy electron.

N. CARRERA: Perturbation of a problem of proper values by deformation of the boundary.

J. ROUBAUD-VALETTE: Certain equations representing a photon.

Mme. M.-A. TONNELAT: Relations between the theory of the photon and the theory of the heavy electron.

A. PROCA: A symbolic equation combining the equations of the mesotron (heavy electron), those of Kemmer, of Klein-Gordon and the L. de Broglie equations of the photon.

O. SALCHAND: Experimental arrangements for measuring the velocity of sound in liquids by a resonance method: measurement of the velocity of sound in mercury. The mean velocity at 22.5° C. found was 1,407 m./sec.

L. TISZA: Viscosity of liquid helium and the Bose-Einstein statistics.

T. BOGGIO: Movement of an electrified particle in an electric field and in a superposed magnetic field.

Y. ROCARD: Weakening of the electromagnetic fields on ultra-short waves at river crossings. Such local effects may give useful information to aircraft.

M. LEMARCHANDS and W. JUDA: Discussion of the phenomena of electrolytic rustion.

(To be continued.)

Rome

National Academy of the Lincei (*Atti*, 27, 471-492; 1938).

G. GHERARDI: Construction of equivalence series on a reducible algebraic curve.

O. CATTANEO: Contact of two elastic bodies: local distribution of the forces (3).

A. ALIBRANDI: New experimental confirmation of the necessary participation of the inborn afferent path in the mechanism of conditioned reflexes.

G. ARAGONA: New observations on the blood-sugar raising pancreatic hormone of G. Martino.

V. CAPRABO: pH value of the content of the seminal vesicles of the albino rat.

V. ZAGAMI: Experimental researches on the seminal fluid. (3) Variation of the pH of the human fluid with temperature and dilution.

Atti, 27, 493-603; 1938.

F. ENRIQUES: Characteristic properties of irregular algebraic surfaces.

U. BARBIERI: Geodetic-astronomical station erected on the trigonometric vertex of Montecastello near Alessandria in August 1934.

G. QUAGLIARIELLO and F. CHIDRANGOLO: Solubility of fatty acids and of glycerides in bile and in bile salts.

A. STELLA: New studies on the tin deposit of Campiglia.

J. C. VIGNAUX: Polygenic functions of one and of several dual complex variables and of bidual variables (1).

E. FROLA: Cauchy's problem and equations with linear partial derivatives having constant coefficients.

G. N. WATSON: Tabulation of a particular function defined by an improper integral.

T. BOGGIO: Solutions of a system of equations with partial derivatives.

O. CHISINI: A more general theory of the existence of multiple planes.

G. C. MOISIL: Geometrical considerations of the integration method of Hadamard-Théodoresco (1).

A. CARRAS: Resolution of a problem relating to the perturbations imposed on continuous systems.

G. LAMPARELLO: Stationary motions in the dynamic problems of Liouville.

O. ZANABONI: Possibility of neglecting the work due to the deformation of the cutting surface and of the axial force in comparison with that of the moments.

G. L. ANDRISCI: Solar radiation at Rome from 1933 until 1936.

G. WATAGHIN: A system of gravitational equations of the first order (2).

G. GIACOMELLO: Structure of some triterpenes.

C. PERRIER and E. SEGRÈ: Some chemical properties of element 43 (2).

R. PIONTELLI: Influence of ultra-sonics on discharge potentials of hydrogen, oxygen and chlorine.

A. CAVINATO: The Permian in the Orroli territory (Sardinia).

S. DOZZI DI DELUPIS: Phenomena of activation in plant growth (1).

G. GONDANICH: New observations on the drying of shoots of poplars.

A. ALIBRANDI: Efficacy of the spoken word in producing the conditioned reflex of blinking in dogs.

V. ZAGAMI: Experimental researches on the seminal fluid (4). pH value of dog's seminal fluid.

Forthcoming Events

Tuesday, January 10

PHARMACEUTICAL SOCIETY, at 8.30.—Prof. J. H. Gaddum: "Recent Discoveries about Animal Hormones".

Friday, January 13

PHYSICAL SOCIETY, at 5.15—Sir Ambrose Fleming, F.R.S.: "Physics and Physicists of the Eighteen-seventies".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned

ASSISTANT LECTURER IN ELECTRICAL ENGINEERING in University College, London—The Secretary (January 14).

UNIVERSITY READER IN METEOROLOGY in the Imperial College of Science and Technology—The Academic Registrar, University of London, Senate House, W.C.1 (January 20).

UNIVERSITY READER IN BIOCHEMISTRY in Guy's Hospital Medical School—The Academic Registrar, University of London, Senate House, W.C.1 (February 1).

CHEMIST in the Institute for Medical Research, Federated Malay States—The Director of Recruitment (Colonial Service), 8 Buckingham Gate, London, S.W.1 (February 10).

ASSISTANT PROFESSOR OF PHYSICAL AND GENERAL CHEMISTRY and ASSISTANT PROFESSOR OF MINERAL AND INORGANIC CHEMISTRY in the Indian Institute of Science, Bangalore, India—The Registrar (February 16).

ASSISTANT ADVISORY OFFICER to the Board of Greenkeeping Research—The Director, St. Ives Research Station, Bingley, Yorks.

DIRECTOR OF RESEARCH to the Research Association of British Flour-Millers—The Secretary at 40 Trinity Square, London, E.C.3.

BACTERIOLOGIST in the Research Laboratory of the Royal College of Physicians of Edinburgh—The Secretary, Royal College of Physicians, Edinburgh, 2.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Journal of the Electrodepositors' Technical Society. Vol. 14, 1937-38. Pp. viii+252. (London: Electrodepositors' Technical Society, Northampton Polytechnic Institute.) 15s.; to non-Members, 21s. [512]

A Report on the Museum and Art Galleries of the British Isles (other than the National Museums). By S. F. Markham. Pp. hi+179+24 plates. (Dunfermline: Carnegie United Kingdom Trust.) [512]

Museums and the Public. Pp. 14+2 plates. (Dunfermline: Carnegie United Kingdom Trust.) [512]

West Cumberland (with Alston): a Survey of Industrial Facilities. By G. H. J. Dayah. Pp. 176+10 plates. (Whitehaven: Cumberland Development Council, Ltd.) [512]

Other Countries

Cornell University: Agricultural Experiment Station. Bulletin 697: Some Facts concerning means of Transportation and Methods used in Marketing New York State Fruits and Vegetables. By M. P. Rasmussen. Pp. 118. Bulletin 701: Economic Studies of Vegetable Farming in New York. 4: Production and Marketing of Cauliflower in Delaware County, 1936. By J. N. Hifferson. Pp. 46. Bulletin 702: Economic Studies of Vegetable Farming in New York. 5: Production and Marketing of Lettuce in Oswego County, 1936. By J. N. Hifferson. Pp. 41. Bulletin 703: Soil and Field-Crop Management for South-western New York. By A. F. Gustafson. Pp. 47. Bulletin 704: Types of Farming in New York. By R. S. Beck. Pp. 71. Bulletin 706: Soils in relation to Fruit Growing in New York. Part 12: Tree Behavior on Important Soil Profiles in the Peru, Plattsburg and Crown Point Areas in Clinton and Essex Counties. By Joseph Oakamp. Pp. 37. (Ithaca, N.Y.: Cornell University.) [512]

U.S. Department of the Interior: Office of Education. Bulletin, 1937, No. 31: A Survey of Courses of Study and other Curriculum Materials published since 1934. By Bernice H. Leary. Pp. v+138. (Washington, D.C.: Government Printing Office.) 20 cents. [512]

Conseil Permanent International pour l'Exploration de la Mer. Bulletin statistique des pêches maritimes des pays du nord et de l'ouest de l'Europe. Rédigé par Sir D'Arcy Wentworth Thompson. Vol. 26, pour l'année 1936. Pp. xxviii+49. (Oopenhague: Andr. Fred. Hest et fils.) 3.00 kr. [512]

Annual Report of the Public Health Commissioner with the Government of India for 1936. Vol. 1, with Appendices. Pp. vi+353. (Delhi: Manager of Publications.) 2 rupees; 3s. 6d. [512]

Union of South Africa: Department of Mines, Geological Survey. Memoir No. 32: Analyses of Rocks, Minerals, Ores, Coal, Soils and Waters from Southern Africa. Compiled by Dr. A. L. Hall. Pp. 876. (Pretoria: Government Printer.) 15s. [512]

The Hills Sachs Plotis Foundation for the Advancement of Scientific Investigation. Fifteenth Annual Report, 1938. Pp. 6. (Boston, Mass.: Dr. Joseph C. Agh, Secretary, Huntington Memorial Hospital.) [512]

Journal of the Indian Institute of Science. Vol. 21A, Part 27: Hydrogenation of Oils by the Continuous Process. Part 5: Mechanism of Continuous Hydrogenation of Oils. By V. T. Athavale and S. K. K. Jathar. Pp. 821-830. 14 annas. Vol. 21A, Part 28: Studies in Binary Systems. Part 1: Adsorption from Binary Mixtures of Toluene and Acetic Acid by Charcoal and Silica Gel. By J. G. Kame and S. K. K. Jathar. Pp. 831-844. 12 rupees. Vol. 21A, Part 29: Metal-Metal Oxide Electrodes. Part 1: Studies in Tungsten and Molybdenum Electrodes. By O. T. Abichandani and S. K. K. Jathar. Pp. 845-863. 14 rupees. Vol. 21A, Part 30: Differential Titrations with Tungsten Electrode. By O. T. Abichandani and S. K. K. Jathar. Pp. 863-868. 10 annas. Vol. 21A, Part 31: Automatic Potentiometric Titration Apparatus. By O. T. Abichandani and S. K. K. Jathar. Pp. 869-872. 8 annas. (Bangalore: Indian Institute of Science.) [512]

Bulletins of Indian Industrial Research. No. 13: A Study of Indian Mustard and Rape Seeds and their Oils. By D. Y. Athavale, J. A. Hare Duke and P. N. Mathur. Pp. ix+20+8 plates. (Delhi: Manager of Publications.) 14 annas; 1s. 3d. [512]

Southern Rhodesia, Geological Survey Bulletin, No. 33: The Geology of the Country around the Jumbo Mine, Masoe District. By J. O. Ferguson and the late T. H. Wilson. Pp. iv+137+8 plates. (Salisbury: Government Stationery Office.) 4s. 6d. [512]

National Research Council. Transactions of the American Geophysical Union, Nineteenth Annual Meeting, April 27 to 30, 1938, Washington, D.C.: Regional Meetings, December 28 to 29, 1937, Spokane, Washington, January 7-8, 1938, Davis, California, June 21, 1937, Denver, Colorado (Addendum). Part 1: Reports and Papers, Washington, D.C. General Assembly and Sections of Geodesy, Seismology, Meteorology, Terrestrial Magnetism and Electricity, Oceanography, Volcanology and Hydrology. Pp. 585. Part 2: Reports and Papers, Section of Hydrology and Western Interstate Snow-Survey Conference. Pp. 587-745. (Washington, D.C. National Academy of Sciences.) [512]

Department of Agriculture, Fiji. Annual Bulletin of Divisional Reports, 1937. Pp. iv+90. (Suva: Government Printer.) 2s. 6d. [512]

Intensity Relations in the Low Voltage Helium Arc. By John Jacob Heilmann. Pp. 10. On the S-States of the Two-Electron Atom. By Fred George Fender. Pp. 16. Growth and Decay of Phosphorescence in Calcium Sulphide by a Photo-electric Method. By Peter John Minkler. Pp. 24. (Philadelphia: University of Pennsylvania.) [512]

Abridged Scientific Publications from the Kodak Research Laboratories. Vol. 19, 1937. Pp. 298+viil. (Rochester, N.Y.: Eastman Kodak Company.) [512]

Advisory Committee on Education. The Federal Government and Education. Pp. 32. (Washington, D.C.: Government Printing Office.) 10 cents. [512]

Brooklyn Botanic Garden Record. Vol. 27, No. 3: Botanic Gardens of the World; Materials for a History. Second edition. Pp. 151+406. (Brooklyn, N.Y.: Brooklyn Institute of Arts and Sciences.) 2.50 dollars. [512]

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 23, No. 23: Studies on the Cladoceans of Monterey Bay. By Harriet Marguerite Baker. Pp. 311-365 (plates 25-31). (San Francisco, Calif.: California Academy of Sciences.) [512]

Transactions of San Diego Society of Natural History. Vol. 9, No. 1: An Apparently Unrecognised Race of Redwing from Utah. By Louis B. Bishop. Pp. 4. Vol. 9, No. 2: A New Race of Cliff Swallow from Northwestern Mexico. By A. J. van Rossum and the Marquis Hachisuka. Pp. 5-6. Vol. 9, No. 3: A Dimorphic Subspecies of the Bush-Tit from Northwestern Mexico. By A. J. van Rossum and the Marquis Hachisuka. Pp. 7-8. Vol. 9, No. 4: Descriptions of Three New Birds from Western Mexico. By A. J. van Rossum. Pp. 9-12. Vol. 9, No. 5: A Colorado Desert Race of the Summer Tanager. By A. J. van Rossum. Pp. 13-14. Vol. 9, No. 6: *Megascops asio*, a New Pleistocene Ground Sloth from Southern California. By Gretchen M. Lyon. Pp. 15-20+1 plate. Vol. 9, No. 7: An Illustrated Note on the Mating and Egg-brooding Habits of the Two-spotted Ocotopus. By Denis L. Fox. Pp. 31-34+plate 2. Vol. 9, No. 8: A New Form of *Procyonatus formosus* from the Mohave Desert Region of California. By Laurence M. Huey. Pp. 35-36. Vol. 9, No. 9: Bees collected on the California Islands in the Spring of 1938. By T. D. A. Cockrell. Pp. 37-38. (San Diego, Calif.: San Diego Society of Natural History.) [512]

Catalogues, etc.

Dichloro-Indophenol Tablets (2:6-Dichlorophenol-Indophenol) for the Estimation of Vitamin C. Pp. 2. (London: The British Drug Houses, Ltd.)

X-Ray Apparatus: Totally Immersed Units. Pp. 16. (London: Outhbert Andrews.)

Radiography and Clinical Photography. Vol. 2, No. 4. Pp. 61-76. (London: Kodak, Ltd.)

Wirtschaftsgeographie: Produktions-, Konsumtions-, Handels- und Verkehrsgeographie. (Antiquariatkatalog Nr. 726.) Pp. 178. (Leipzig: Gustav Fock, G.m.b.H.)

Catalogue of Important Works on Botany, Zoology, Paleontology, and a few works on Mineralogy, Astronomy, Mathematics, etc. (No. 26.) Pp. 16. (London: John H. Knowles.)

Marmite (Yeast Extract) in Medicine and Dietetics. New edition. Pp. 24. (London: The Marmite Food Extract Co., Ltd.)

The Metallurgical Progress and Science of Heat Treatment for all Materials. Pp. 8. (Wembley: R. M. Oaterson-Smith.)

Myologia, Pathologia Plantarum. (No. 96.) Pp. 23. (Den Haag: Antiquariat Junk.)

Diary for 1939. Pp. 32+32+32 maps+Diary. (Bonnybridge: John G. Stein and Co., Ltd.)

Kunst und Kunstgewerbe: Zeitschriften, Sammelwerke, Bücher, Abhandlungen. (Antiquariatkatalog Nr. 727.) Pp. 186. (Leipzig: Gustav Fock, G.m.b.H.)

NATURE

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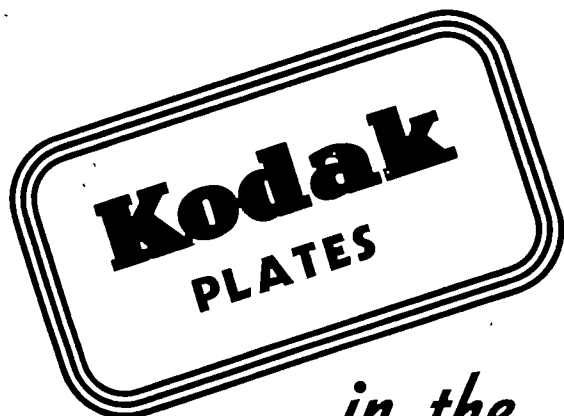
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Vol. 143

SATURDAY, JANUARY 14, 1939

No. 3611

Intellectual Co-operation between the Nations

WE live and move and have our being in a world of contradictions—in a world which has shrunk in its dimensions to an almost incredible extent during the last generation. America and the Antipodes are but a few days' journey from Europe; wireless can put a girdle round the globe in a time undreamt of by Puck; the concerted labours of the physicist, the engineer, and the biologist have made it possible to transport perishable produce on a large scale from country to country—produce which adds in a high degree to the amenities of life in our community. All these results have been achieved by thought and labour which were truly international in character.

The fundamental problems of life, of art and of ordered knowledge know neither racial nor geographical boundaries. Grant that we have reached a certain stage in our gropings into the infinite, then, within those limits, the message of Plato and of Confucius, of Dante and of Wordsworth, of Beethoven and of Brahms, of Newton and of Einstein, are for all ages and all climes. Unless man is free in thought, and free in the expression of his thoughts, the wisdom of the past and of the present is of small avail for the increase of the happiness of the human race; and it is a bitter comment on the trend of our modern civilization that men should be turning to the noble words of the Areopagitica as expressing beliefs still to be fought for, not as truths for ever demonstrated by the struggles and aspirations of centuries past and gone.

"As good almost kill a man as kill a good book; who kills a man kills a reasonable creature, God's image; but he who destroys a good book, kills

reason itself, kills the image of God, as it were, in the eye. . . . We should be wary, therefore, what persecution we raise against the living labours of public men, how we spill that seasoned life of man, preserved and stored up in books; since we see a kind of homicide may be thus committed, sometimes a martyrdom; and if it extend to the whole impression, a kind of massacre, whereof the execution ends not in the slaying of an elemental life, but strikes at the ethereal and fifth essence, the breath of reason itself; slays an immortality rather than a life." How would these immortal words have struck our ears in the freer air of a generation ago? How do they read to-day?

We have said that we live in a world of contradictions, for, though the gifts of science have brought the nations closer in space and in time than ever before in the history of civilization, yet, paradoxically enough, man stultifies the effects of these benefits in countless ways. He erects economic barriers between the nations; he exacerbates national disagreements, visualizing the exchange of commodities, on which our mutual prosperity depends, as a process of warfare; he produces want and misery in a world which, wisely ordered, could go far in using the gifts which scientific advance is providing, to supply the material needs of all.

All the more reason, then, to welcome any national pronouncement which emphasizes the spirit of co-operation rather than that of cut-throat competition, and such a pronouncement is doubly welcome when it is concerned with the fostering of general cultural relations between a great democracy and the other countries of the

world. • The order recently signed by Mr. Cordell Hull, the Secretary of State in President Roosevelt's Government, establishing in the Department of State a Division of Cultural Relations, is of great significance. In a civilization where knowledge is increasing, where values are changing, at a rate never before dreamt of, and in which almost every possible element of instability is present, no opportunity should be lost for bringing together nationals of all countries to discuss, amicably and fraternally, problems which are the concern of all, and few better meeting grounds could be chosen than those which are provided for the encouragement and strengthening of cultural relations. Individual attempts to institute such contacts have been many and have been attended with varying degrees of success, or failure, but Governments are slow to take such action, and Mr. Cordell Hull's order marks an important step in advance, and provides an example that may well be followed by other Governments as a most weighty means of diminishing the tensions, and alleviating those differences which, unhappily, are such a prominent feature in international relations to-day. The order, which takes effect as from July 1938, has scarcely, as yet, received the notice which its importance merits. The significant part of the text, as published in the issue of *Science* of November 25, 1938, runs :

For the purpose of encouraging and strengthening cultural relations and intellectual co-operation between the United States and other countries, it is hereby ordered that there shall be established in the Department of State a Division of Cultural Relations.

The division will have general charge of official international activities of this department with respect to cultural relations, embracing the exchange of professors, teachers and students; co-operation in the field of music, art, literature and other intellectual and cultural attainments; the formulation and distribution of libraries of representative works of the United States and suitable translations thereof; the preparations for and management of the participation by this government in international expositions in this field; supervision of participation by this government in international radio broadcasts; encouragement of a closer relationship between unofficial organizations of this and of foreign governments engaged in cultural and intellectual activities, and, generally, the dissemination abroad of the representative intellectual and cultural works of the United States and the improvement and broadening of the scope of our cultural relations with other countries.

In fulfilling its functions, the Division of Cultural Relations will direct the conduct of exhaustive studies and have responsibility for the elaboration and the carrying into effect of a comprehensive and co-ordinated plan of activity in this country for the

strengthening of international intellectual and cultural relations; it will assist in the preparation and interpretation of treaties in this field; it will supervise the formulation of regulations and procedure necessary for the fulfilment of obligations under the Convention for the Promotion of Inter-American Cultural Relations and other treaties and conventions relating to cultural relations to which the United States may become a party; it will draft or review correspondence with foreign governments, American diplomatic and consular officers and all other correspondence pertaining to these activities; it will collaborate with the Office of Education and other government departments and agencies, the National Committee on Inter-American Intellectual Co-operation, other educational and cultural organizations and institutions and foreign missions in Washington.

The Division of Cultural Relations will function under the general supervision of the Under Secretary of State and in close co-operation with the geographical divisions.

It will be noted that science receives no overt mention, but it is to be presumed that scientific advances and the implications of such advances will receive full consideration under some of the more general heads of the order.

Official action in democratic communities is apt to follow, rather than to lead public opinion, save in exceptional instances, but Mr. Cordell Hull's order synchronizes with other movements which have already been discussed in the columns of *NATURE*. The British and American Associations for the Advancement of Science, in their arrangements for an exchange, in alternate years, of lecturers to deliver at the meetings of the Associations addresses which shall, broadly speaking, be conceived on the lines of presidential addresses, have initiated a movement which will undoubtedly have far-reaching effects; and this movement is further assisted by the decision of the Associations to keep officials of each Association intimately acquainted with the details of the proceedings of their respective bodies. It is good to know that the Government of the United States of America regards these decisions as having sufficient importance to warrant their forming part of a wider national policy, and such recognition inspires the hope that other countries will participate in this movement for the encouragement of international cultural relations.

The structure of our civilization is cracking; if it is to be saved at all—and, imperfect though it may be, it is worth conserving and developing—it can only be saved by the encouragement of those movements which stress the urgent need for international co-operation and understanding.

The Colonial Service in the British Empire

The Colonial Empire and its Civil Service
By Charles Jeffries. Pp. xxv + 259. (Cambridge:
At the University Press, 1938.) 10s. 6d. net.

THIS book, as explained by Lord Harlech in his introduction, is an "attempt to tell, as straightforwardly and simply as possible, the story of the development of the British Colonial service". The author has had a difficult task, but has succeeded admirably in condensing into the pages of a comparatively small volume an immense amount of matter that concerns the Colonial Service.

His Majesty's Colonial Service of a hundred years ago dealt with regions that are now no longer under its control. In these days, the great Dominions have their own separate form of administration and although the island Colonies, such as those in the West Indies and Mauritius, and the West African Colonies of Sierra Leone and the Gambia do indeed appear on the old list, others such as Malaya, Nigeria, the Gold Coast and the East African territories were not then parts of the Empire. The chapter on the early history of the Service indeed affords fascinating reading and gives one a clear idea of the way in which the Colonial Empire has grown and how many changes have had to be made to meet its expanding needs. One cannot help feeling that in those early days the territories which now form the Colonial Empire were the Cinderellas to what are now the Dominions. These were larger and more vociferous in their demands and had developed far more rapidly than the smaller Colonies.

Matters have changed since the Dominion Office was formed in 1925, and we read of the remarkable way in which the Colonial Service proper has been strengthened and re-organized since the Great War. The time was evidently ripe, for a perusal of these pages enables one to realize in what a haphazard, not to say casual, manner the Colonial Empire of Great Britain has grown up. The laws and regulations even now differ in a remarkable way between territories often adjacent, and it was presumably to counter the parochial attitude that was (and still is) so often exhibited by individual Colonies that the wide reforms of the post-War period were instituted. The Great War had indeed brought to light many glaring defects in our organization, more particularly perhaps in the failure to develop fully the natural resources of the Colonies, and the public health and education of the natives. As an example of the new outlook, one may instance the reports of the Lovat Com-

mittee in 1927 and 1928, which made recommendations on agricultural research and administration in the non-self-governing Dependencies and also suggested the institution of one service for all the Colonies. Its proposals, after implementation, have done much to develop the agricultural, forestry and other technical services.

The Warren Fisher Committee followed with further recommendations, and this led to the decision of the Secretary of State to form a unified Colonial Service in 1930. Subsequent developments recognized the existence of a single Imperial Colonial Service. Within this, branch services have been organized on a professional and not on a regional basis. Thus we now have Colonial administrative, legal, medical, agricultural services, and so on, each having a technical adviser in the Colonial Office itself. A further step was to lay down that members of these unified services would normally be recruited from outside the Colony itself. This, as is explained, "left room for the fullest scope to be allowed to each Colony to develop its public service in the best way suited to its local conditions". There is little doubt that the unification of the service has done much to increase the prestige and sense of *esprit de corps* among its members, a point that has been ably brought out by the author. The clarification of the proposals regarding recruitment has also had the effect of attracting a number of desirable recruits from the universities.

Difficulties in the strict application of these ideals naturally occur, since the Colonies differ from each other in so many ways: Disappointment may be felt when the Colonial Office feels it expedient to give way to a local Government in the matter of filling some post locally instead of by an appointment from the unified Colonial Service. These difficulties are always likely to crop up from time to time in communities that are in the process of developing a political self-consciousness. Again, much remains to be done in levelling up the anomalies that undoubtedly exist between various Colonies in respect of salaries, housing, leave passages, and so on. This matter needs urgent attention, as unless it is equitably settled one suspects that certain Colonies will acquire a reputation that will render them unpopular to the serving officer and this will lead to an inevitable deterioration in the standard of work.

The subdivision of the unified Colonial Service into separate technical services has many points in its favour. It is to be hoped, however, that these

sub-services will not become too water-tight. The closest co-operation between all officers is needed to solve many of the pressing problems, and indeed their solution is almost always a matter of teamwork. The higher posts in the Service should be open to every member, whether he be a specialist or an administrative officer, for it is ability and

personality that count, and the wider the net is spread the more likely is the right man to be found.

The book is to be commended to all who are in any way interested in colonial questions, as it gives a complete history of the Colonial Service from its very early days to the present time.

G. E.

The Mechanism of the Egg

Embryonic Development and Induction

By Prof. Hans Spemann. (Yale University: Mrs. Hepsa Ely Silliman Memorial Lectures.) Pp. xii+401. (New Haven: Yale University Press; London: Oxford University Press, 1938.) 22s. 6d. net.

AT last we have the pleasure of welcoming the largest work so far written by one who is perhaps the greatest living master of experimental morphology. It has received admirable treatment by the Yale University Press; the clear printing aids the reader's eye, and the matt paper does justice to every nerve-cell in the numerous illustrations.

It was Gustav Born who long ago discovered the remarkable healing power of amphibian embryos, and the manner in which they can be operated upon with very fine glass needles, hair-loops, and other delicate instruments. Under the dissecting microscope the tissues cut cleanly "like a mixture of cheese and cotton-wool" and the methods permit, of course, of that fundamental requirement of experimental morphology, namely, the transplantation of pieces or regions of one embryo into another, that is, into an abnormal but living environment. It may then be seen whether they follow their previous course of development, or whether they fall into step, as it were, with their new environment, and go along with it to whatever its destiny may be in the finished embryo.

Born did not carry the experiments far. It was Hans Spemann who, in a "Gedankengang" extending over thirty years, analysed, with various collaborators, the process of determination in the amphibian embryo. With Hilde Mangold in 1924 he discovered the primary organization-centre (organizer), in the dorsal lip of the blastopore, which determines the main axis of the vertebrate embryo, that is to say, the neural tube, notochord and somites.

The present book, after a short historical discussion of some of the ideas current in earlier days of embryology, begins with a detailed account, not of this 'primary organizer' just now mentioned, but of the 'secondary organizer' which works on

the ectoderm to produce the lens of the eye, when the eye-cup grows out towards the skin from the forward end of the nerve-tube. At first sight, this way of introducing the subject of organizer phenomena may seem to have more disadvantages than benefits, for the processes of lens-induction vary a good deal as between different species of amphibia. Yet this very fact allows of a special insight into the relation of stimulus and response in organizer action. In some amphibia, the skin is absolutely incapable of producing a lens without the stimulus from the eye-cup, but in others it produces a more or less good lens if the eye-cup stimulus is not allowed to act. Hence the concept of 'double assurance' derived from engineering. If one mechanism should fail in the normal course of development, another appears in reserve. It is not yet clear, however, whether the second process only comes into play if the first is inhibited, or whether both processes work together in the same direction in normal development as a "kombinative Einheitsleistung". In any event the question does not arise so acutely with regard to the primary organizer.

The next series of chapters is devoted to the state of affairs in the gastrula during the working of the primary organizer. Spemann deals in turn with tests of potencies, inductions of secondary (twin) embryos by normal organizers and by abnormal media, such as dead tissues of adult organisms, or by chemical preparations. Although his account of the morphological problems has all the brilliance which we expected, the same can scarcely be said of those sections dealing with the biochemical aspects of the phenomena. It is a striking exercise in the psychology of science to observe how his assured touch deserts him when he appraises chemical evidence and chemical arguments. Thus he does not appreciate the importance of Holtfreter's discovery that on heat-coagulation (or other protein denaturation), tissues such as ventral ectoderm, which do not normally possess inductive power, acquire it, although he himself says (p. 232) that the "substance is then either produced anew, or *set free* by suitable treatment" (*italics mine*).

He does not see that the ventral ectoderm, in which the substance may be set free, is precisely the same thing as the presumptive epidermis, on which organizer activity has perforce to be tested. He does not therefore distinguish between implants which do injury to the tissue and so liberate the tissue's own organizer-substance, and those which act in minute concentrations, and are hence less likely to liberate it. He thus gives up too easily the search for logical consistency in the chemical facts, and takes refuge in a facile writing off of the whole effect as probably "unspecific".

What puzzles the reader most, however, is the kind of assumption which Spemann regards as self-evident. Thus on pp. 220 and 370, where he is discussing the induction of eyes and lenses after implantation of adult heart, he says, "One thing is evident from the beginning, that a cooked heart, for instance, which induced an isolated lens, cannot have brought about this effect by some specific lens-forming agency". Now the evidence that the primary organizer involves a chemical substance is accepted by everyone. Since all adult tissues act, the simplest assumption is that they all contain the substance, capacity to react to it having long been lost. If they contain the primary organizer, why not various secondary organizers? There is at any rate no lack of chemical compounds present in cells for which no function has yet been found. So why is it self-evident that heart tissue cannot contain secondary lens-organizer substance?

There are two places where the characteristics of the morphologist's outlook appear with special force. Thus on p. 242 Spemann says, "The altered metabolism in the dorsal lip of the blastopore is, surely at first, a consequence of the induction, not its cause". This is strikingly reminiscent of Liebig's view which called forth from Traube in the early days of the study of yeast fermentation the famous remark: "Der Chemie vermag wohl die physiologische Tatsachen, aber nicht der Physiologie die chemische, erklären". Or again, on p. 245, Spemann asks how "structure can be produced by a factor which, like a chemical substance, lacks structure in itself, in the morphological sense of the word?" Surely the whole of organic chemistry is, in a real sense of the word, a realm of structure. With molecules of the complexity of proteins, we need surely have no excessive intellectual difficulty in picturing a relation between morphological differences and chemical differences, even though as yet we have no detailed knowledge of the manner in which this occurs. On the other hand, no book could show better than this one the beauty of the analysis of biological phenomena which can be accomplished by the morphological mind. Around p. 354, for example, the results of exposing the

ectoderm of different species to the action of the same organizer is discussed. The ectoderm reacts, but it gives the answer, as it were, in its own language. Stimulated to form a balancer, it does so, but it makes one like embryos of its own species, and not like that of its host. Stimulated to form mouth parts, it forms teeth or horny jaws as the case may be, irrespective of which of these formations is characteristic of its host. The 'cue', says Spemann, therefore, is rather vague; the ectoderm reacts, but in its own way, according to the tradition of its species.

In later chapters, Spemann considers the gradient theory of Child from a critical point of view. Some may feel that he displays an almost too excessive aversion from gradients. We may grant that the claim of Child to show that gradients are gradients of respiratory rate has never been substantiated. But not a few writers have found the concept of gradient useful, and indeed if the diffusion of a chemical substance takes place from a point in space, as may well happen in the case of the primary organizer, a gradient system must be formed. Even a differential supply of nutrient substances in the ovary as a factor in polarity is objected to (p. 325). The fundamental trouble is stated on p. 331: "It is hard to understand how qualitative differences may arise from quantitative ones in different regions". That depends on one's philosophy. There are philosophers who have found the transformation of quantity into quality a fundamental property of Nature, observable in many fields besides embryology, as in the classical instance of the increasing length of the paraffin chain.

In the conclusion, Spemann justifiably says that the more exact our knowledge becomes about the chemical substances involved, the more the burden of explanation is thrown back on the reactivity, the competence, of the tissues affected by them (p. 369). He even writes, "the very conception of the organizer became problematical". It is to be hoped that this will not cause misunderstanding. The facts of organizer action have been demonstrated again and again. Organizer phenomena involve the action of 'morphogenetic hormones', and their importance is that for the first time they bring home to us how closely bound up normal morphogenesis is with normal embryonic metabolism.

This is a great book. But it is not a book to be read uncritically. The best way in which we can render homage to one who is perhaps the last great representative of that "reine deutsche Wissenschaft—Entwicklungsmechanik", is to read and re-read him, framing new hypotheses, which may or may not be better than his, for his perdurable facts.

JOSEPH NEEDHAM.

History of Cambridgeshire

The Victoria History of the County of Cambridgeshire and the Isle of Ely

Edited by L. F. Salzman. (The Victoria History of the Counties of England.) (Published for the University of London Institute of Historical Research.) Vol. 1. Pp. xiii + 436 + 21 plates. (London: Oxford University Press, 1938.) 63s. net.

IT may seem a matter for surprise that Cambridgeshire, a county in which is a great centre of learning, should have had to wait so long for the first volume of its Victoria History. The delay is the reader's gain. Most of the chapters in this volume, but more especially those dealing with geology—at least as regards the quaternary deposits—botany, and archaeology could not have been written a generation ago, when publication of the County Histories began, as they appear here. This is not entirely a matter of fresh evidence, though this plays its part; but new methods of investigation and interpretation have remoulded the reconstruction of prehistory, while a new orientation has broadened, and at the same time intensified, the study of the environmental conditions and culture of early man. For this we are largely indebted to the geographico-archaeological studies of the Cambridge region by Sir Cyril Fox in the period immediately following the Great War, and the later studies of the Fenland Research Committee, to which the investigation of the formation of the peats of the Fenland has contributed not a little.

The first volume of the Cambridgeshire series follows the general plan of the History as a whole. It deals with the natural conditions, the geology, botany, and zoology of the county, and with the evidence of human occupation in prehistoric and Saxon times, ending with the Domesday record. In the last named the county is peculiarly fortunate in the survival of three independent records of the land tenures of the period.

Although the geological structure of the county is simple, being divided between Jurassic and Cretaceous, the surface, although nowhere greatly elevated, is sufficiently varied. The feature which gives the county its special interest is the fenland and its influence on the fauna and flora. Although the fenland has been drained, Wicken Fen survives for the study of former conditions; but as is shown by the chapter on botany by Dr. H. Godwin and those dealing with the zoology under its several divisions, many rare and interesting species have vanished. Among these are the avoget

and the ruff as breeding species and the great bustard; while the county was probably the last haunt of the large copper butterfly and, it may be, the polecat. The oldest specimen of the *P. daplidice* butterfly, now in the Oxford entomological collection, was caught here in the last decade of the seventeenth century; and the swallow-tail, *P. machaon*, rare in Britain, still survives.

Cambridgeshire, however, is in a marked degree a marginal area; and it is noticeable how in the discussion of numerous questions a crucial piece of evidence is drawn from areas at varying distances outside the county border. This point especially is to be noted in connexion with the quaternary deposits and their relation to the history of early man, here considered in the revised studies of the late Dr. J. E. Marr, which show the county as marginal to the great East Anglian area, while in the later periods Dr. Clark's analysis of culture indicates how it bears a like relation, now to the south and south-west, now to the cultural spread, which can, as a rule, be traced to the Wash.

In the chapter on early man, for which Dr. J. G. D. Clark is responsible, the palaeolithic period is represented by the records of a number of finds, extending from the Challeian to the close of the period; but on the whole the showing is poor. This, as the author indicates, is due to a lack of systematic investigation, rather than proof positive that palaeolithic man did not spread to this area from the East Anglian region. In the earlier chapter on geology, it pointed out that Cambridgeshire offers a poor field for observation, owing to the closing down of the industrial undertakings upon which the geologist has to rely for his opportunities; and the same applies to observations of the earliest periods of prehistory, when funds are not available for specific investigations. Incidentally, it may be pointed out that in both the Iron Age and in the Saxon period, with which Mr. T. C. Lethbridge deals, much valuable information was undoubtedly lost through the development of the sites at the St. John's cricket ground, Grange Road, and at Girton in the eighties of the last century, when archaeological knowledge and method were immature.

From mesolithic times onward, much evidence has come from research within the county area, and is still accruing, which is of great value in the study of the character, succession, and chronology of prehistoric cultures. For this, as already mentioned, thanks are due to the Fenland Research Committee, for which Dr. J. G. D. Clark himself

has to no small extent been responsible. The application of the methods of pollen analysis to the peat deposits, it is true, has not as yet produced the results which were anticipated; nevertheless, the investigations at Plantation and Peacock's farms, Shippea Hill, to which frequent reference is made here, have provided an illuminating and unique sequence from Tardenoisian to Early Bronze Age, and demonstrated their relation to the marine deposits laid down when this area was at a lower level in relation to the sea.

The chapter by Dr. Clark on early man and that on the Anglo-Saxon period by Mr. Lethbridge raise numerous points, which invite discussion. Not the least interesting of these is the question of the continuity of the population in the successive phases of the Bronze Age, the thickly populated Romano-British period, and Saxon times. If these and other matters have to be passed over, it is for lack of space, rather than of inclination. Cambridgeshire, so far, has indeed been fortunate in its county historians.

Comparative Study of the Lower Plants

Vergleichende Morphologie der niederen Pflanzen:

eine Einführung in deren Formbildung und Formwechsel auf entwicklungsgeschichtlicher Grundlage. Von Prof. Dr. Bruno Schussanig. Teil I: Formbildung. Pp. viii + 382. (Berlin: Gebrüder Borntraeger, 1938.) 36 gold marks.

THE appreciable advances in our knowledge of lower plants during the present century has led to the publication, especially on the Continent, of a large number of relevant works, but most of these deal with Algae or Fungi only as the case may be. A comparative treatment of the lower plants is therefore to be welcomed, and there can be no doubt that Prof. Schussanig has produced a book that will take its place among the accredited works on Thallophyta. This first volume is divided into four sections, two dealing with the cell and cell-division and two with the organization of the multicellular thallus. Here also is included a consideration of structure in relation to physiological function which is as unconvincing as most earlier accounts dealing with this topic.

It is natural that in a book of this scope new points of view should be advanced. Schussanig propounds the hypothesis that all parenchymatous types of thalli (for example, the polystichous Ectocarpales of Oltmanns) represent condensed systems of branching filaments, either uni- or multi-axial. This interpretation is extended not only to the parenchymatous Ectocarpales and Bangiales, but also to the Laminariales, Fucales, and even Dictyotales. Such a view has long been accepted for the Florideae, but the facts provided by the author in support of its application to the parenchymatous Phaeophyceae carry little conviction. It is not feasible to discuss this theory here, the more since additional evidence is to be furnished in the second volume. Schussanig also

reaffirms (p. 180) his view that the Conjugales are derived from a polyenergid ancestry, and a similar origin is suggested for the Red Algae, but it cannot be said that any strong evidence is adduced.

With the very wide range of topics discussed, it is perhaps inevitable that the treatment should in places be somewhat one-sided; for example, the problematic cytology of the Blue-Green Algae would seem to have merited a fuller discussion than is afforded it on p. 33, where really only Baumgärtel's point of view is considered.

The treatment of the Fungi is not as full as that of the Algae, a fact which is particularly noticeable in the very brief consideration of the plectenchyma of the former and in the discussion of parasitism. There are diverse minor points that call for criticism. As examples, we may note the reference to the spore as a normal stage in mitosis (p. 18) without mention of the fact that many recent authorities regard it as typical only of meiosis, the homology of the pseudocilia of Tetrasporaceae with flagella (p. 59) for which there appears to be no adequate evidence, the use of the term oonobium as synonymous with colony (p. 190), and the statement that growth-rings occur in the medulla of Laminariales (p. 375). The reference to Juller, rather than to Klebs or Pascher on p. 216 is misleading.

Despite such criticisms, however, Schussanig's book is often suggestive and stimulating, and the comparative treatment of many topics, especially in the first two sections, of great value. The book is essentially one for a specialist, since the matter is treated in such a way as to render it accessible only to those with considerable previous knowledge. It would, moreover, have fulfilled a more useful purpose had the text not been encumbered by the introduction of many new terms. The illustration is ample and excellent.

F. E. FRITSCH.

Farm and Garden Seeds

By Prof. S. P. Mercer. With a Section on the Seeds Act, 1920, by A. W. Munro. (Agricultural and Horticultural Handbooks.) Pp. 205+14 plates. (London: Crosby Lockwood and Son, Ltd., 1938.) 10s. 6d. net.

PROF. MERCER has produced an interesting and readable book on farm and garden seeds. While it may not make an appeal to a very wide public, it should find a place in the libraries of those for whom the author, in his preface, states he has attempted to cater; namely, the agricultural student, those concerned in the business of seed testing, and such others as are interested in how things grow and the methods adopted to ensure that the seeds they buy are what they purport to be and may reasonably be expected to germinate.

The book consists of five chapters, together with one appendix giving physical data about crop seeds and a second giving notes on practical seed testing. The first four chapters are by Prof. Mercer. After a short and somewhat condensed chapter on the formation, structure and growth of a seed, he goes on to give an interesting account of commercial seed production in Great Britain and indicates the sources of supply for other commercial seeds which are drawn from other countries. The chapter on seed testing bears the authoritative imprint of one who has for a number of years been in charge of an official seed-testing station. Prof. Mercer's final chapter contains a short description of each of the main crop and weeds seeds with the most beautiful and delicate illustrations of the seeds which the reviewer has ever seen. These illustrations are the author's own drawings and he is to be congratulated on them.

The final chapter in this book is contributed by Mr. Munro, of the Ministry of Agriculture, who, from intimate personal knowledge, gives an account of the provisions and administration of the Seeds Act of 1920.

An index, sufficiently comprehensive to make reference easy and quick, is included. R. R.

Biology for Pharmaceutical Students and Others

By Prof. S. Mangham and A. R. Hockley. Pp. viii+613. (London: Baillière, Tindall and Cox, 1938.) 21s.

LIKE many other introductory biology books recently published, this is a comprehensive, though elementary, survey of the subject; but it is difficult to believe that the authors were sufficiently alive to the needs of those for whom the book was specifically written, namely, students preparing for the preliminary scientific examination of the Pharmaceutical Society of Great Britain. The price, and also the length, are too great for a student's book, particularly in view of the fact that it is supposed to be of a preliminary nature; no doubt the latter determined the former. One explanation of the undue length is that the authors have borne in mind the students' later needs in pharmacognosy and physiology; but to forestall this later teaching in the student's first year is doubtful policy. In fact, it does not seem feasible to expect preliminary students

to assimilate profitably all that this book offers at the beginning of their professional studies.

Furthermore, especially in those parts dealing with plant physiology, there are too many names—usually surnames only—of research workers. These, too, in places seem to crop up indiscriminately. For example, in the two pages dealing with vitamins, apart from that of Hopkins, the names of Howard and Hirst only are mentioned. The account would be better balanced if these had been omitted. Again, in the section on the mechanism of photosynthesis, the first paragraph alone contains six names of workers from Priestley to Bousisingault. These can mean little to a visitor to the subject. They will make little impression on his mind and can only be a useless burden to the student, for whom the volume is written.

The book contains numerous excellent illustrations.

The Flight of Birds

By C. Horton-Smith. Pp. 182+17 plates. (London: H. F. and G. Witherby, Ltd., 1938.) 7s. 6d. net.

THIS book is a short popular account of bird flight. Some of its readers will be primarily interested in birds, others in aeronautics; it is perhaps inevitable that a few should be disappointed. The author is at his best when describing those attributes of the bird's wing which he has obviously studied at first-hand; he is not quite so convincing when translating the behaviour of the wing into aeronautical language. It is impossible at present to make any useful comparison between the air flow past a bird's wing during active flapping flight and that past a simple aerofoil, and it is therefore much to be regretted that Dr. Horton Smith does not always make it quite clear whether his statements apply to the wing of a bird or the 'wing' of an aeroplane.

Some of Dr. Horton-Smith's views may possibly be open to criticism on aerodynamical grounds, but as a biologist he has performed an extremely useful task in bringing into this small volume a large number of important observations which can scarcely fail to stimulate an interest in the subject.

Mineralogie von Bolivien

Von Friedrich Ahlfeld und Jorge Muñoz Reyes. Pp. vii+89+1 plate. (Berlin: Gebrüder Borntraeger, 1938.) 10.50 gold marks.

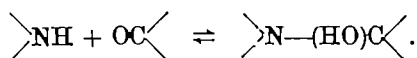
SINCE David Forbes in 1865 wrote his account of his researches in the mining districts of South America, many other British mineralogists have taken an interest in the rich mineral localities of Bolivia and the many rare species found there. A German translation of the Spanish "Mineralogia Boliviana" by Ahlfeld and Muñoz Reyes will be very welcome. In this book descriptions are given of 171 mineral species with brief mention of the places and modes of occurrence. Some of the occurrences recorded are new. There is a good index of localities, and the book is illustrated by crystal drawings and a frontispiece.

Nature of the Cyclol Bond

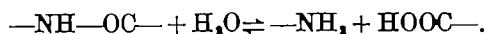
By Dr. Irving Langmuir, For. Mem. R.S., and Dr. Dorothy Wrinch

I

THE confirmation by X-ray data^{1,2} of C₆, the 268-residue cage structure proposed for the insulin molecule³, makes it of interest to consider the nature of the cyclol bond, upon the postulation of which this structure and the cyclol theory of protein structure in general⁴ depend. The making and breaking of a cyclol bond between an NH group of a polypeptide chain and a CO group of the same or of another polypeptide chain requires only the migration of an H atom thus:



The making and breaking of a cyclol bond is therefore a prototropic tautomerism, inter- or intra-molecular, which indicates a special type of binding of the H atom. (A recent investigation has shown that a similar situation actually exists in crystalline diketopiperazine⁵). As a prototropic tautomerism, it is to be sharply contrasted with the making and breaking of a peptide link which, requiring the intervention of another molecule, say water, may be written:



In order to direct attention to the fundamental difference between a prototropic tautomerism on one hand and a hydrolysis (or alcoholysis, etc.) on the other, it is convenient to talk in future of cyclol *bonds* and peptide *links*.

In current usage, the term protein is applied to anything having the chemical composition of amino acid condensation products. One class stands out as of paramount importance for the understanding of living matter, namely the crystalline globular proteins such as trypsin, pepsin and so on. These substances are already well defined in a number of ways, and it is with proteins belonging to this category that the cyclol theory is concerned.

Among the properties by which the substances are already characterized are the following:

(1) They have definite molecular weights which are discretely arranged.

(2) They contain certain numbers of various particular amino acid residues and these numbers are frequently powers of 2 and 3.

(3) They are soluble in water or salt solutions, but their solubility is affected by changes in pH.

(4) They denature under very slight stimulus.

(5) They spontaneously form monolayers of extreme insolubility.

(6) They exhibit a high degree of specificity in biological reactions.

It has already been shown that the cyclol hypothesis explains (1), (2), (4). With regard to (3) and (5), we may point out that the extreme insolubility of the monolayer formed from a soluble protein^{6,7} indicates that the globular protein has a structure in which hydrophobic groups can be completely masked, so leading directly to the idea of a cage structure which presented itself in the cyclol theory as a deduction from the geometry of polypeptide chains. The

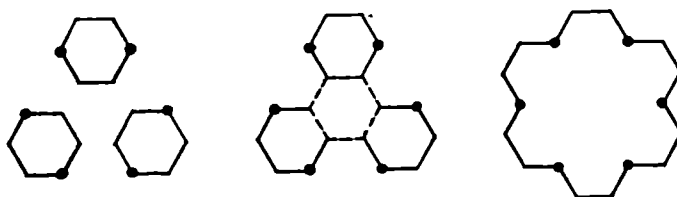


Fig. 1.

CYCOL-6 (IN CENTER) WITH ITS TRIAZINE RING DOTTED. THE OPENING OF THIS RING YIELDS EITHER THREE DIKETOPIPERAZINE MOLECULES (SHOWN ON LEFT) OR A CLOSED POLYPEPTIDE CHAIN OF SIX RESIDUES (SHOWN ON RIGHT).

lacunae in the fabric allow ionized (and other) *R* groups to modify their positions profoundly in response to changes in pH, and indeed to lie inside or outside the cage. The spontaneous formation of protein monolayers from globular proteins in solution indicates that weak bonds only are broken. This we interpret to mean that, in the formation of monolayers, some or all of the cyclol bonds are opened, few or none of the peptide links being broken, so that protein monolayers consist of polypeptide chains partially or wholly decyclized, for the most part without open ends, the hydrophobic groups forming a separate phase in the surface. This type of structure explains many of their striking characteristics: for example viscosity, elasticity, etc.^{8,9}

It may be emphasized that the breaking of cyclol bonds yields different degradation products according to the path of fragmentation. Thus cyclol-6 yields three diketopiperazine molecules or a single 6-residue chain (Fig. 1). In standard circumstances, a preferential path of fragmentation, probably largely determined by the *R*-groups,

II

is to be expected*, and it may be presumed that one and the same structure will under standard conditions break down in a unique way. Further, if preferential paths of breaking cyclol bonds be postulated, preferential paths of making cyclol bonds must also be postulated. Experiments have recently been reported purporting to disprove the cyclol hypothesis, in which glycyl leucine and leucyl glycine dipeptides were mixed and glycyl glycine and leucyl leucine dipeptides were not formed¹⁰. Even if triazine rings were formed (and of this no evidence was offered), there seems no reason to suppose that the structure will break down to yield anything except the original molecules. We are therefore unable to accept these experiments as evidence against the cyclol hypothesis.

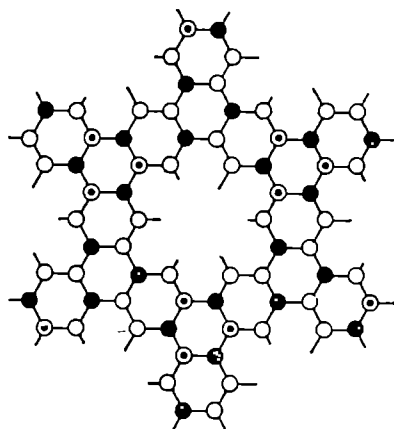


Fig. 2.

A FRAGMENT OF THE CYCLOL FABRIC. THE MEDIAN PLANE OF THE LAMINA IS THE PLANE OF THE PAPER. THE LAMINA HAS ITS 'FRONT' SURFACE ABOVE AND ITS 'BACK' SURFACE BELOW THE PAPER.

- — N.
- — C(OH), HYDROXYL UPWARDS.
- — C(OH), HYDROXYL DOWNWARDS.
- — CHR, DIRECTION OF SIDE CHAIN INITIALLY OUTWARDS.
- — CHR, DIRECTION OF SIDE CHAIN INITIALLY UPWARDS.

These suggestions of preferred paths of fragmentation apply equally to the globular proteins characterized, on the present view, by a specific set of amino acid residues, in a definite spatial interrelationship. They imply that for each protein there are one or more points at which the breaking of cyclol bonds normally starts. Thus an insulin molecule forming a monolayer would form a specific set of wholly (or partially) decyclized polypeptide chains. In this way, we can explain the highly characteristic films formed by different proteins, which permit an unknown protein to be recognized instantly as insulin or pepsin or papain and so on^{7,8}.

From the point of view of biology, cytology and immuno-chemistry, however, the most striking characteristic of the globular protein is its high degree of specificity. This, we suggest, indicates an organized structure with its own characteristic modes of vibration, which depend on the nature and arrangement of the various constituent amino acids. Since the breaking and making of cyclol bonds is a prototropic tautomerism, we anticipate that in appropriate circumstances there may be a kind of resonance in the molecule which accounts for the stability of the cyclol fabrics and the cyclol polyhedra. The cyclol fabric, a fragment of which is shown in Fig. 2, contains no double bonds and thus Frank¹¹ believed that "the cyclol molecule in itself offers no chance of constructing a resonant system". But each triazine hexagon has three parallel hydroxyls on the three carbon atoms, the next triazine hexagons in the fabric having their three hydroxyls on the other side of the fabric. With a symmetrical structure of this kind, it seems highly probable that the protons, instead of being attached to individual oxygen atoms, lie between the oxygen atoms serving as hydrogen bonds between them. There may thus be a marked resonance involving the three oxygens and the three hydrogens. Furthermore, resonance on a larger scale between neighbouring triazine groups may also be expected.

This suggestion of intramolecular hydrogen bonds in the cyclol fabric is in line with the intramolecular bonds already postulated in a wide variety of compounds, including ice, alum, natrolite and other zeolites, oxalic acid dihydrate and formic acid, in which oxygen atoms are shown, by crystal structure data, to lie abnormally close together¹². Such a close distance of approach is evidence of considerable mutual energy of oxygen atoms, which can only be due to the presence of hydrogen between them¹³. For certain compounds, for example, salicylaldehyde and *o*-nitrophenol, the presence of intramolecular hydrogen bonds has been confirmed spectroscopically by the non-appearance of the hydroxyl band¹⁴. In these cases the oxygen-oxygen distance is about 2.5 Å., considerably shorter than the distance of 2.7 Å., that represents double the radius of the ion O⁻ and very much shorter than that for neutral oxygen. In the case of the cyclol fabric, hydroxyls are carried by three carbons in a triazine ring, which lie at the distance apart of $\frac{3}{2}\sqrt{6}a$, which is equal to 2.45 Å. if a , a length intermediate between the C-C and C-N distances is taken (as has so far been done) as 1.5 Å.

One of the most extraordinary properties of proteins is their specificity in biological reactions.

The haemoglobin in each different type of animal seems to differ in spectrum and in details of its behaviour with oxygen. We are thus forced to conclude that, in proteins, certain features of the molecule can transmit some effect to other parts of the molecule, particularly to prosthetic groups. Such transmission of chemical influence, although observable to some extent in such compounds as sterols, seems to exist in a unique degree in the proteins: in long-chain compounds, on the other hand, there is practically no evidence of such transmissions to distances of more than a few atoms. It is well known that in aromatic chemistry the resonance, for example in the benzene molecule, causes substituents in different parts of the molecule to have an effect on one another very different from what would be expected if no resonance occurred. The high specificity of the proteins therefore in itself seems to demand resonance to a degree greater than that in other known chemical compounds. It would seem that the cyclol polyhedral structure with its sets of rings within rings and its multiple paths of linkage between atoms (cf. Fig. 2) should be capable of just such a type of resonance.

May we not perhaps regard each diazine ring in the cyclol fabric as the analogue of an electrical resonant circuit, the natural frequency of which is determined by the character of the side chains in this ring? Then n resonant circuits coupled together would be characterized by n frequencies, no one of which being exactly what it would be if the resonant units were separated from one another. An electrical network, the resonant circuits of which have the geometry of the cyclol polyhedra, would give very close coupling between the adjacent hexagonal units. Thus the structure as a whole should possess a wide range of frequencies. The situation is somewhat analogous to that in the Debye theory where a crystal has a large number of modes of vibration. So in the protein the cyclol structure may be characterized by a whole spectrum of frequencies definitely correlated with the symmetry of the structure as a whole. Thus if a single factor disturbs the symmetry, it might have a profound effect upon some of the characteristic frequencies. If we imagine that these frequencies are important in the interactions between proteins and in funnelling the energy to certain parts of the molecule, we have a possible reason for the important effects produced by apparently minor changes in the structure of the protein molecule.

III

It appears that a strong case can be made out for the cyclol theory, since its implications, derived

by simple geometrical arguments, fits the facts summarized above. The theory depends upon one postulate which thus becomes of special interest, particularly as its formulation has occasioned some uneasiness in chemical circles. The question then arises as to the possibility of proving directly the existence or non-existence of cyclol bonds.

The work on protein monolayers indicates that only weak forces are required to open cyclol bonds. We are of the opinion that many chemical techniques are sufficient to rip open the cyclol fabric into polypeptide chains, so that the chemist by his very operations may destroy the structure he seeks to study. On this view, any apparent contradiction between the cyclol hypothesis (which regards the globular proteins as polypeptide fabrics) and the chemical data relating to proteins (which appear to show them to be polypeptide chains) disappears. The situation is thus reminiscent of that in quantum physics, where the conditions required for the observation of the position and velocity of an electron themselves modify the phenomena under study. Similarly, it has recently been suggested¹⁴ that enzyme studies do not permit the deduction that cyclol bonds do or do not exist in globular proteins. Direct knowledge of protein structure must therefore depend upon physical methods of investigation such as X-rays and spectroscopy, etc.

The picture of a globular protein with hydrophilic groups on its outer surface and hydrocarbon groups in contact within the cage is strikingly akin to the picture of the structure of certain micelles to which recent studies have led¹⁵. Ions, such as octyl trimethylammonium sulphate, which contain long hydrocarbon chains form micelles in very low concentration. It is found that the size of such particles corresponds to a sphere of radius about equal to the length of the individual molecules and it is shown that the micelles are spherical particles, in which the tails are crowded together in the interior and the hydrophilic heads form the outer surface. The micelles in soap solutions have a similar structure.

Little or nothing is known at present as to the path or the nature of protein synthesis. We see no reason to suppose that a cyclol fabric forms spontaneously from polypeptide chains. If on occasion such cross linking occurs, this is probably a relatively unstable state. The non-formation of cyclol bonds between simple molecules^{16,17} is thus irrelevant to the cyclol hypothesis and to the problem of the formation of complete globular protein molecules. Using the information obtained in recent studies of protein monolayers formed spontaneously, we deduce that, in the globular state, the CH_2 groups are completely masked from

the aqueous medium. The globular protein in water is thus pictured as having its outer surface predominantly hydrophilic, the hydrophobic groups lying close together in the interior of the cage. A protein molecule of the size of insulin must contain several hundred CH_2 groups to account for the insolubility of the monolayer which it forms. When two CH_2 groups come into contact, energy of the order of 2,000 calories per gram molecule is involved¹², totalling for a protein molecule of the size of insulin, containing at least 300 CH_2 groups, an energy of upwards of 600,000 calories. This suggests one possible factor in the formation of a protein cage molecule.

We would also direct attention to the difference between the stability to be expected when a single cyclol bond forms within or between polypeptide chains and when three cyclol bonds form a triazine ring, and to the still more striking difference to be expected between the stability of a piece of cyclol fabric and of a complete cyclol polyhedron. Undoubtedly there are a number of factors favour-

ing the complete polyhedral structure over and above any uncompleted cyclol structure. These may account for the existence of cyclol cages even if there should be an intrinsic instability in isolated cyclol bonds.

- ¹ Wrinch, *J. Amer. Chem. Soc.*, **60**, 2005 (1938).
- ² Wrinch and Langmuir, *J. Amer. Chem. Soc.*, **60**, 2247 (1938).
- ³ Wrinch, *Science*, **86**, 565 (1937); *Trans. Far. Soc.*, **33**, 1353 (1937).
- ⁴ Wrinch, *NATURE*, **137**, 411 (1936) *et seq.*
- ⁵ Corey, *J. Amer. Chem. Soc.*, **60**, 1598 (1938).
- ⁶ Langmuir and Schaefer, *J. Amer. Chem. Soc.*, **60**, 1851 (1938).
- ⁷ Langmuir, Cold Spring Harbor Symposium on Proteins, **6**, 1938.
- ⁸ Langmuir, Pilgrim Lecture, Royal Society, 1938.
- ⁹ Wrinch, *Phil. Mag.*, **25**, 705 (1938); Cold Spring Harbor Symposium on Proteins, **8**, 1938.
- ¹⁰ Meyer and Hohenester, *NATURE*, **141**, 1138 (1938).
- ¹¹ Frank, *NATURE*, **133**, 243 (1936).
- ¹² Bernal and Megaw, *Proc. Roy. Soc., A*, **151**, 384 (1935).
- ¹³ Hilbert, Wulf, Hendricks and Ladd, *NATURE*, **125**, 147 (1935); Herrera and Mollet, *C.R. Acad. Sci., Paris*, **200**, 814 (1935).
- ¹⁴ Lindstrom-Lang, Hotchkiss and Johansen, *NATURE*, **142**, 906 (1938).
- ¹⁵ Hartley and Bunnicles, *Proc. Roy. Soc., A*, **108**, 401 (1928); Hartley *J. Chem. Soc.*, 1908 (1928).
- ¹⁶ Jenkins and Taylor, *J. Chem. Soc.*, 406 (1937).
- ¹⁷ Neuburger, Royal Society discussion on proteins, November 17, 1938 (*NATURE*, **142**, 1024; 1938).
- ¹⁸ Langmuir, *J. Amer. Chem. Soc.*, **39**, 1848 (1917); Colloid Symposium Monograph **3**, 48 (1925); "Colloid Chemistry", vol. 1, 525 (1926). (Edited by J. Alexander, Chemical Catalog Co., N.Y.)

Remoras or Sucking-Fishes*

By J. R. Norman, British Museum (Natural History)

THE principal characteristic of the Remoras (*Echeneidae*), which with the Eocene *Opisthomyzonidae* form the order *Discocephali*, is the oval, laminated, adhesive disk, placed anteriorly on the broad, flat upper surface of the head, and representing the much modified spinous dorsal fin.

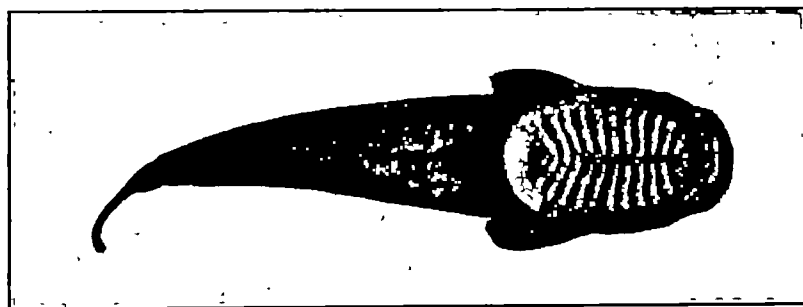


Fig. 1.

REMORA ALBIGESCENS (TEMMINCK AND SCHLEGEL). $\times \frac{1}{2}$.

In the form and position of the remaining fins, as well as in their general osteology,* these fishes resemble the *Percoids*, and especially the families *Pomatomidae*, *Carangidae*, *Rhachicentridae*, etc., and Regan¹ has suggested that they may well have

arisen from *Percoids* of this type. There are about ten existing species, grouped by some into five, by others into only two genera. In any event, they fall into two fairly well-marked groups: the *Echeneis* group, with a long, slender body, usually striped on the sides; and the *Remora* group, with a short, rather robust body, and a uniform brown, grey or black coloration (Fig. 1). Remoras occur in all warm seas, and one species is an occasional visitor to the British coasts. The larger species attain to a length of nearly four feet, but the smaller may not exceed fifteen inches.

In spite of its highly specialized structure, a close study of the cephalic disk reveals all the elements of a spinous dorsal fin². Each of the fin-spines is shortened, depressed posteriorly, and expanded transversely, and forms a pair of broad, flat laminae, the hinder parts of which are denticulated on their upper surfaces. Posterior projections of each pair of laminae are connected by ligament medianly, and there is a low fin-membrane joining them to the next pair. Viewed from below, it

* Substance of an address delivered before the Linnean Society of London on November 24.

may be seen that the large overlapping laminae actually represent the small lateral expansions of the radials generally to be found in the Percoids, and that the basals, although directed very obliquely posteriorly, have an almost normal form. The laminae composing the disk vary in number in the different species from nine to thirty-six.

It is a little difficult to visualize the manner in which this remarkable modification of the fin has been brought about, but Regan has suggested that the Remoras were probably derived from fishes which had, as the pilot-fish (*Naucrates*) has to-day, the habit of associating with sharks. "The spinous dorsal fin of the pilot-fish, and of other oceanic fishes of the same type, with the spines folded back within a groove, might possibly have some power of adhesion if the edges of the groove were applied to another object and the spines were then slightly raised."

As to the mechanism of adhesion it seems probable that when the flat surface of the disk is applied to the skin of the host, the marginal membrane creates a partial vacuum and a degree of adhesion is acquired. Then, by a slight raising of the transverse laminae, a further series of subsidiary vacuum chambers are created and the hold is firmly established. The denticulations on the laminae are evidently of use in preventing the disk from sliding on the surface of attachment and the fish avoids the danger of being swept away as its host makes its way through the water.

The power of adhesion is remarkable, and when firmly attached a Remora can be dislodged only with difficulty. A backward pull only tends to raise the edges of the laminae and thus to increase the hold, but by sliding the fish forward, the laminae are lowered and it can be detached more or less readily. Experiments made with living fishes have shown that a full-grown Remora can withstand a vertical pull of more than 40 lb. without giving way. Sewell³ has made some interesting observations on living Remoras, and has shown that, while holding on, all movements of the fish, except those associated with respiration (that is, of the mouth and gills) seem to be suspended. "In the case of a fish that had been well hooked, it was found that by allowing the fish to attach itself to a glass plate it would hang motionless, while the hook and a great part of the fish's jaw was out out!" It appears that the action of the sucker causes inhibition of all movement of the body and tail, and in this connexion a detailed study of the nervous mechanism involved would be of interest.

The Remoras are carnivorous in habit, and, judging from the stomach contents of captured specimens, feed mainly upon other fishes, which they catch freely in the water. They must also obtain a share of the host's meals at times. The advantage of the association to the Remora would seem to be twofold: it obtains transport, without effort on its own part, to fresh feeding-grounds, and it gains a measure of protection from the proximity of its formidable partner. The larger species attach themselves to the surface of the body of the host, generally in the region of the belly or sides, but some of the smaller species are not infrequently found inside the mouths of whales, sharks, giant rays, etc., and others regularly shelter within the branchial cavities of swordfishes, sailfishes, barracoutas and other large teleosts. It has been suggested that the frantic leaps of sail-

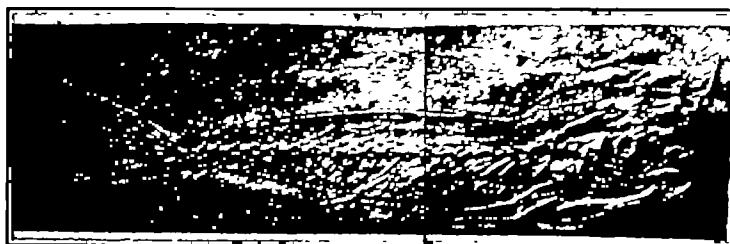


Fig. 2.

OPISTHOMYZON GLARONENSIS (WETTSTEIN). FROM WETTSTEIN. $\times$ ABOUT $\frac{1}{2}$.

fishes are made in an endeavour to get rid of the unwelcome guests in the gills. There is some evidence that certain species of Remoras are ordinarily associated with certain definite hosts, but further data are necessary on this head⁴.

A fossil Remora—*Opisthomyzon glaronensis* (Wettstein)⁵—from the Upper Eocene of Switzerland, is of considerable interest (Fig. 2). Here the adhesive disk consists of about six segments only, and, in addition to being smaller and narrower than its modern counterpart, is placed farther back and does not reach the interorbital region of the head. Further, the broader opercles and widely forked caudal fin suggest that the Eocene form was a stronger and more active swimmer than its descendants. "Perhaps," as Regan remarks, "it swam more and held on less than they do." The only other fossil Remora so far described is *Echeneis carpathica*, Szajnoch, from the Oligocene of Poland, but this is a comparatively modern form.

As might be expected, the available embryological evidence, although still far from complete, is also of considerable interest. Until recently, nothing at all was known of the early stages in the life-history of these fishes, but in 1926 Tani⁶ published preliminary descriptions and figures of

post-larval stages of both *Echeneis lineata* and *Remora remora*, based upon material obtained in the Atlantic by the *Dana* and other Danish vessels under the direction of the late Dr. Johannes Schmidt. His figures show that the disk is developed ontogenetically in the position normally occupied by the spinous dorsal fin, and that it later undergoes a gradual migration anteriorly. Thus, in specimens of *Remora remora* less than 8 mm. in length, no disk is visible. In an example of 9.8 mm. it has the appearance of a narrow oblong structure situated just behind the head: no laminae are yet visible macroscopically, but can be seen to be developing in prepared sections. In a specimen of 12 mm. the anterior edge of the disk lies just behind the eyes, in one of 18 mm. it is level with their anterior edges, and in one of 25 mm. it is well in front of the eyes. Sanzo⁷ has described and figured the pelagic eggs and early larval stages of *Remora remora* from the Mediterranean, but his account adds little to that of Tåning, whose detailed paper will be awaited with interest. Tåning⁸ has shown that the pelagic free-swimming post-larval life is of somewhat short duration, since *Remora remora* joins its host at a length of 30–40 mm., while at a length of 50 mm. the adhesive disk of *Echeneis lineata* has attained its full efficiency.

In the later stages of development, it may be noted that in the species of the *Echeneis* group the young have a peculiar type of caudal fin, the middle rays being prolonged to form a narrow pointed process. This gets progressively shorter with age, the hinder margin of the fin becoming plumose and finally more or less concave⁴.

There is a notable and persistent myth or legend associated with the Remoras, concerning the alleged powers of these fishes to retard the progress or even to stay the course of a ship⁹. This idea is inherent in the names given to the fish by the Greeks and Romans—*Echeneis* (one that holds back a ship) and *Remora* (a holding back). The earliest reference to the fish itself is that of Aristotle, but there seems to be reason for supposing that he never saw the fish in the flesh. The fact that he refers to it as a fish "which some call the *Echeneis* or 'ship-holder'" suggests that the belief was already current in the fourth century B.C. The credit for the first definite reference to the ship-retarding powers of the Remora belongs to Ovid, but the most detailed account is that of Pliny. The latter asserts that the naval battle of Actium was lost by Mark Antony because at the critical moment the praetorian ship was delayed by a fish of this kind. He also tells us that the death of the Emperor Caligula was presaged by a Remora arresting the progress of his galley on the voyage to Antium.

In addition to stopping a ship, states Pliny, a Remora could stay or hasten an *accouchement* or a law-suit! Later writers repeated this legend, with or without embroideries, and it remained popular throughout classical, medieval and renaissance times. It is of some interest to note that the term Remora has attained a definite place in literature, especially in English literature of the sixteenth and seventeenth centuries. Rabelais, in order to illustrate the law's delays, refers to "your beneficial remoras, that is the eternity of law-suits: the needless let that keeps them undecided". Spenser, in his "Visions of the World's Vanitie", has the following:

"All suddenly there clave unto her keel
A little fish that men call Remora,
Which stopt her course, and held her by the heel,
That wind nor tide could move her thence away."

Also Ben Jonson applies the term to describe a tedious bore (Poetaster), thus:

"Death, I am seized on here
By a land remora."

Various attempts have been made to illustrate the legend, and one of the more curious is shown



Capitulum. xxxvj.

Fig. 3. ONE OF THE EARLIEST KNOWN FIGURES OF *Remora* OR 'SHIP-HOLDER'. FROM JOHANN VON CUBE'S "ORTUS SANITATIS" (2ND ED., LEIPZIG, 1490).

Fig. 3. ONE OF THE EARLIEST KNOWN FIGURES OF *Remora* OR 'SHIP-HOLDER'. FROM JOHANN VON CUBE'S "ORTUS SANITATIS" (2ND ED., LEIPZIG, 1490).

in Fig. 3. This is to be found in the "Ortus Sanitatis" of Johann von Cube, first published at the end of the fifteenth century, and shows some six or seven Remoras adherent to a ship.

Although it is possible that a number of attached Remoras might retard somewhat the progress of a small boat, it is inconceivable that one (or even a dozen) fish could exert sufficient power to affect the course of a vessel of any size.

As Gudger¹⁰ has pointed out, the more probable explanation of a ship being suddenly held up or losing way is a physical one—the phenomenon known to seamen as 'dead-water'.

In various parts of the world the natives make use of leashed Remoras to capture large fishes, dugongs, turtles, etc., and many accounts have been given by travellers and others of the methods employed¹¹. Often a ring is fastened round the

Remora's tail, and to this is attached a long cord. The fish is kept in a bucket of water until, say, a turtle is sighted near the surface, and it is then released so that it may attach itself to the quarry:

Figura hac desumpta est ex tabula quadam descriptionis orbis terrarum.



Fig. 4.

FISHING WITH THE REMORA. FROM CONRAD GESNER'S "HISTORIAE ANIMALIUM", LIB. 4, 1558.

Remora and turtle are then pulled in together. Some skill is required in playing the 'catch', for any undue strain on the line may detach the Remora or, what is more probable, pull the ring

from its tail. In the Torres Straits, according to Dr. A. C. Haddon, a hole is bored through the tail, and through this a line is passed and made fast. A second line is passed through the jaws and out through the gill-openings. When the canoe sets out the fish is towed through the water by the head-line, and if it should attach itself to the boat it can be released by a forward pull when required.

What appears to be the earliest account of the employment of the Remora in this way occurs in Peter Martyr's account of the second voyage of Christopher Columbus to the New World, published in the early part of the seventeenth century. The story has been repeated by many writers of this and later times, and appears in the early works on natural history of Gesner (Fig. 4), Aldrovandi and others.

¹ Regan, *Ann. Mag. Nat. Hist.*, (8), 10, 634 (1912).

² Beck, "Ueber die Haftschlebe der *Echeneis remora*", Inaug. Diss. Schaffhausen (1879); Storms, *Ann. Mag. Nat. Hist.*, (6), 2, 67 (1881); Houy, *Nool. Jahrb. Abt. Anat.*, 20, 101 (1909).

³ Hora and Sewall, *NATURE*, 115, 48 (1925).

⁴ Gudger, *Amer. Mus. Novit.*, No. 234 (1926).

⁵ Wettstein, *Mém. Schweiz. Palaeont. Ges.*, 12, 82, pl. VII, Fig. 10 (1886).

⁶ Tanning, *O.R.*, 182, 1298 (1926).

⁷ Sanzo, *Mém. Com. Talass. Ital.*, 138, 1 (1928).

⁸ Tanning, *NATURE*, 120, 224 (1927).

⁹ Gudger, *Ann. Mag. Nat. Hist.*, (9), 11, 271 (1918).

¹⁰ Gudger, *Amer. Nat.*, 53, 290, 446, 515 (1919).

Obituary Notice

Mr. Emile Mond

MR. EMILE MOND died at the age of seventy-three years on December 30, 1938. He was a nephew of the late Dr. Ludwig Mond.

Emile Mond received his early education in Paris at the Collège de Sainte Barbe and at the Lycée Condorcet and specialized in chemistry at the Polytechnicum, Zurich, where he took his diploma. He began his technical career in England with Brunner, Mond and Co. with whom, at first, he did not stay very long, leaving them to found the West Indies Chemical Works in Jamaica with his friend and former fellow-student, Dr. Emile Bucher of Geneva. Afterwards, he returned to Great Britain and became technical assistant to his uncle, specializing in patent work. Later, he joined the board of Brunner, Mond and Co., Ltd., and the Mond Nickel Co., Ltd., becoming vice-chairman of the latter. In addition, he held the chairmanships of the South Staffordshire Mond Gas Co., the Power-Gas Corporation, Ltd. and Ashmore, Benson, Pease and Co., Ltd.

Emile Mond married Angela, youngest child of the late James Henry Goetze, who has been so closely identified with his many benefactions and scientific and social activities. From its beginning, he was intensely interested in the Institut Français du Royaume Uni which was founded by Madame

Marie Bohn and, being greatly concerned at the lack of educational facilities in Great Britain for French and Belgian refugee children, he provided for the establishment of the Lycées de Londres in May, 1915. These institutions became so important that the British Government provided a house for them and the Lycées became part of the Institut Français. Later, in 1921, they were formally recognized by the French Government and affiliated to the Université de Lille. In recognition of this important work, Emile Mond was made Officier de la Légion d'Honneur by the French Government and Officier de l'Ordre de Léopold by the King of the Belgians. In 1919, Emile Mond established the 'Francis Mond' professorship of aeronautical engineering—the first chair in that subject in a British university—at Cambridge in memory of his son, who was killed while flying in France in May 1918.

Although he always under-estimated his own ability and attainments in the science, Emile Mond was keenly interested in the advancement of chemical knowledge and, when he could spare the time, delighted to visit laboratories where original investigations were proceeding and invariably was able to contribute usefully to the discussion of the results. It was this interest in the subject and his desire to help in the attainment of new knowledge which led

him to accept the honorary treasureship of the Faraday Society in 1930, succeeding his cousin, the late Sir Robert Mond, and in 1931 he also became honorary treasurer of the Chemical Society. The work of this latter office is particularly onerous, and Emile Mond never spared his efforts on behalf of the Chemical Society and of the Faraday Society. His work was carried out with meticulous care and foresight, and during the time he has looked after their affairs—he held both offices at the time of his death—the two Societies have made outstanding progress, and the publication and discussion of new knowledge in chemistry have been greatly extended.

Emile Mond was a man of rare discernment, great modesty and charm. Severely critical of his own efforts, he was always appreciative of those made by others. Only a few have any idea of his great generosity during many years, and this generosity was guided by his intense desire to help the younger generation, to advance science and other branches of knowledge and to extend international good will. For many years, Mr. and Mrs. Emile Mond have made their houses delightful centres of refinement and culture for their numerous friends in this and many other countries.

Emile Mond was a type of man unfortunately too rare in these days. His greatest happiness was in helping others towards a fuller appreciation of things that are worth while. He will be greatly missed, and

to Mrs. Mond and the family very many who were privileged to know this truly great man will wish to tender their deepest sympathy.

CHARLES S. GIBSON.

We regret to announce the following deaths:

Prof. G. Barger, F.R.S., regius professor of chemistry in the University of Glasgow, on January 5, aged sixty years.

Mr. J. O. Borley, O.B.E., formerly fisheries adviser to the Colonial Office, known for his work with the "Discovery" Committee in connexion with the international control of whaling, on December 30, aged sixty-six years.

Mr. Reynold Bray, ornithologist of the British Canadian Arctic Expedition, aged twenty-seven years.

Prof. H. A. Cummins, O.M.G., emeritus professor of botany in University College, Cork, on December 31, aged seventy-four years.

Sir Robert McDougall, known for his services to the National Trust and his interest in agricultural research at Rothamsted, on December 15, aged sixty-seven years.

Prof. M. Pavlova, professor of palaeontology in the University of Moscow, aged eighty-four years.

Prof. L. G. Schnirelman, professor of mathematics in the University of Moscow, aged thirty-one years.

News and Views

Sir Frank Smith, G.B.E., K.C.B., F.R.S.

SIR FRANK EDWARD SMITH will relinquish on January 31 his appointment as secretary to the Committee of the Privy Council for Scientific and Industrial Research, a post which he has held with distinction for the last ten years. Born in Birmingham in 1876, he gained a national scholarship in physics at the Royal College of Science in London. He was one of the first assistants appointed by the late Sir Richard Glazebrook when the National Physical Laboratory began in 1899, and he was superintendent of the Physical Department of the Laboratory from 1901 until 1920. During this time he did a great deal of advanced original research work, introducing many novel methods, but he was never satisfied with the results obtained until he had checked them by other methods. He designed and helped to construct many new instruments and devices, and his results on the measurement of absolute units showed an accuracy unrivalled at the time. Accounts of many of these researches, some of them written by himself, will be found in Glazebrook's "Dictionary of Applied Physics", vol. 2. The gradual evolution of the current balance, in which the electric attractions between currents in coils were balanced by weights, so that it became possible to measure a current in absolute measure and thus determine the ampere, was a triumph of

research. The agreement now arrived at by international physicists as to the absolute value of the units justifies the great skill and time expended in measuring them, in which Smith took a leading part. In addition to all the routine and research work he did, he was always pleased to discuss with his colleagues the problems in which they were mutually concerned. Among other important work he did at the Laboratory was his work on the 'current weigher' in collaboration with Ayrton and Mather. He co-operated with Duddell and Glazebrook in perfecting radio telegraphic apparatus for direction finding, and he also co-operated with some of the physicists at the Bureau of Standards, Washington, D.C., in perfecting standards of electromotive force. His work with Rosa of this laboratory on standards of inductance was also of great value.

FROM 1920 until 1929, Sir Frank was director of scientific research, Admiralty; from 1929 until the present time he has been secretary to the Department of Scientific and Industrial Research. He has been one of the secretaries to the British Association for Advancement of Science (1922-29) and a secretary of the Royal Society from 1929 until 1938. As an administrator he has been most successful, partly due to his tact and the many friendships he formed with leading men in the industrial and engineering

world. He forms an admirable link whereby the industrialist can get into touch with Government departments—and vice versa. During recent years, in furtherance of his duties, he has made voyages to South Africa, the Argentine, the United States, etc. He has been of great service to the Royal Society and has given lectures, generally in connexion with electrical subjects, to many scientific and industrial societies in towns in all parts of the kingdom. He has been president of the Physical Society and of the Junior Institution of Engineers, and has been given various degrees by universities in Great Britain and abroad. He has been awarded the Hughes Medal of the Royal Society, the Duddell Medal of the Physical Society and the Faraday Medal of the Institution of Electrical Engineers. All men of science will hope that his advice will be available to us for many years to come.

Prof. E. V. Appleton, F.R.S.

H.M. THE KING has approved the appointment of Prof. E. V. Appleton to succeed Sir Frank Smith as secretary to the Committee of the Privy Council for Scientific and Industrial Research. Prof. Appleton, who will take up his new appointment on February 1, has been Jacksonian professor of natural philosophy in the University of Cambridge since October 1936. He is a fellow of St. John's College, Cambridge; and, after a period of service on the staff of the Cavendish Laboratory, he held the post of Wheatstone professor of physics in the University of London during 1924-36. Prof. Appleton's research work has included a study of the operation of thermionic valves and their associated circuits, the nature and origin of atmospheric and the phenomena associated with thunderstorms; but he is perhaps best known for his investigations on the ionized regions of the upper atmosphere, and their influence on the propagation of radio waves. In this field the results of his work have been of far-reaching importance both in connexion with our knowledge of the physics of the atmosphere and also in assisting the general development of long-distance radio communication. It is well known that by using waves sufficiently short to penetrate the Heaviside layer, Prof. Appleton was able to demonstrate the existence of a second, similar but denser, ionized region at a greater altitude. Most of this research has been conducted on behalf of the Radio Research Board, of which Prof. Appleton has been a member for many years. The work itself has brought him international recognition: he was awarded the Morris-Liebmann prize of the American Institute of Radio Engineers, in 1929 and was elected a vice-president of the Institute in 1932. He has been president of the Union Radio Scientifique Internationale since 1934, and in this capacity he conducted the general assembly of the Union which took place in Italy last September.

Prof. P. G. H. Boswell, O.B.E., F.R.S.

PROF. P. G. H. BOSWELL, who has resigned from the professorship of geology at the Imperial College, is followed by Prof. H. H. Read, who succeeded him

as George Hardman professor at the University of Liverpool. After some early work on the glacial deposits of eastern England, Prof. Boswell's researches on the Tertiary rocks of the London Basin extended the study of detrital minerals originated by H. H. Thomas to the elucidation of problems of genesis, provenance and age. He thus gave a new life and meaning to the old "test by included fragments", inaugurated a method of research which has been widely followed, threw new light upon processes of sedimentation, and laid the foundation for his work on sands and other mineral substances of vital importance to the metallurgical, glass and brick-making industries during the War. He also devoted much attention to the Chalk, its movements and its sub-Tertiary surface, to the history of the Suffolk rivers, to the Pliocene 'Crag', and to the classification of the Glacial Drifts especially in their relation to early man, on which he gave his presidential address to Section C of the British Association at York. As an authority on East Anglia, his services were called upon by the Geological Survey for three of its memoirs, while he contributed a series of articles to the 'Encyclopædia Britannica' and to 'Regionale Geologie' and its successor the 'Handbook of the Geology of Great Britain'.

WHEN Prof. Boswell moved to Liverpool to take the chair of geology there, he tackled the difficult area of the Denbighshire Moors, which had been long neglected by geologists, and started a series of papers on their geology which he has since continued. He was able to give advice on the geological conditions of the Mersey valley which contributed no little to the success of the new tunnel; and, later, he was sent out to adjudicate on disputed evidences on the age of human skeletons obtained from Kanam and Kanjera in Kenya. In spite of all this research and the stringent duties of his chair, he found time to make a translation of Heritsch's 'Nappe Theory on the Alps', which an eminent German professor was heard to say he preferred reading to the original. He has acted as president of the Prehistoric Society, as secretary of the Geological Society, and as a general secretary and treasurer of the British Association. In his latter positions he has taken an active part in the recent increased activities of that body. We may look forward with confidence to a rich harvest of further research from him now that he is free from the heavy strain of professional duties.

Technical Non-Teaching Staff in Laboratories

AN important unit on the science side of educational establishments is that which includes the minor technical staff, namely, laboratory and technical assistants, workshop assistants, store keepers, etc., and science teachers know from experience the help which a really good laboratory assistant renders to a department. This is particularly the case in those departments which employ only one assistant. His experience, probably gained from the problems encountered while performing the tasks associated with his post, covers a wide range, depending upon the particular type of science department in which

he is engaged. One agrees that the services rendered by these assistants should be adequately recognized from a financial point of view. In addition, their conditions of service should be such that they are encouraged to take a real interest in their work, and are given facilities for proper training. There is no need to stress examples of such assistants attaining the highest academic distinctions; but it is a fact that many of them, given help and encouragement, display marked resources, particularly in experimental technique. The conditions of employment are not too good in some institutions, and so within the past three or four years a Technical Non-Teaching Staff Branch of the National Union of Public Employees has been formed to safeguard the interests of such technical assistants.

THE objects of this branch, which is of national character, although its activities have been confined mainly to London, include the following: to improve the status of all stewards and assistants employed in the laboratories, or workshops, of any educational establishment, and to secure a fair wage, reasonable hours of work, suitable working conditions, together with a reasonable expectation of permanent employment. One obvious difficulty is the grading of assistants in university laboratories with those employed in secondary schools. There is no comparison between the ability, responsibilities and skill of the members in the two classes. It must also be remembered that salaries and conditions of employment in educational institutions are bound to vary with the locality. The Branch of the Union is also endeavouring to organize suitable training courses for juniors, and specialized practical classes for others. It is proposed that these classes shall extend over a minimum period of five years, the final specialization being in biology, chemistry or physics—for some reason no mention is made of engineering. After successfully passing through the course, the candidate would be entitled to receive a nationally recognized certificate, or diploma, which would be a guarantee of competence in laboratory management. It must be remembered, however, that the Institute of Physics has a scheme in operation, whereby certificates are awarded to technical assistants in physics who attend approved courses of instruction, and pass examinations in accordance with certain regulations. Other activities of the Branch of the Union include educational visits to laboratories, factories, etc., and it is hoped to arrange for demonstrations of new apparatus, experiments, etc., similar to those held in connexion with other associations. The secretary of the Branch is Mr. E. J. Chilton, 361 Kingston Road, Ewell, Surrey.

Data on the Ionosphere (F_2 Region)

It is important to the radio engineer to know the highest frequency radio waves returned from the ionosphere at any time or season, since this critical frequency represents the division between those frequencies which can be used for long-distance radio communication and those which are suitable for transmission only over quasi-optical ranges. The

same knowledge is of importance also to the geophysicist, since it provides him with a reasonably accurate statement of the most intense ionization existing at any level in the ionosphere. For some years past, the Radio Department of the National Physical Laboratory has conducted a comprehensive investigation into the propagation of waves as part of the programme of the Radio Research Board of the Department of Scientific and Industrial Research. Included in this work are daily measurements of the height and critical frequencies of the various regions of the ionosphere made at the field station of the Radio Department at Slough (lat. $51^\circ 29' 30''$ N., long. $0^\circ 33' 30''$ W.). When electric waves from a radio transmitter pass through the ionosphere, they are split into two components with different velocities and opposite senses of circular polarization, under the influence of the earth's magnetic field. The region capable of returning the higher radio frequencies to earth is known as the F_2 region and the highest frequency which can just be returned by that region is known as the critical frequency and refers to the extraordinary component of the wave. It is, however, more convenient to measure the ordinary component, and in the northern hemisphere the plane of polarization of this component has a left-handed direction of rotation when looking along the direction of propagation. The critical frequency for this component is generally about 0.7 Mc./s. lower than that of the extraordinary component in the case of the results quoted. The daily measurements are carried out with waves returned from the ionosphere at vertical incidence, and the values of height and critical frequency of the regions studied refer to this condition. The corresponding values for oblique incidence can be derived from these results, and from these, the conditions for long-distance communication can be deduced.

In view of the widespread use of long distance radio communication and broadcasting on the short wave band between 10 and 100 metres (3 and 30 Mc./s.), it is proposed that the ionospheric data relevant to this band should be made available as a special service to those interested in the subject. Typescript copies of monthly tables, including sufficient data for any day to enable a simple curve to be plotted showing the relation between height and critical frequency of the region under consideration, and beginning with January 1939, is now available at 2s. 6d. per annum for subscribers in Great Britain or in the Empire overseas, and 5s. per annum for foreign subscribers. Applications, with the appropriate remittance, should be addressed to the Director, National Physical Laboratory, Teddington, Middlesex. Arrangements have also been made by which those desiring to obtain early information on the state of the ionosphere as soon as the data are available may obtain them by telephoning the Radio Research Station (Slough 1560) between the hours of 10 a.m. and 4.30 p.m. Those wishing to avail themselves of this service should write to the Director of the National Physical Laboratory asking

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Science and Faith

THE meeting of the American Association for the Advancement of Science, which took place at Richmond, Va. during December 27-31 will be memorable in the annals of science as being the first to mark that closer co-operation between this body and the parent British Association, to which Lord Rayleigh, in his presidential address to the latter body at Cambridge in August last, looked for aid in promoting international amity. No less will it be remembered as the occasion of the delivery of the two addresses of which the main parts are given in the following pages.

In these pronouncements, two of the leaders of scientific thought in the United States and Great Britain at the present day, Prof. G. D. Birkhoff, the president of the American Association, and Sir Richard Gregory, chairman of the newly formed Division for the Social and International Relations of Science of the British Association, declared their faith in the mission of science in the resolution of the maladjustments which lie deep-seated at the root of the difficulties and the dangers with which the world of to-day is faced. In the words of Prof. Birkhoff, "The increasing number of unco-ordinated theories and mechanical inventions confuse and chill many of us. Man is felt to be a tragic detail in a vast incomprehensible whole, and the old sense of values seems to become less and less real". But he went on to show in his lucid analysis of the function of intuition, reason and faith in the approach to his hierarchy of five ascending levels in the nature-mind spectrum, that while reality is to be attributed to each and all, at each level there is an ever-widening succession of abstract ideas, each explaining imperfectly some aspect of the stupendous whole; but that at the

social level a fundamental truth of transcendent importance is truth and good will in all social relationships. In concluding that a new injunction has been laid upon the spirit of man to know and to understand ever more broadly and deeply, he added that in the daring effort of the man of science to extend knowledge there arises a spontaneous faith which is the most powerful incentive and the best guide to further progress.

In essence, Sir Richard Gregory's address is complementary to that of Prof. Birkhoff. Just as Prof. Birkhoff holds that faith in the ultimate truth of certain fundamental principles is the guiding star of the man of science, so Sir Richard shows that in the study of man and society from the earliest ages it is seen that faith in an unseen power which lies behind the appearance of things is a fundamental component of man's nature. He goes on to demonstrate that, in the course of the development of mankind, faith also has developed, not only in the conception of the object of devotion and the relation of that object to the universe, but also in the extension of the circle of those to whom the ethical system which is its accompaniment is made to apply. Although it has to be admitted that the development of spiritual and ethical concepts has been retarded in comparison with material development, nevertheless it is in the recognition of this conception of a process of continuous development in theological and ethical ideas that Sir Richard sees hope for the ultimate approach one to the other of religion and science, while in the fundamental urge of faith he sees a guide pointing the way to an enlargement of the ethical ideal, in which present differences and antagonisms may be resolved.

Intuition, Reason and Faith in Science*

By Prof. George D. Birkhoff, Harvard University

FROM the earliest times scientific ideas, even when crudely conceived, have been of immeasurable importance, not only for man's material advancement and control over Nature, but also in modifying and expanding his philosophic and religious outlook. In the effort to obtain a better understanding of his place in the cosmos, he is compelled to proceed largely by considerations of analogy based upon supposed or actual fact. So he turns more and more toward the ever-widening vistas suggested by science in its continual discoveries of new truth.

To-day, the significance of science as a principal source of revelation is almost universally recognized. Thus recently, on behalf of Pope Pius XI, Cardinal Pacelli spoke before the Pontifical Academy of Sciences concerning the enlightenment that comes from "the potent streams of the natural and rational sciences and the great river of revealed wisdom". He said that the former are found "wherever man looks for and finds truth". As for "the great river of revealed wisdom", is it not to be found in all the absolutely sincere utterances of poets, philosophers and prophets, based on the relevant knowledge of their day and made after deepest meditation? It would seem that such utterances are in essence similar to the pronouncements of the scientist. Is not the vague, prophetic conjecture of Pythagoras that Nature is mathematical as true as Newton's more precise law of gravitation? From this point of view, the great streams of revelation seem to merge insensibly into one.

Nevertheless, the immediate effect of scientific advances is often very disquieting. The strong opposition long shown to the Darwinian theory of evolution bears witness to this fact. Similarly at the present day, the ever-increasing number of unco-ordinated theories and mechanical inventions confuses and chills many of us. Man is felt to be a mere tragic detail in a vast incomprehensible whole, and our old sense of values seems to become less and less real.

To persist in such an attitude of discouragement

is unjustified. Every individual has implanted within him the desire to understand his role in the existing order. He feels an inalienable right to find out his duties and privileges as a citizen of the universe. By the light of any new knowledge he is always certain to gain deeper insight into his position. The wise advice of our own great Emerson comes to mind: "Fear not the new generalization. Does the fact look crass and material, threatening to degrade thy theory of spirit? Resist it not: it goes to refine and raise thy theory of matter just as much."

What, then, are some of the larger points of view which are suggested by science to-day? In attempting a reply, I can of course only offer a personal interpretation, inevitably reflecting the fact that I speak as a mathematician having some acquaintance with physics.

Let us observe in the first place that our universe presents antipodal aspects—the objective and the subjective, the impersonal and the personal. If we take the objective aspect as more fundamental, we put our emphasis on the notion of reality; and if we start from the subjective, we prefer to speak of knowledge. In either case we are able to discern a kind of nature-mind spectrum; for there appears a roughly given hierarchy of five ascending levels—mathematical, physical, biological, psychological and social. Each level has its appropriate special language. The basic corresponding concepts are respectively: *number* at the mathematical level; *matter* at the physical level; *organism* at the biological level; *mind* at the psychological level; and *society* at the social level. If we choose to select one of these as somehow more real than the others, a great distortion arises in our point of view. For example, if we regard the physical level as the most fundamental, we become materialists. But why make such an unnecessary choice? The languages of the various levels are essentially independent of one another, and the observed laws are best expressed in their own natural terms. Why mix up the levels of knowledge unnaturally? Does it clarify our ideas of social justice to try to explain it in terms of the reactions between protons and electrons in the brain?

* From the address of the president of the American Association for the Advancement of Science delivered at Richmond, Va., on December 27, 1938.

These considerations bring us to a first general point of view towards the levels of knowledge: it is desirable to accord reality in equal measure to all kinds of knowledge everywhere, and so to view the universe as broadly and impartially as possible.

Another very important observation is that in order to understand the various facts and their interrelations we must always use abstractions, that is, conceptual tools of a logical or mathematical nature. Contrary to opinions which prevailed until recently, any abstraction serves only limited specific ends. At best it will enable us to grasp more clearly some small fragment of reality. For example, by use of the abstraction of Euclidean geometry, and in that way alone, we understand the nature of space with a considerable degree of exactitude; and yet to-day scarcely any physicist would ascribe objective reality to space in itself. It has been Einstein more than anyone else who has taught the scientific world the true role of Euclidean geometry by means of his theories of space-time and relativity. More generally, we have come to realize that our only approach to a better understanding of the world is by means of a widening succession of abstract ideas, each explaining imperfectly some aspect of the stupendous whole. This is a second synthesis deserving of especial emphasis.

Thirdly, I would state a fundamental truth about the social level, which in some sense is the highest level of all: the transcendent importance of love and good will in all human relationships is shown by their mighty beneficent effect upon the individual and upon society.

Thus I have begun by presenting very briefly three important articles of my personal faith. It is my especial purpose to show how this phenomenon of faith arises inevitably in the mind of the scientist whenever he tries to evaluate technical conclusions in his special field. In doing so I shall discuss the role of intuition, reason and faith in science, first at the mathematical and physical levels, and then more briefly at the biological, psychological and social levels. This will lead me in conclusion to formulate two other items of my personal *credo* in the hope that they may be worthy of attention.

By way of definition it must be indicated first what is meant by intuition. There are certain elementary notions and concepts which come spontaneously to the minds of all who observe, experiment with and reflect on a specified range

of phenomena. Such generally accepted ideas or intuitions constitute the consensus of reaction of intelligent men to a certain part of the world of fact. John Stuart Mill has said, "The truths known by intuition are the original premises from which all others are inferred." It is in this sense that I shall refer to intuition. By reason I shall mean the rational superstructures which may be erected upon the basic intuitive ideas by means of deductive or inductive reasoning. These superstructures will also be accepted by all who are able to follow the sequence of logical steps involved. By faith I shall mean those heuristically valuable, more general points of view, which are beyond reason, and sometimes in apparent contradiction with one another, but which to the individual concerned seem of supreme importance as he endeavours to give his conclusions the widest possible scope.

It is clear that in this way we obtain a basic classification of knowledge into three easily distinguishable types. Let us consider the occurrence of these types at the various levels of knowledge.

INTUITION IN MATHEMATICS

By continual crude experimentation with classes of concrete objects, man has come gradually and inevitably into the possession of certain numerical ideas. In particular he has been led to think of the positive integral numbers 1, 2, 3 . . . as entities which exist in almost the same sense as the objects themselves. This concept finds its realization in the designation of the integers by corresponding marks 1, 2, 3 . . . Such integers are found to be subject to certain simple arithmetic laws, and these laws are regarded as intuitively true.

The integers form the basis of a great part of mathematics. For it is found that with their aid one may construct fractions and, more generally, real and imaginary numbers. In the course of the centuries, mathematicians have thus built by processes of pure reason the elaborate structures of algebra, the theory of numbers and analysis. An extensive array of beautiful and useful theorems has been deduced.

Similarly in geometry—which in its origin may be regarded as the most elementary branch of physics—we experiment with rigid material objects and arrive readily at the notions of idealized small rigid bodies or 'points' and of idealized 'lines' and

'planes'. Then we observe that certain postulates hold, such as the familiar ones of Euclid. By means of these postulates which embody our intuitions, we are able by deductive reasoning to arrive at other geometrical theorems, including such results as the celebrated Pythagorean theorem which shows us in particular that a right triangle with legs of 3 units and 4 units in length has a hypotenuse of exactly 5 units in length. The vast mathematical domain called 'geometry' has arisen from these elementary geometrical facts as a primary source.

There are many other abstract mathematical structures besides those just alluded to. In all cases it is found that they are made up of certain accepted intuitions (or postulates) and their logical consequences.

Now what I desire particularly to point out is that the mathematician goes far beyond such generally accepted clean-cut assumption and conclusions, in that he holds certain tacit beliefs and attitudes which scarcely ever find their way into the printed page. Yet these form none the less part of a considerable oral tradition. For example, he believes in the existence of various infinite classes, such as that made up of all the integers. He believes also that the whole body of strict logical thought called mathematics is self-consistent: in particular, when he finds that the number π admits of diverse forms of expression, as, for example,

$$\pi = 4 \left[\frac{1}{1} - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \dots \right]$$

and

$$\pi = 2\sqrt{3} \left(\frac{1}{1} - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \dots \right),$$

he feels absolutely certain that if the unending calculations could be fully carried out, the results would be exactly the same in all cases. Furthermore, when he recalls that in the past the most difficult mathematical questions have been ultimately answered, he is inclined to believe with the great German mathematician, Hilbert, that every mathematical fact is provable. Besides all this, he attributes certain values to his results and their mathematical demonstrations: some theories seem important; some proofs are regarded as elegant, others as profound or original, etc.

Such somewhat vague ideas illustrate what I would call mathematical faith. Nearly all the greatest mathematicians have been led to take points of view falling in this broad category, and have attached the deepest significance to them.

What I wish to emphasize concerning this generally overlooked aspect of mathematical thought is that on one hand, the beliefs involved have been of the utmost heuristic importance as instruments of discovery, and, on the other hand, when examined in detail they generally turn out to involve ideas which are held true or false, according to the specific definitions which may be afterwards adopted.

Suppose, for example, that we turn to the first question of the existence of infinite classes. There was no question about the unconditional acceptance of such classes until within a few decades, although a few, like the ancient Greek philosopher Zeno and the German algebraist Kronecker, profoundly distrusted the use of the infinite in mathematical reasoning. To-day, however, due primarily to the theory of transfinite aggregates created by Georg Cantor about fifty years ago, mathematicians have come to realize that such an infinite class may exist in the so-called 'idealistic' sense but not in the sense of explicit constructibility. Thus the class of all collections of positive numbers less than 1 exists in the idealistic sense, but not in the alternative, more concrete sense.

A similar situation has arisen in the detailed study of the self-consistency of mathematics. It has appeared that very limited parts of mathematics can be proved self-consistent. But such a general assertion as that "the whole of mathematics is self-consistent" would be considered to-day not to be sufficiently precise; and each time that the proof of self-consistency is extended further, a definite logical price has to be paid in that certain so-called metamathematical ideas are tacitly employed, which need themselves to be investigated in the same respect. For example, the work on the foundations of logic by Whitehead and Russell (1910) showed that if the notion of class was not restricted, certain logical paradoxes would inevitably result. For this reason a theory of the 'hierarchy of types' was devised by them, which limited the notion of class and so avoided the apparent inconsistencies. We are thus entitled either to say that mathematics as of the year 1900 was self-consistent or was not, according to the point of view which is adopted. In any event the belief in question has led us to a much deeper insight into the nature of logic.

With regard to the unlimited power of mathematical demonstration, it has been recently proved by the Austrian mathematician Gödel that, if we restrict ourselves to reasoning of an ordinary

type, there exist explicit 'undecidable' theorems, while from a higher metamathematical point of view such a theorem might be demonstrable. Hence Hilbert's affirmation is in one sense false. But despite this fact, the open question on which he focused attention is much better understood than ever before.

Likewise in the question of value in mathematics, such as the importance of theories, or the elegance, profundity and originality of proofs, it is clear that these obscure ideas depend in large measure upon the momentary state of the science. Thus the theory of functions of an imaginary variable and classical geometry were regarded as extremely important a quarter of a century ago; while to-day the theory of functions of real variables and the basic kind of geometry called analysis situs have respectively displaced these subjects in general mathematical esteem. It would be hard to explain adequately the reasons for this change, but the increasing role of discontinuous quantity in physical theory and the relativistic point of view towards space and time have certainly been contributing factors.

An excellent instance of the power of individual mathematical faith in bringing about creative advance has been afforded by an American mathematician, the late Eliakim Hastings Moore. Moore was a thorough-going abstractionist who believed that mathematics itself should be reorganized from a still higher point of view by the dissection of essential common parts out of apparently different abstract fields. His point of view was strongly confirmed by the analytic work of Hilbert and Erhardt Schmidt near the beginning of this century. So Moore was led to create his 'general analysis' in 1906. This aimed at embodying his conviction that "The existence of analogies between the central features of various theories implies the existence of a general theory which underlies the particular theories, and unifies them with respect to these central features."

As time has elapsed, the deep truth of Moore's contention has been amply sustained. Indeed one of the most active schools of contemporaneous mathematical thought follows the higher abstract point of view adopted by Moore. But it has been found necessary to modify Moore's programme in that instead of a single 'general analysis' serving as an *omnium gatherum*, it has been desirable to employ a few typical forms. In this way his faith in the power of higher abstraction has been largely and yet not fully justified.

A good many mathematicians are seriously hampered by lack of the ardent positive faith which Moore showed. This type of deficiency is generally due to a strong development of purely critical powers and to over-specialization. Several times I have observed this lack in myself only to be counteracted by definite effort. For example, I did not make active use of the fundamental integral of Lebesgue for a long time, and so was prevented from pursuing to their natural conclusion certain ideas which finally led me to establish the basic 'ergodic theorem' in 1931. Here I was finally converted, as it were, to the use of this tool by the important advances of Koopman and von Neumann, and in particular by the latter's proof of the 'quasi-ergodic theorem'. It is worthy of note that the related ergodic hypothesis goes back in its origins to the physicists Boltzmann and Maxwell.

SPACE, TIME AND FORCE

Let us turn next to the physical level, where the corresponding situation is at least equally interesting.

If we accept the ordinary conceptions of space and time, which seem destined always to play a basic role in workaday physics, we find that the simplest physical ideas are those which arise through the manipulation of massive bodies. As these ideas have become clarified, they have been given abstract formulation in terms of such concepts as those of mass, force, etc. Newton's celebrated three fundamental laws of motion embody the final form of the refined intuitions thus arrived at. With these as a basis and the acceptance of certain further special observed laws, one may deduce by mathematical reasoning the theory of mechanics as applied, for example, in the solar system.

Similarly, through experimentation with electrified bodies, electric currents, magnets, etc., there was developed by Faraday the intuitive ideas of electric and magnetic lines of force which are now generally accepted. Later, Maxwell incorporated these ideas in the appropriate electromagnetic equations. Upon this basis all classical electromagnetic theory has been logically constructed. Furthermore, by means of the identification of the light wave and the electromagnetic wave, due to Maxwell, an adequate theory of light has been obtained.

Thus we see the important part which intuition and reason have played in two fundamental

branches of physics—mechanics and electromagnetism. A cursory survey of the various other branches of the subject would show that a similar situation holds throughout, except in the rapid developments of quantum mechanics during the last decade or so. In this strange theory the physicist begins indeed with a planetary model of the atom, reminiscent of Niels Bohr's earlier theory. But a flying leap is made from this temporary scaffolding to what is thenceforth regarded as the only basic reality—the wave equations of Schrödinger and, better still, of Dirac. Once having arrived at these mathematical equations, the physical theorist proceeds to show how he can predict innumerable facts previously out of his range by use of this arbitrary *ad hoc* machinery. The process involved somehow reminds me of a record sea voyage made through a fog!

The fact remains, however, that the recent development of quantum mechanics forms one of the most astounding and important chapters of all theoretical physics. It is interesting to recall how this great advance came about through the faith of the German physicist Planck at the outset of the present century. His direct experience with the phenomena of radiation had led him to believe that there were discontinuous processes at work, not to be explained by any modification of the time-worn classical theories, and so he was led to formulate his celebrated quantum hypothesis in 1900. It was this daring concept of Planck, more than anything else, that has freed the minds of physicists from the shackles of too conventional thinking about atomic phenomena, and so has made possible the quantum-mechanical quest, of which the end is not yet in sight.

There has always been an abundance of faith among the physicists. Everyone knows how Newton and others have found confirmation even for their religious beliefs in the lawful character of physical phenomena. It is not hard to understand why the tendency towards dogmatic affirmation among the physicists has been stronger than among the mathematicians. For the physicist, with considerable justice, feels that he is exploring the mysteries of the only actual and very exciting universe; whereas the mathematician often appears to live in a purely mental world of his own artificial construction. A good illustration of this tendency of the physicists is afforded by their changing attitudes towards the wave theory versus the corpuscular theory of light. Over a considerable period the corpuscular theory of Newton held

sway; then this was displaced by the wave theory of Huygens, the Dutch physicist; and nowadays a kind of vague, uncertain union of the two is generally accepted.

In this connexion it is especially interesting to recall the scientific beliefs to which Faraday was led in his fundamental work on electricity and magnetism. From his experimental results in this field, he saw that there was obeyed here as elsewhere the law which he called the 'conservation of force' and which we to-day would call the 'conservation of energy'. He saw that this energy was localized in space, and he could only conceive of it as being propagated in time; and so he was led to the belief that electromagnetic energy is also propagated with finite velocity. Thus in an article, "On the Conservation of Force," published in 1857, he expressed himself as follows: "The progress of the strict science of modern times has tended more and more to produce the conviction, that 'force [energy] can neither be created nor destroyed' . . ."; "time is growing up daily into importance as an element in the exercise of force; to inquire, therefore, whether power acting either at sensible or insensible distances always acts in time is not to be metaphysical." By way of justification of the rather mathematical direction in these thoughts, Faraday said further, "I do not perceive that a mathematical mind, simply as such, has any advantage over an equally acute mind not mathematical . . ."; "it could not of itself discover dynamical electricity nor electromagnetism nor even magneto-electricity, or even suggest them." But the achievements of the more mathematical Maxwell were later to show that Faraday had underestimated the power of pure reason.

It is thus clear that through an act of faith Faraday attained to a kind of deeper insight; for the existence of the electromagnetic wave has long since been established experimentally. However, the beliefs of Faraday in this connexion cannot be regarded as absolutely true, since according to present-day conceptions the notion of energy which he accepted is only roughly valid as a statistical approximation. Nevertheless, Faraday certainly penetrated more into the nature of electrical and magnetic phenomena than any of his contemporaries; and it is difficult to see how, with the limited mathematical and physical knowledge at his disposal, he could have gone any further in the way of prophetic conjecture.

The intimate relation between philosophical-

scientific points of view and actual advances in theoretical physics has been admirably illustrated by Einstein's gravitational theory of 1915. Taking as his starting point the bold but reasonable hypotheses that matter must condition space and time, and that, in parts of space remote from matter, elementary particles move with uniform velocity in a straight line, he arrived at his field equations as the most elegant mathematical embodiment of these ideas. Thus there was obtained a quasi-geometrical theory of gravitation which in certain respects is more natural than the celebrated theory of Newton, while the predicted differences, although excessively minute, are in favour of the new theory. But Einstein's theory cannot be regarded as true in any absolute sense since it gives us at best a partial, highly idealized view of the physical universe.

It is scarcely too much to say that, since the beginning of the present century, the main advances in theoretical physics have been the outcome of a similar kind of mathematical guesswork, in which, however, the mathematician himself has taken little or no part! The guessing of the physical theorist is guided almost entirely by considerations of subtle mathematical analogy.

In my own limited experience in mathematical physics I have seen how natural it is to take a positive attitude on open questions. Thus a good many years ago I showed mathematically that mere spatial symmetry about a centre necessitates a *static* gravitational field. This led me to believe that the Einstein field equations were probably too inelastic to fit the facts, but I did not put forth this opinion. Shortly afterwards Lemaitre, in trying to explain the expanding (non-static) stellar universe, found it necessary to modify the field equations, in part because of my result; and so my belief was to this extent justified.

Again, I have had during the last few years a feeling that a conceptual space-time model for quantum mechanics is likely to be found, although theoretical physicists would in general disagree. Nevertheless, this faith is so strong that my recent researches lie principally in this direction. I have already found interesting results, and feel confident that these efforts will not be wasted, since the possibilities of the conceptual approach need to be more carefully explored.

In ending these remarks about the role of intuition, reason, and particularly of faith, at the physical level, it is to be remarked that the physicist

as such systematically ignores the phenomena of life, for it is inorganic and not living matter with which he concerns himself in his laboratory.

All in all, it is a faith in the uniformity of Nature which remains the guiding star of the physicist, just as for the mathematician it is a faith in the self-consistency of all mathematical abstractions, although these faiths are more sophisticated than ever before.

INTUITION IN THE BIOLOGICAL FIELD

Although I have no especial acquaintance with the biological, psychological or social domains, it seems clear to me that a similar situation prevails in them. In the biological field the intuitions upon which one depends are those associated with the concept of the organism and its evolution. These intuitions cannot be formulated conclusively and completely in simple postulates, as is possible at the mathematical and physical levels. It is rather through an acquaintance with an immense array of interrelated, analogous facts that the biologist finds himself able to deal with novel situations. By means of the geological record on one hand, and the results obtained in the field and laboratory on the other, he acquires a better and better understanding. His principal weapon is always inductive reasoning. It seems certain that a deductive treatment of biology is at least very remote, and if ever accomplished will be utterly different from anything which we can imagine to-day. There are, however, a few special fields like the theory of heredity, in which a considerable mathematical structure has been developed. In this theory, by means of the chromosomes and their corresponding abstract genes, it has been possible to explain a complicated array of facts.

The faith of the biologist generally tends in the direction of a mechanistic theory of life or of some opposing vitalistic theory. In fact, he is forced to employ the principle of physical causation in his efforts to understand biological phenomena and does not yet know of definite limitations in its use. Recently there has been some indication of a return to vitalism, so that once more a considerable group of biologists are convinced that not all the phenomena of living matter are to be accounted for by ordinary physical and chemical law. The controversy involved has long been a burning one, and accordingly one naturally suspects that the question is really meaningless. In any event, however, special mechanistic

hypotheses have so far pointed the way to new creative advances.

It is interesting to remark that the insufficiency of a rigorously deterministic theory of the living organism admits almost of mathematical demonstration in the following manner. A genuinely mechanistic universe would have to be free of any infinite factors. For example, if one accepts a simple Newtonian theory, there might be reaching the earth from infinite space unknown quantities of matter and energy, so as to change arbitrarily the course of events upon the earth. But in any completely mechanistic system, free of such infinite factors, it is not difficult to prove that there will necessarily be a kind of eternal Nietzschean recurrence. For example, we are here together this evening considering a particular topic. The strict adherence to the deterministic point of view would entail the consequence that in the eons yet to come this same scene will be re-enacted infinitely often. I submit that this is dramatically improbable!

Recent advances in the chemical knowledge of large organic molecules seem to indicate an innate hospitality of actual matter toward the evolution of the living organism. In this way a plausible genetic account of the origin of life is suggested, which, however, can scarcely be called mechanistic. It begins to seem possible that we are on the verge of further refinements in our concept of matter, such as Emerson anticipated in the quotation made above.

The situation at the psychological level is even less amenable to precise treatment. All of us have a lifelong experience with ourselves and other human beings. This automatically gives rise to a vast complex of intuitive psychological notions. We all are aware of course that there are concomitant physiological processes going on in the body, nervous system and brain. Now it is the business of the professional psychologist to give exact definition and interpretation to these crude ideas; and he finds his greatest illumination in the facts of abnormal psychology, with which most of us are unacquainted. However, in the case of either layman or professional, the processes of reasoning are mainly by analogy. Even the psychiatrist, familiar with many concrete cases, must treat each new patient by the inductive method. There are too many psychological intuitions and too few exact laws for any imposing edifice of pure reason to be erected.

In certain restricted psychological domains,

formalization is to some extent possible. Thus I have ventured to formulate a theory of 'aesthetic measure', by explicit numeration and weighting of aesthetic factors. This aims to explain certain simple aesthetic facts in our enjoyment of visual and auditory forms. The theory has been to some extent substantiated by experiments made at Harvard and elsewhere. But in any event, no matter how successful the theory might prove, it would be wholly absurd to try to set up an elaborate logical structure on the basis of the fairly arbitrary and inexact assumptions involved. Generally speaking, as we proceed from the more objective to the more subjective levels of thought, we find that elaborate logical structures seem to be of less and less utility.

The basic belief of the professional psychologist is in the completeness of the physiological accompaniment of every psychical fact; and he formalizes the observed facts by means of this parallelism. But there is a conflict between this attitude of the technician towards mind, for whom the individual is a complex of neurally characterized components, and that of the ordinary man—equally an expert though of a different kind—who sees all sorts of permanent values in personality, not adequately characterized in neural terms. The second attitude leads nearly all of us to have deep affections and abiding personal loyalties, whether or not we are psychologists!

Here again I think that these apparently opposing points of view are both more or less true; and I incline all the more to this opinion because of my conviction that as yet we know relatively little about the phenomena of personality. For it seems certain to me that the extent of hidden organization in our universe is infinite, outside as well as inside space and time; such a conviction is very natural to a mathematician, since the three ordinary spatial dimensions and the single temporal dimension are for him only particular instances of infinitely many other conceivable dimensions! If this be true, any broad conclusions concerning the nature of personality would seem altogether premature.

At the social level the most serviceable intuitive ideas cluster around the concept of societal evolution. It is of course the comparative study of human institutions which furnishes the principal interest. The analogy between forms of society and evolving organisms is a deep-lying one. Here again the useful logical structure which can be built around the very complicated facts is exceedingly

simple. Even in such a formalized field as ethics, dealing with the behaviour of the individual as a member of society, logic takes an almost negligible role.

Belief here seems to gather principally around the idea of societal progress. Progress—or its non-existence—serves as our fundamental tenet. Some believe that society can improve indefinitely, tending toward a perfect society. Such a belief is of course a fundamental one in most religious systems. Others find this idea too naive. They stress the gregarious instinct in man and tend to think of societal changes as taking place in various directions strongly conditioned by changing physical environment. All would admit, however, that without the concept of dynamical social processes, social theorizing would be stale and unprofitable.

SCIENCE AND SOCIETY

Let us turn now to consider some further conclusions, towards which this brief survey of intuition, reason and faith at the various levels seems to point.

So far as intuition and reason are concerned, these are the common property of all competent individuals. The narrow, closely articulated chains of deductive reasoning serviceable at the earlier levels are more and more replaced by loose webs of inductive reasoning at the later levels, as we pass from the objective to the subjective. At the same time the basic intuitions change from the simple and precise types employed in mathematics and physics to the increasingly complicated and diverse forms characteristic of biological, psychological and social phenomena.

However, it is just as necessary to clarify and to formalize our knowledge at these later levels as at the simpler ones. The processes of systematic reasoning, whether inductive or deductive, have always a definite prophylactic value, and in particular enable us to avoid the dangers of prejudiced and intolerant points of view. It may be observed in passing that the careful application of impartial thoroughgoing analysis is as important for everyday living as it is in the study and the laboratory.

The striving for rational comprehension is one of the noblest attributes of man. In his age-long difficult struggle he has been able to secure greater freedom only through a better technical mastery of his environment. No other method of liberation has been vouchsafed to him. But this increased

mastery has brought with it automatically new intellectual responsibilities and a more complex way of life. In consequence, unforeseen and threatening dangers arise from time to time; and there is thus imposed on him the necessity to advance still farther, which is to-day more urgent than ever before. A new injunction has been laid upon the spirit of man, to know and to understand ever more broadly and deeply.

Now along with the increase in scientific knowledge there appear certain crudely expressed, deeper insights, not completely true or false, some in opposition to others, but all supremely valuable, nevertheless. These are embodied in beliefs which seem the inevitable accompaniment of all creative thought.

Thus in the daring effort of the scientist to extend knowledge as far as possible, there arises an aura of faith. It is this spontaneous faith which furnishes the most powerful incentive and is the best guide to further progress.

Such are some of the very general points of view to which a considerable mathematical and scientific experience has led me. If they are worthy of serious attention it is not because of their novelty, but rather because in their aggregate they rise above the details of the numerous specialized fields of knowledge and sustain the scientist in his unceasing and ardent search after truth.

Doubtless many will be ready to ask the ever more insistent question: If science has thus profoundly modified the general outlook and way of life of mankind, is it not the especial duty of such an association as ours to point out constructive remedies for the ensuing maladjustments? In "Part II; Science and Warfare" of his admirable address as president of the British Association last August, Lord Rayleigh closed by expressing the hope that our two associations could co-operate in such a way as to "bear useful if modest fruit in promoting international amity". In this hope all of us will deeply concur. The presence of Sir Richard Gregory among us at this meeting is the first token of the projected closer relations between the parent British Association and ourselves. It is much to be desired that this action will encourage further unification of the whole scientific world. I am sure that practically all our joint membership would agree with me that it is the wider diffusion of "the steady light of scientific truth" which holds out most hope of a better understanding among men.

Religion in Science*

By Sir Richard Gregory, Bart., F.R.S.

IF religion be understood in the broadest sense as the belief in spiritual being, it may be said that prolonged inquiry has failed to show any authenticated instance of a people, however backward, who do not hold to some form of belief which, though vague and rudimentary, can be deemed religious. It is difficult to draw a hard and fast line between magic and religion; and indeed it is a question whether such a differentiation is essential from the point of view of the inquirer who is attempting to trace the development of the religious idea. For even 'magic' implies some form of spiritual influence humanly directed. Belief in the efficacy of magic is as much an act of faith in some form of spiritual action as the Christian belief in Divine intervention in human affairs; and the essence of a religious belief is that it is an act of faith.

Faith may be defined as a belief which is not dependant upon material evidence or logical demonstration from premises ultimately based upon sensory phenomena (although such phenomena may be invoked to support faith as 'proof'); but it acquires its validity from some general scheme or theory of the nature and purpose of 'being', 'life', the universe, or, as the philosopher would say, of 'the Absolute', or, to use a popular phrase, 'the scheme of things'. In essence it is emotional: not rational. In its contact with 'facts', faith interprets them not by observation and experiment—that is by the approach of reason and science, which demand proof in the strict logical sense, by reference to phenomena—but it evaluates them by the test of coherence with its theory of life and the universe. Such a scheme need not necessarily be consciously formulated or even realized as a whole. Probably, in the early phases of development, such realization rarely, if ever, takes place, as the minds of backward peoples work concretely and are averse from abstraction.

Whatever may be thought of evolutionary faith, evidence from comparative study shows that there is, in the mentality of man, a generalized urge towards a belief in spiritual values underlying the material appearances of the universe. This urge is fundamental. Various influences such as the influence of geographical and cultural environment, and possibly mental differences of racial strains, if there are such, have combined to produce

the different types of belief and the religious systems which have been followed, or are now followed, by mankind. It is at least significant that in the so-called primitive religions of the less advanced cultures there should be such strikingly close similarities in ritual and belief as have been recorded by the anthropologist. Further, when we try to attain an objective view of the more advanced religions, it is no less striking that they fall into a more or less uniform pattern in regard to the relation of the three elements—tradition, ritual and ethics; in other words, in the relation of belief to worship and the conduct of life. Dissension arises not so much out of the nature of tradition as when interpretation is added to it and made a test of orthodoxy. When there is a difference in the central objects of the various cults, opportunities for dissension are multiplied and reconciliation might seem wellnigh impossible.

RELIGION AND LIFE

Many reasons have been put forward to account for the origin of religion, but it cannot be said that any of them has solved the problem. Ancestor-worship, ghost-propitiation, worship of the soul, belief in spiritual beings, reverence for tribal leaders, and other causes, have all been suggested as originating causes of religious sentiment. Primitive man had no religion, except such as was embodied in a system of social virtues. Men possessing these virtues to a high degree, and using them to make the tribe powerful or conditions of life more pleasant, would be esteemed as benefactors or heroes not only during life but also after death, and this veneration would develop into ancestor worship and later into soul worship.

If it is assumed that the Divine purpose of the existence and evolution of life upon the earth is that man should work out his own salvation, it is difficult to understand what the ultimate gain will be when the earth will no longer be in a condition to maintain life as we conceive of it. All that science can say as to the future of the earth or any other planet or system in the astronomical universe, is expressed in the words of the hymn "Our little systems have their day: they have their day and cease to be". We may contemplate the progressive development of man and society to whatever stage may satisfy our ideals, but, so far as we now know, the whole phantasmagoria will eventually

* From a public lecture delivered before the American Association for the Advancement of Science meeting at Richmond, Va., on December 27 1938.

be dissolved, and the death of mankind will be the final penalty for achieving the highest type conceived by the human mind. This thought should not, however, be subversive of effort and aspiration on the part of humanity as a whole, any more than the individual should neglect noble motive and conduct because he himself has to pass away whether his influence has been for good or evil. Though science is unable to provide any positive evidence for survival of personality after death, it must acknowledge that belief in such survival is a powerful ethical factor in human development.

Evidence of the progressive development of forms of life in the past, and of changes still going on, is so convincing that it may almost be regarded as a law of Nature. In so far, therefore, as evolution signifies an orderly succession of organic growth, few would venture to deny the fact; but how and why such changes are brought about has not yet been established beyond discussion. Whether organic evolution has proceeded by gradual development of small variations of structure and habits, or by the sudden appearance of new forms, is a question for naturalists to decide among themselves in their search for natural causes. The govt of observational science is concerned only with evidence which throws light upon such causes and effects without assuming the existence of supernatural design or intervention. Whether behind the natural causes producing evolution there is a transcendental principle or architect is not the concern of naturalists, but of other philosophers. Their position is that even if the facts of organic evolution cannot be explained by existing knowledge, they will be explicable when more is known about natural causes and consequences, without introducing a *deus ex machina* to conceal our ignorance and suppress the pursuit of objective evidence.

We have passed the stage when, in order to afford support for Christian belief in general, and the Mosaic account of creation in particular, it was only necessary to find naturalistic or rationalistic explanations of miraculous and other elements in Biblical records. Such attempts to fit all new knowledge into a system of thought having no claims to scientific accuracy or intantion served no useful purpose to the Bible or to science, and to-day would satisfy neither historical students nor naturalists. A much sounder basis can be found by applying evolutionary principles to religious thought, and by studying sacred books as stages in the story of man's progressive discovery in theology. It is only by disregarding history that the idea of a fixed and final theology becomes possible. In science, there are no final interpretations or unchangeable hypotheses; and if the

same principle were recognized in theology, religion would share some of the vitality of the natural sciences. Evolution can be regarded by the theologian as merely the means of creation; and this conception of gradual development is not incompatible with Christian theology. It is through the acceptance of the idea of evolution in the spirit as well as in the body of man that the partition which formerly separated religion and science is being dissolved.

All religions—primitive and advanced—include ethical ideals relating to human conduct and its supreme end. The highest form of religious ethic is that in which the aim of conduct is complete and implicit obedience to a code which is conceived as the will of God. In the less generous manifestations, this obedience may be rendered against natural inclination as an outcome of fear; for "Fear of the Lord is the beginning of wisdom." It may then degenerate into a formalism as lifeless, and even more harsh, than that of those systems which stress ceremonial purity. On the other hand, it may become a joyous and spontaneous acceptance of a mode of life, such as it is conceived would be consonant with the nature of God, subject to such limitations of the flesh as are ineradicable—the idea of saintliness. Hence arises the desire for uprightness as an end in itself, either with a view to reward, if not in this world, in another; or pursued selflessly for its own sake. This concept of religious ethic, which rests ultimately on personal and intimate relationship between the individual soul and its God, has led to the highest idealism in human conduct; but it has also degenerated into many unpleasant forms of exaggerated and distorted continence and self-torture in the monastic, ascetic and mystic conceptions of the holy life.

SCIENCE AND SOCIAL ETHICS

In recent years, there has been much discussion of the ethical or social consequences of the application of mechanical and other scientific discoveries to industry. In the early days of the industrial revolution in England, there was little of the scientific spirit in industry. The discoveries of science were used with as much indifference to science as to humanity. The inventions of the eighteenth and early nineteenth centuries came from the workshop rather than from the scientific laboratory. Machines were devised and operations developed largely by trial and error methods, and academic research had few points of contact with industrial practice. The characteristic of the present age is the utilization in industry of principles, properties, and products revealed by scientific research, whether carried on solely in the pursuit of knowledge or with a practical purpose in mind.

It is sometimes suggested that progressive science and invention are responsible for the troubled condition of the world at the present time, owing largely to over-production. It would be just as reasonable to blame the Almighty for good harvests, or for providing in some parts of the world all the means of existence for primitive man without the need for labour. The fault is not with those who create gifts for men's comfort and enjoyment, but with the social system which prevents their easy distribution and use.

Material progress must be more striking, more patent to observation than is man's ethical and social development; and it is also no more than to be expected that there should be a lag in the latter. It was more than a generation after the initial movement of the industrial revolution in Britain that progress in other directions began to affect the population of the country at large. To anyone who takes long views and compares conditions of to-day with those of a hundred to a hundred and fifty years ago, it must appear a rash statement which characterizes man's progress in that period as one of command over the material resources of the world only. This is to deny certain patent facts. For example, in every department of human life—at any rate, in Great Britain—there has been in that period a stupendous awakening to a sense of social responsibility—a very real development in man's mentality and the growth of society. In effect, it now demands that the latest results of all branches of scientific research, but more especially of those affecting hygiene, both physical and mental, should be applied to the conditions of life of the population as a whole. This is not philanthropy or religion as such in the narrow sense, but arises from a broadening in the conception of the relations and obligations of man to man.

Apart from the mental and moral effect, difficult to gauge, of improved conditions of life, the increased application of the results of scientific research to those conditions has been accompanied by a parallel growth in the sense of responsibility in the community towards every member of that community—the concept that of the wealth of the community a toll must be taken to ensure that from the cradle to the grave each individual member shall be ensured a certain measure of healthy nourishment, opportunity for growth in body and adequate instruction in mind by education to become a useful member of the community, with assurance of medical attention in employment, of a measure of sustenance to the unemployed and of provision for old age.

This is not communism, unless it be communism to admit that I am my brother's keeper; but it is precisely towards this admission that practical

application of the modern science of man is directing mankind, both as an inference from the study of societies of the past and the humbler societies of to-day among primitive peoples, as well as from a diagnosis of the elements which appear to make for progress in modern civilization. It is true that a modern society with a sense of responsibility, but which, it must be admitted, we have not yet fully attained, is only now approaching the position of the primitive group in its sense of responsibility to its members; but the advance, the spiritual progression, lies in the range of that sense of responsibility. Whereas in the primitive form it embraces the members of the blood kin only, or those of the local group within which the members are more or less intimately acquainted, within a modern society it may reach out to embrace all members of a great nation, and possibly, when warring creeds agree to sink their differences, it may extend to all men of good will, to whom the dignity of man as an individual entity transcends racial and political boundaries. When, if ever, that comes to pass, it will be possible to gauge how far man has advanced along the road of ethical as well as material progress.

To many, the way seems long to go. The urge of nationalism and its ideals has diverted the thoughts of peoples—both Fascist and Communist—away from the main stream of human progress into narrower channels in which rocks and rapids threaten at every turn to shipwreck all that is best in civilization. The result is that instead of science having to save modern civilization from being overwhelmed by barbarous hordes, it seems to have provided the means of self-destruction. Man has advanced so little in spiritual evolution that he is just as much a barbarian in his use of aerial bombs and poison gas as he was when his weapons were only clubs and arrows.

Such prostitution of the rich gifts with which modern science has endowed the human race must be condemned by all who see, in the general feelings of civilized people to-day, incipient stages in the development of characteristics which distinguish man from other living creatures. The law of the jungle is that of the battle to the strong, and the race to the swift. It recognizes no right to live except by might; destroys the weak; has no sympathy with suffering; and no sense of the highest human values. In the struggle for existence, man has survived because his physical structure and intelligence have enabled him, individually and in communities, to master the things which would destroy him. His social instincts have at the same time been extended from the family to the tribe, the nation and the empire, and will reach their highest and best when they embrace the world.

that their names may be registered, and at the same time enclosing a remittance of one guinea, which will cover fifty telephone inquiries.

Association of Women Science Teachers

THE annual meeting of the Association of Women Science Teachers was held at Bedford College, London, on January 4 and 5. At the evening meeting, Prof. Allan Ferguson, lecturing on eighteenth century physics, stressed the value of the research of that century's Gargantuans in science, some interesting points of detail not always being known to present-day teachers. At the morning session, the Joint Standing Committee with the Association of Assistant Mistresses (Science Panel) presented its recent General Science Examination Syllabus, containing the maximum of content and topic for examination in general science after a five-year course to school certificate standard in girls' schools. Copies of this syllabus can be obtained on application to the Hon. General Secretary. A discussion was held on new methods of biology teaching, emphasising practical problems with living organisms. Both plants and animals were discussed. It appeared there is less need for the keeping of animals in the school, except occasionally, when the biology is taught from the functional view-point and with reference specially to the mammal. Discussion ensued as to whether there may be consequent application or lack of it, in the pupil's mind, to man. The study of the characteristics of living things based upon exact observational work on plants and animals in school appears to present more practical difficulties in the keeping of living creatures in captivity. Opportunities for visiting a glass factory and a precious metals refinery were welcomed by members. It is announced that the Association proposes to devote a whole day's discussion on March 4, in London, to the Science Masters' Association General Science Report and to the Spens Report in its bearing upon science in the curriculum.

Chinese Red Cross and Chinese Universities

MRS. HALDANE, who has recently returned to London after a visit to China, writes as follows: "I paid a visit to the training centre established by the Chinese Red Cross Medical Commission. This Centre is under the direction of Dr. Robert Lim, formerly professor of physiology in the National University of Peiping. Dr. Lim has temporarily given up his scientific work and has taken in charge the reorganisation and extension of the Chinese Red Cross. . . . In Kunning, formerly known as Yunnan Fu, I had the pleasure of meeting President Chiang, formerly of the National University of Peiping, and his staff; and also President Mei of Tsing Hua University, Peiping, and his colleagues. . . . Premises have been placed at the disposal of the universities by the Yunnan Provincial Government, but although they still have remnants of their former libraries, there is an almost complete dearth of equipment, scientific instruments and other material. The two Presidents and the professors of pure and

applied engineering and biology informed me that they would be deeply grateful if their colleagues in Europe could send them copies of current periodicals, such as the *Proceedings of the Royal Society*, the *Journal of Physiology* and *Biochemical Journal*, physical and engineering journals, etc. If members of the various scientific societies in Great Britain would care to assist either the Chinese Red Cross Society, or Prof. Chiang and Prof. Mei and their staffs, I should be most grateful if they would communicate with me, c/o The China Campaign Committee, Parliament Mansions, Orchard Street, S.W.1. The Committee would be glad to make arrangements to forward either periodicals or money, and to put British scientific or university circles in touch with their Chinese colleagues who at present so badly need their moral encouragement and active assistance."

Earth Tremor at Quetta

ON January 6 at 4h. 43m. (Madras Time), an earth tremor of considerable intensity shook Quetta, in Baluchistan. The shock was of short duration and no damage or casualties are reported. It will be remembered that this district is liable to be visited fairly frequently by earthquakes and that it was visited by a particularly strong one on May 31, 1935, of duration about 30 seconds and having an epicentral tract 68 miles long and 16 miles wide in a direction S. 15° W. from Balali. The epicentre was stated by Sen and Bakshi to be lat. 30° 5' N., long. 66° 5' E., and although the intensity was 10 on the Rossi-Forel scale, road and rail communications were not interrupted, nor was the supply of electric current, so that the intensity was not so great as at Assam in 1897, Kangar in 1905, or Bihar in 1934. No fault movement was apparent at the surface, and as the intensity fell off rapidly from the central region, the focal depth was assumed to be shallow. On that occasion, Kalat, Mastung, several villages and Quetta itself were completely destroyed, and Quetta was sealed for a considerable period owing to the extreme difficulty of the rescue work. The death roll was estimated at 15,000-20,000. The buildings of the new Quetta are of reinforced concrete and brick, and some attention has been paid to earthquake-proof design. They have withstood well the shocks of September and October 1937 and the present earthquake.

Roads and Traffic

IN his presidential address on "Roads and Traffic" to the Junior Institution of Engineers on December 9, Sir Charles Brossy raised many interesting questions the answers to which are not easily found out. He says, for example, that deductions from the most careful traffic observations are apt to be stultified, at any rate in a free country like Great Britain, by the essential fluidity and waywardness of traffic. The installation of traffic lights may lead drivers to make use of hitherto unfrequented side roads, so as to avoid the signals. These vagaries vitiate comparisons, and are particularly disconcerting in

London, where so many alternative streets are available for an intelligent driver. In addition, the science of mechanical engineering advances so rapidly that steep road gradients which render a road unpopular at present may in ten years time offer practically no hindrance to a motor-car. Any attempt to replan an ancient capital must be largely empirical; opportunism must play a leading part. The inertia of habit is a powerful force. Theoretical considerations have to be tempered by common sense based on a general knowledge of London's development and of the improvements which have been carried out or rejected during past years. However carefully the flow of traffic be recorded, we are still at a loss to account for the underlying causes of the waywardness. The mysterious flittings of trade and industry influence the distribution of the nation's population. The advantages of undeviating directness over great distances, unhesitatingly accepted by the Roman road engineers, who were untrammelled by county boundaries and ring fences around estates, would not be accepted implicitly to-day.

Archæological Discoveries on Monte Alban, Mexico

EXCAVATION of the Mixteco-Zapotecan necropolis on Monte Alban, near Oaxaca, Mexico, which has been in progress under the direction of Dr. Alfonso Caso without interruption since 1932, has produced a remarkable assemblage of objects, ornamental and ceremonial, in gold, semi-precious stone, or other material, illustrating the religion, life and customs of these peoples. In large measure the remarkable character of the finds justifies the dictum of the excavator that in the archæological sense this is the most important region in the whole of the Americas, not even excepting the Peruvian site of Cuzco. When one hundred and two tombs had been explored, the site was visited in the course of the past year by General L. Cardenas, President of the Republic. The occasion was marked by the opening of three further tombs, which the President, accompanied by Señor Caso, was the first to enter. The first tomb offered little calling for comment, but the second and third afforded the unexpectedly important and spectacular discovery of series of vivid polychrome frescoes adorning the walls. These depict gods and their symbols, as well as priests in ceremonial garb, sacred and mythological motives, and ritualistic symbols of life and death. In the third tomb, painted figurines were standing in ritual niches, and on the floor was a skeleton, obviously of a great chief, surrounded by a number of funerary objects, axes and knives in obsidian and flint, a green jade statuette of Quetzalcoatl, the Plumed Serpent of the Zapotecs, and a number of domestic and liturgical vessels. The mural decoration is considered to be the most important discovery yet made on Monte Alban. The President was so strongly impressed by the importance of the excavation that not only did he promise a Government subvention in order that the work might be continued, but also ordered an immediate grant of 10,000 piastres (approximately 60,000 francs). A brief account of the discovery and of the frescoes and contents of the tombs by Dr. Núñez y Domínguez,

secretary of the National Museum of Mexico, has recently appeared (*J. Soc. des Americanistes*, N.S., 29, 2).

Insects of Cambridgeshire

A LIMITED number of copies of the "Zoology of Cambridgeshire", the major part of which is occupied by the account of the Insecta, are now available. They are reprinted from the "Victoria County History of Cambridgeshire and the Isle of Ely", vol. 1, pp. 77-245 (1938), reviewed elsewhere in this issue (p. 46). Applications for these reprints, accompanied by a remittance of £1 ls., which covers postage, should be made to the editor, Dr. A. D. Imms, Zoological Laboratory, Cambridge.

Announcements

DR. R. L. SMITH-ROSE has been appointed, as from January 1, superintendent of the Radio Department of the National Physical Laboratory, which includes the Radio Research Station at Slough in addition to the section of the Department at Teddington. Dr. Smith-Rose has been principal scientific officer-in-charge of the Departments since Mr. Watson Watt left the Laboratory in 1936 to take up a position in the Air Ministry.

A BIBLIOGRAPHY on the housing and equipment of school libraries, compiled by Ellen L. Anderson, has been issued by the Office of Education, United States Department of the Interior. The bibliography consists of an annotated and selected list of references intended to show what schools have done for their libraries and to give concrete suggestions to those interested in starting a school library or in improving an old one. The list is limited to the physical aspects of the library and administration.

IN NATURE of December 24, p. 1130, in an article on "Future Developments in Coal Treatment and Utilisation", reference was made to a paper by Prof. A. O. G. Egerton and to experimental work described by Mr. Armstrong. Mr. Armstrong was said to be a research student from South Africa. We are informed that this is incorrect; Mr. Armstrong is from New Zealand.

THE National Research Council of Canada, Ottawa, announces the forthcoming publication in book form of a scientific account of a comprehensive study on the effect of sulphur dioxide on vegetation. The book covers an investigation carried out under the auspices of the National Research Council during the period 1929-38 on the effect on vegetation in Northern Stevens County, Washington, of sulphur dioxide from the large metallurgical plant at Trail, B.C., and also elaborate experiments planned to elucidate the many questions which arose in connection with the investigation.

ERRATUM.—NATURE, January 7, p. 34, article entitled "Structure of Proteins", col. 2, paragraph 2, last line, for "marked" read "masked".

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 80.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Patterson Diagrams in Crystal Analysis

LETTERS on the interpretation of Patterson Fourier syntheses (vector maps) have recently appeared in NATURE^{1,2,3}. Is not the claim made or implied in these letters, that a new method of interpretation has been discovered, due to a misapprehension concerning the existing methods of crystal analysis?

What may be termed the classical method of crystal analysis, which has successfully elucidated numerous structures, is briefly as follows. Observations are made of the intensities of a number of X-ray spectra or reflections from crystal planes. The unit cell and symmetry scheme of the crystal is determined, and the composition and density of the crystal indicate the number of atoms of each kind in the unit cell. The efficiency with which the individual atoms scatter X-rays through various angles can be deduced from the known distribution of electron density around each atomic centre. The investigator then has the problem of adjusting the positions of the atoms in the unit cell until he hits on an arrangement which explains the intensities of the observed spectra. The atomic positions are fixed by a finite number of co-ordinates (parameters) and it is his task to assign values to these parameters. Given a sufficiently extensive set of observations of intensities, no reasonable doubt can be entertained that a solution which explains these observations is unique.

In the second paragraph of his letter², Prof. E. H. Neville outlines an argument which purports to demonstrate that substantial reconstruction of the crystal structure is theoretically impossible, since the observations may correspond to an infinity of solutions, and then proceeds to combat this view. I do not know from what source he got the impression that such a view has ever been expressed or could possibly be held by anyone who is acquainted with the methods of crystal analysis. If the distribution of scattering matter within the unit cell could have any general form, the problem would of course be indeterminate; but in actual fact we know the scattering matter to be clustered in a characteristic way around a finite number of atomic centres; this makes the solution unique. This has been the basis of crystal analysis for the last twenty-five years, and is so well known that it is generally taken for granted and not specifically referred to in recent work, which perhaps explains how Prof. Neville's misapprehension has arisen.

The elegant Fourier series methods now so widely used have been summarized in the recent letters, and need only be very briefly outlined here. The distribution of scattering matter in the crystal cell may be represented by the sum of a three-dimensional Fourier series. X-ray measurements determine the amplitudes of the terms of this series, but not the

phases. Hence the observations do not lead directly to a solution by straightforward Fourier summation. The problem is simplified by the fact that in most cases one is dealing with a projection of the structure which has centres of symmetry. In such a case the uncertainty of phase reduces to one of plus or minus sign, since each term must have a crest or a trough at each centre of symmetry. A common method of procedure is to get by trial and error a first approximation to the structure which decides the signs of the more important Fourier terms, and then by summing the Fourier series with these terms to get a better idea of the atomic distribution, which enables more signs in turn to be fixed. Two or three such stages of approximation complete the structural determination. In special cases, other methods of fixing the signs can be used. The basis of this procedure is again our knowledge that the scattering matter is concentrated around a finite number of atomic centres as explained above.

The Patterson synthesis⁴ or vector map does not demand a knowledge of phases, because the coefficients of its Fourier series are proportional to measured intensities, not amplitudes. The density in a Patterson projection at the end of a vector drawn from the origin represents the integration over the unit cell of the product of densities at all pairs of points in the crystal structure which have that vector relationship. Patterson sections can also be constructed.

Since a Patterson diagram can be directly constructed from the observations and summarizes all the measurements in a graphic way, it has certain very attractive features. It is a comparatively novel method, and it is highly important to explore ways of using it to deduce the crystal structure. Papers by Beevers and Schwartz⁵, Lipson⁶, Gaskell⁷, Goodwin and Hardy⁸ and Wells⁹ may be quoted as examples where it has already been successfully employed. In most of these cases there are certain outstandingly heavy atoms in the crystal structure, and the relative positions of these atoms can be deduced from the positions of peaks in the Patterson diagram. These heavy atoms are so important in fixing the signs of the Fourier terms that the analysis can then be completed. The 'geometrical method' proposed by Wrinch, which Prof. Neville claims 'has opened a new chapter in crystal analysis', is essentially the same as that used in these and other investigations.

Experience with Patterson diagrams brings home to one, however, the very great difficulty of interpreting them owing to their complexity. Dr. Wrinch gives an example¹⁰ of the relation between point diagram and vector diagram to show how the first can be deduced from the second, but the idealized case she takes is so extremely simple that any method of analysis would immediately succeed. If we compare the density distribution (point diagram) and

Patterson (vector diagram) for a moderately complex case such as an aromatic molecule, it is quite difficult to trace the relationship even when the structure has been determined and we know the answer to the problem set by the Patterson. Not only the relative positions within the molecule, but also those of atoms in neighbouring molecules related by the symmetry elements, are represented by superimposed diffuse peaks in the Patterson, and these combine in such a way that it is extremely hard to unravel the tangle.

The molecule of a protein such as insulin, for which Crowfoot¹ gives Patterson diagrams, is of a much higher order of complexity than an aromatic molecule containing a few benzene rings; it is far beyond anything as yet analysed by X-rays. Experience with the difficulty of interpreting the Patterson of simpler molecules warns us to be extremely cautious in basing conclusions upon the diagram of insulin. I would not venture to suggest that analysis is a hopeless task; on the contrary, there is every hope of ultimate success, for aromatic molecules seemed hopeless problems not many years ago, and their analysis is now almost a matter of routine. I would plead, however, for a due sense of proportion. Langmuir and Wrinch claim that the main features of the Crowfoot diagram can be explained by a certain concentration of scattering matter in a simple way at a few typical points in the molecule. If this claim is substantiated, it affords a useful hint as to one possible solution; but whether it is unique depends, as in all cases of X-ray analysis, on the justification for the assumptions which are made. In simple structures, we are on sure ground, for we know the scattering units to be a finite number of atoms. In a protein, the assumptions must as yet be vague and provisional. Exaggerated claims as to the novelty of the geometrical method of approach and the certainty with which a proposed detailed model is confirmed are only too likely, at this stage, to bring discredit upon the patient work which has placed the analysis of simpler structures upon a sure foundation.

W. L. BRAGG.

Cavendish Laboratory,
Cambridge.
Jan. 4.

¹ NATURE, 143, 581 (1938).

² NATURE, 143, 585 (1938).

³ NATURE, 143, 994 (1938).

⁴ Phys. Rev., 46, 372 (1934).

⁵ S. Krist., 91, 157 (1935).

⁶ Proc. Roy. Soc., A, 186, 402 (1936).

⁷ S. Krist., 93, 203 (1937).

⁸ Proc. Roy. Soc., A, 184, 509 (1938).

⁹ Proc. Roy. Soc., A, 187, 169 (1938).

¹⁰ Proc. Roy. Soc., A, 164, 580 (1938).

Vector Maps and the Cyclol Hypothesis

IN recent issues of NATURE, letters have appeared in which claims of a new method of analysis of Patterson vector diagrams are put forward with particular reference to those of crystalline insulin¹. Substantially this method is not new to crystallographers; it is implied in Patterson's original paper in 1934², has been used in a number of published analyses³, and has been taught to students in Cambridge for the past three years.

What is new, however, is the use of certain additional assumptions and their application to cases

where they are of extremely dubious validity. Thus the substitution, suggested in Prof. E. H. Neville's letter, of points for peaks in the Patterson vector map, and the subsequent attempt to find a point system to which this vector map corresponds, is not a reliable procedure in the analysis of complex crystals. The maxima in the vector map can only be assumed to correspond in position to steps between regions for which the electronic density ρ is a maximum if the maxima of ρ are sharp and the vectors between them are distinguishably different. While these conditions hold for simple structures where each peak stands for one atom, they cannot be assumed to do so for compounds as complicated as the proteins and here, therefore, much greater caution would seem to be required. Even if, however, we make this simplifying assumption and are prepared to treat as a geometrical point a group which we know to be composed of some hundred atoms, far greater ambiguity exists than might be imagined from reading Dr. D. M. Wrinch's papers⁴.

In analysing the insulin structure on the basis of the X-ray evidence, there are two possible courses of procedure; that of discovering the maximum information that can be deduced from the position and relative intensity of the peaks on the Patterson diagram; and that of building an *a priori* model structure and attempting with it to account for the observed pattern. The first method, which I have described in a recent discussion on protein structure and which will be published in detail elsewhere, leads to a family of solutions obtainable by attributing different weights to the seven symmetrically distinct points in a hexagonal packing of two layers. A large number of these give no worse fits than the particular case which Dr. Wrinch claims as the unique solution. None of them, however, gives a complete fit, and to discriminate between them would appear, for lack of further experimental evidence, to present considerable difficulties.

The second method is one often employed in crystal analysis, but until now only for relatively simple structures. Its likelihood of success depends very largely on the possibility of selecting on the basis of chemical knowledge a structure which has a finite probability of being near to the true one. In the case of the protein this task is one of enormous difficulty, but Dr. Wrinch claims to have accomplished it with her cyclol cage model. In judging its *a priori* plausibility, two features need to be borne in mind; first, that it involves the assumption of a four-linked instead of a two-linked amino acid residue, for which no chemical evidence has been put forward and which, as Prof. Bergman⁵ and Dr. Neuburger⁶ have pointed out, is open to grave objections on chemical grounds; secondly, that it is only one arrangement, though admittedly a simple and symmetrical one, out of the multiple possibilities of arrangements of such four-linked residues. Nevertheless, if the proposed structure were found to account for the X-ray data, Dr. Wrinch would have a *prima facie* case for its acceptance.

To what extent, however, does it account for the X-ray data? Vector maps of Dr. Wrinch's hypothetical cyclol structure bear no resemblance to those which have been derived by Miss Crowfoot from her observations⁷. The distribution of atoms in the cyclol skeleton is far too continuous to give rise to any definite peaks, and no distribution of side chains can do other than increase the blurring of the picture. Dr. Wrinch has not however used the vector map of

the cyclol skeleton. Instead of this, she has chosen certain density concentrations, which are treated as positive and negative point scattering centres, for the construction of the vector diagrams. It is difficult to see on what principle in relation to the structure these centres have been chosen. Two of the strongest of them are completely arbitrary and another is attributed to a zinc atom the 28 electrons of which would scarcely seem effective scattering centres in a molecule with 20,000 electrons.

Even if the selected points led to the observed Patterson diagram, this would not prove the correctness of the cyclol structure, as the characteristic pattern is not involved in deriving them. At the most it would show that the cyclol model had been a useful working hypothesis for arriving at a structure based on scattering centres which might have very different physical structure. It is, however, certain that it does not do so. Out of the possible 3,600 vectors between scattering centres which this model would provide for the vector map, only thirteen are published in Dr. Winch's paper, but the selection is almost completely arbitrary as it contains vectors corresponding to weak pairs of scattering centres while many corresponding to strong pairs are omitted. It is stated that this omission makes no difference to the general agreement with the observed vector maps; but this is demonstrably incorrect, for a basal projection using *all* the vectors from the stronger scattering centres shows a pattern in which all resemblance with the observed vector map has vanished.

*In view of this, it can fairly be claimed that the scattering centre model derived from the cyclol hypothesis fails completely to account for the X-ray evidence for insulin, and further that the cyclol model itself leads to results incompatible with that evidence. In rejecting it, therefore, it is not necessary, however desirable, to put forward another model—the problem still remains an open one. Such a result is disappointing, but the discussion to which this attempt has given rise will not be wasted if it focuses attention on the need for an active collaboration of physicists and chemists in a concentrated attack on the structure of the protein molecule.

J. D. BERNAL.

Birkbeck College,
London, E.C.4.
Dec. 21.

¹ NATURE, 142, 955 (1938).

² Phys. Rev., 45, 372 (1934). *Z. Krist.*, 90, 517 (1935).

³ For example, Fankuchen, I., *Z. Krist.*, A, 94, 212 (1936) Gaskell, T. F., *Z. Krist.*, A, 98, 203 (1937). Wells, A. F., *Proc. Roy. Soc.*, A, 167, 169 (1938).

⁴ Winch and Langmuir, *J. Amer. Chem. Soc.*, 60, 2274 (1938). Langmuir and Winch, NATURE, 142, 581 (1938).

⁵ "Annual Review of Biochemistry" (1937)

⁶ Royal Society Discussion on Protein Structure, November 1938.

⁷ Crowfoot, *Proc. Roy. Soc.*, A, 164, 580 (1938).

Vector Maps and Heavy Atoms in Crystal Analysis and the Insulin Structure

CONSIDERABLE discussion has recently been devoted to the use of vector maps in crystal analysis¹ based on the Patterson method². Although much use has been made of this method in the insulin structure³, the complexity of the problem and the inadequacy of the existing X-ray data to yield a solution in terms of atomic positions do not appear to have been sufficiently emphasized. It is quite obvious that fifty-nine relative measurements of amplitude cannot

define a structure consisting of several thousand atoms. So far as these measurements go, the structure is effectively a continuous distribution of scattering matter, and every arbitrary assignment of phase constants to the amplitudes will yield a solution. As individual atoms cannot appear in any of these solutions, there does not seem to be any rigid criterion in favour of one any more than another. The Patterson maps, which summarize the X-ray measurements, do not remove this ambiguity because, for a similar reason, we do not know what meaning to attach to the peaks in these maps. The suggestion that certain concentrations of atoms in the molecule can be treated as point scattering sources does not seem to constitute even a reasonable approximation. As no large gaps between the atoms are likely, it may also be very difficult to distinguish between regions of high and low density which are due to real features in the structure, and those which are due to unavoidable deficiencies in the series representing it.

The situation must be sharply contrasted with that of the more simple organic molecules, containing up to about forty atoms, which have been successfully analysed by the X-ray method. In these, the number of observed amplitudes is always very much greater than the number of co-ordinates defining the positions of the atoms, and an exact solution becomes feasible. It is accepted if it outlines the number of separate atoms required by chemical analysis, and if each of these atoms shows its expected scattering power for X-rays.

Even in these relatively simple organic structures (20–40 atoms), the Patterson method has not so far proved very helpful, in spite of its great power and usefulness where only a few atoms are concerned⁴. This is partly due to the difficulty of analysing structures where all the atoms (except hydrogen) have nearly the same scattering power for X-rays. A vast number of inter-atomic vectors results, all nearly equally important, while those which are prominent are frequently due to chance concurrences.

For many organic structures, a more powerful method of attack is available, and has recently been extensively developed and studied^{5,6}. By chemical methods a heavy atom can often be inserted in an organic molecule the structure of which has to be determined. Co-ordinated complexes with metal atoms are sometimes easy to make, and with unsaturated compounds, alcohols, acids and certain weak bases, it is in general possible to insert a heavy halogen.

Stated very briefly, the effect of an atom of high scattering power in a complex structure is to translate the unknown phase differences of the X-ray reflections into differences of amplitude which can be measured. In terms of the Patterson method, the vectors between the light atoms become unimportant, and we obtain only the vectors connecting the heavy atom to each of the light atoms—in other words, we get the actual structure directly, instead of its vector representation.

The method must be adjusted to particular cases. When several heavy atoms are involved, their relative positions may be deduced from a preliminary Patterson analysis. With an origin related to these atoms, a subsequent analysis employing the phase constants due to these atoms may then reveal the finer detail. In an isomorphous series, still better results may be obtained from the differential effect of substituting successively heavier atoms^{7,8}.

One very important point is that the swamping effect of a heavy atom on the contributions from the

lighter atoms does not depend very much on the size of the molecule, or the number of these lighter atoms, provided that (as is generally the case for organic molecular structures) there is no definite integral relationship between such intra-molecular periodicities as may exist and the cell dimensions of the crystal. As the molecule gets larger, the geometrical structure factors on the average depart further from their possible maxima. The contributions from the various atoms tend to cancel each other out, and we are left with a small residual. This is, in fact, one of the essential difficulties in analysing a complex structure by trial. A comparatively small change in the structure may mean a big change in these small residuals. But the contribution from the heavy atom is constant and will continue to dominate the situation. In a recent example⁶, a nickel atom, representing only about 10 per cent of the total molecular weight, was found to determine practically all the phase constants.

It may be going too far to suggest that the insulin structure could be determined in this way. The molecule does, however, contain a few zinc atoms, and if these could be replaced by mercury, as has been suggested, a very profitable study might ensue. Of course there are formidable difficulties. If the reflections are swamped in the manner described, much greater accuracy is required in the intensity determinations to reveal the small differences. In the same way, a higher numerical accuracy is required in the calculations to reveal the minor maxima and differentiate them from spurious effects. Recent results have shown that these difficulties can be overcome in a moderately complex molecular structure⁷.

J. MONTEATH ROBERTSON.

Davy Faraday Laboratory,
Royal Institution, London, W.1.

Dec. 28.

¹ Langmuir and Wrinch, *NATURE*, **142**, 581 (1938); Wrinch, *NATURE*, **142**, 965 (1938); Neville, *NATURE*, **142**, 904 (1938).

² Patterson, *S. Krist.*, **90**, 517 (1935).

³ Crowfoot, *Proc. Roy. Soc., A*, **104**, 580 (1938).

⁴ Harker, *J. Chem. Phys.*, **4**, 381 (1936); Llewellyn, Cox and Goodwin, *J. Chem. Soc.*, 883 (1937).

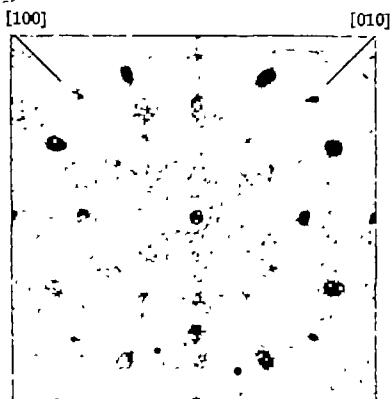
⁵ Robertson, *J. Chem. Soc.*, 615 (1935); 1195 (1936).

⁶ Robertson and Woodward, *J. Chem. Soc.*, 319 (1937).

⁷ Robertson and Woodward, *J. Chem. Soc.*, (1939, in preparation).

A Temperature Effect in Laue Photographs

DURING a study of age-hardening in single crystals of aluminium containing 4 per cent copper, certain anomalies in the Laue photographs were noticed¹.



Aluminium at 20° C.



Aluminium at 550° C.

Some of these were associated with the progress of hardening, but others appeared to be due to another cause. Further investigation showed the presence on the Laue photographs of single crystals of aluminium, of certain faint streaks also observed in photographs of the alloy. When photographed at 550° C., the intensity of these streaks or ill-defined spots greatly increased. Similar effects were observed in sodium chloride and magnesium oxide. The effect observed in sodium chloride at room temperature has already been noted by Wadlund², and an explanation of its origin given by Zachariasen³. The fact that the effect becomes much more intense when the temperature is raised suggests that it is due to thermal vibrations of the lattice. In diamond at 500° C. a faint effect similar to that obtained with the other crystals is present, although little is to be seen at room temperature.

The photographs reproduced herewith illustrate the effect in aluminium. The X-ray beam is parallel to (001) and (110) is vertical; they were taken with a silver target with 60 kv. peak on the tube. The intense spots near the centre are largely due to the silver characteristic radiation, and have also been recorded with monochromatic radiation yielding a 'cross grating' pattern in which the spots have indexes (20) and (81).

G. D. PRESTON.

Metallurgy Department,
National Physical Laboratory,
Teddington, Middlesex.
Dec. 8.

¹ *NATURE*, **142**, 569 (1938).

² *Phys. Rev.*, **52**, 843 (1938).

³ *Phys. Rev.*, **52**, 844 (1938).

Flavo-Protein of the Heart Muscle Tissue

I HAVE shown previously¹ that the coenzyme of the *D*-amino-acid oxidase is present not only in liver and kidney tissues, which exhibit the *D*-amino acid oxidase activity, but also in skeletal and heart muscles devoid of this enzyme. If washed muscle tissue is added to the alanine test (coenzyme-free *D*-amino acid oxidase and alanine), no oxygen uptake is detected. If, however, the extract of a boiled washed muscle suspension is added to the test, vigorous oxygen uptake takes place. It is clear that the coenzyme of the *D*-amino acid oxidase, a flavin compound, is present in a bound form, probably as the prosthetic group of a hitherto unknown enzyme.

When cytochrome oxidase is prepared according to the method of Keilin and Hartree², it is found that the flavin nucleotide follows the cytochrome oxidase and the group of insoluble dehydrogenases. I have now found that a flavo-protein can be extracted from such muscle preparations by the action of dilute alcohol and salt solution. Following this extraction, the flavo-protein has been gradually purified to a flavin phosphate content of 0.65 per cent. This new flavo-protein can be regarded as practically pure,

considering that 0.7 per cent of flavin phosphate found by Haas² in his flavo-protein from yeast is the highest flavin content so far obtained.

The new flavo-protein is readily soluble in distilled water, giving a greenish yellow solution. The prosthetic group can replace quantitatively the coenzyme of the *D*-amino-acid oxidase and is considered to be the same compound.

The details of the purification will be given elsewhere.

F. B. STRAUB.

Moltano Institute,
University of Cambridge.
Dec. 6.

¹ Straub, F. B., *NATURE*, 141, 503 (1938).

² Kellin, D., and Hartree, E. F., *Proc. Roy. Soc., B*, 135, 171 (1938).

³ Haas, B., *Biochem. Z.*, 303, 373 (1938).

Sulphanilamides and Rabies

HITHERTO, chemotherapy has seldom been successful in virus diseases, but the use of sulphanilamides in lymphogranuloma inguinale¹, choriomeningitis², and trachoma³ has opened new possibilities in this field during the past year. There is, so far, no record of experimental work giving favourable results in the chemotherapy of rabies, however, and from an observation in Khartoum, the sulphanilamides appear to have no effect in this condition.

Four rabbits, of approximately equal size and weight, were infected subdurally with an emulsion of fixed virus (Paris strain), and three of these were given 1 c.c. Promotil Soluble daily by the intravenous route for the following six days. The fourth was kept as a control, although this virus has never failed in Khartoum to produce paralytic rabies in six to seven days during numerous passages through sheep and rabbits since 1935, when it was obtained from the Public Health Laboratories in Jerusalem. By the seventh day all four rabbits were moribund, with typical signs of paralytic rabies, and were killed. No difference could be observed between the treated animals and the control, either in the incubation period or in any other feature of the disease.

R. KIRK.

Stack Medical Research Laboratories,
Khartoum,
Anglo-Egyptian Sudan.
Dec. 13.

¹ MacCallum, R. O., and Findlay, G. M., *Lancet*, 126 (1938).

² Neal, J. B., *J. Amer. Med. Assoc.*, 3, 1253 (1938).

³ Kirk, R., McKelvie, A. R., and Hummel, H. A., *Lancet*, 904 (1938).

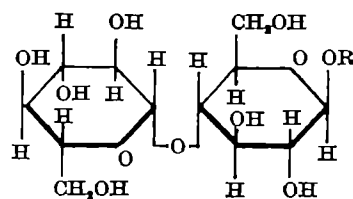
Immunity to Experimental Pneumococcus Infection with an Artificial Antigen

FOR the past few years, we have been engaged in this laboratory in studying the factors which govern the immunological specificity of carbohydrates. This problem has been approached by an investigation of the chemical structure of the specific bacterial polysaccharides themselves and by a study of the immunological properties of artificial antigens prepared by combining the aminophenol or benzyl glycosides of saccharides of known structure with protein. The latter method has been of particular value in revealing certain of the fundamental factors which govern the specificity of carbohydrates. The stereochemical configuration of simple hexoses¹, the

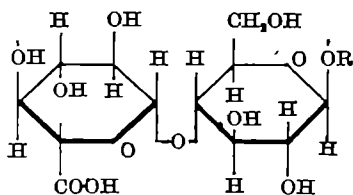
configuration of intramolecular linkages of disaccharides and the position of such linkages² are all important determinants in orienting the specificities of these saccharides. More recently it has been found that the conversion of the primary alcohol group of a hexose to the carboxyl group likewise alters the immunological properties of artificial antigens containing the hexoses, as opposed to those containing the hexose uronic acids³.

Although antigens containing the hexose-uronic acids possess certain of the serological characteristics of the specific pneumococcus polysaccharides, for they precipitate in high dilutions in anti-pneumococcal horse sera of various types, it has as yet not been possible to produce anti-pneumococcal immunity by injecting animals with the glucuronic and galacturonic acid antigens. The reason probably is due to the fact that the hexose uronic acids do not approximate closely enough in structure to the more complex building stones of certain of the pneumococcus polysaccharides, the aldobionic acids. These observations have led to the belief that in order to evoke anti-pneumococcal immunity in experimental animals with an artificial antigen, it is not necessary to have as the immuno-specific group a long-chained type specific polysaccharide, but that a simpler saccharide, the pattern unit from which the polysaccharide is constituted, should suffice.

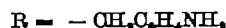
An artificial antigen has therefore been prepared by combining the diazonium derivative of the *p*-amino benzyl glycoside of cellobiuronic acid, the aldobionic acid from which the Type III pneumococcus polysaccharide is constituted⁴, with horse serum globulin⁵. For purposes of comparison, a similar antigen containing the corresponding glycoside of cellobiose has also been prepared. The chemical structure of the cellobioside and cellobiuronide is identical save for the grouping occupying the 12th position, as can be seen from the accompanying graphic formulae.



p-aminobenzyl β -cellobioside



p-aminobenzyl β -cellobiuronide



This difference in chemical structure suffices, however, to confer on each antigen containing the glycosides vastly different immunological properties. The sera of rabbits injected with the cellobiuronic antigen precipitate the Type III pneumococcus specific polysaccharide, agglutinate Type III pneumococci, and produce a typical swelling of the capsule when living Type III organisms are mixed with the anti-serum.

Furthermore, the cellobiuronic acid antisera confer passive protection on mice against infection with virulent Types II, III and VIII pneumococci. The animals injected with the artificial cellobiuronic acid antigen acquire active resistance to infection with virulent Type III pneumococci as well. The sera of rabbits injected with the cellobiose antigen, on the other hand, exhibit none of these phenomena, nor are the rabbits themselves resistant to Type III pneumococcal infections.

These experiments demonstrate that cellobiuronic acid has an important immunochemical function in determining the immunological properties of Types II, III and VIII pneumococci. It is apparent, furthermore, that antibacterial immunity can be evoked by injecting experimental animals with an artificial antigen containing as the immuno specific group the pattern unit of the polysaccharide rather than the intact carbohydrate itself. The results of these experimental studies have brought forth still a new and important principle. Whereas an antigen containing the complex bacterial carbohydrate of Type III pneumococcus gives rise to antibodies which are type specific, those elicited by the antigen containing the pattern unit, or aldobionic acid, exhibit broader specificity and afford passive protection in mice against infection with Types II and VIII pneumococci as well.

In 1936, I described at the Second International Congress for Microbiology in London the synthesis of two aldobionic acids, asciabiuronic and gentiobiuronic acids¹. Whether these synthetic saccharides, when combined with protein, will evoke antibacterial immunity in experimental animals is a problem under investigation at the present time.

WALTER F. GOEBEL.

Hospital of the Rockefeller Institute
for Medical Research,
New York.
Nov. 21.

¹ Goebel, W. F., and Avery, O. T., *J. Exp. Med.*, **50**, 521, 533 (1929).

² Goebel, W. F., Avery, O. T., and Babers, F. H., *J. Exp. Med.*, **60**, 599 (1934).

³ Goebel, W. F., *J. Exp. Med.*, **68**, 29 (1936); Goebel, W. F., and Hotchkiss, R. D., *J. Exp. Med.*, **68**, 191 (1937).

⁴ Haselberger, M., and Goebel, W. F., *J. Biol. Chem.*, **70**, 613 (1936); Hotchkiss, R. D., and Goebel, W. F., *J. Biol. Chem.*, **121**, 195 (1937).

⁵ Goebel, W. F., *J. Exp. Med.*, **68**, 469 (1938).

⁶ Avery, O. T., and Goebel, W. F., *J. Exp. Med.*, **54**, 437 (1931).

⁷ Report of Proceedings, Second International Congress for Microbiology, London, 1937, p. 434; Hotchkiss, R. D., and Goebel, W. F., *J. Biol. Chem.*, **118**, 235 (1936); Goebel, W. F., and Reeves, R. B., *J. Biol. Chem.* (1938).

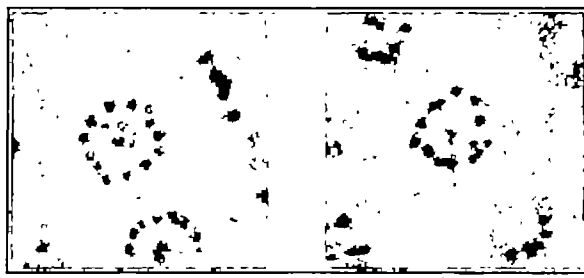
Chromosomes of *Cimex*

THE conclusions drawn from the numbers of chromosomes found during spermatogenesis in *Cimex spp.*¹ require considerable modification as a result of the examination of further material. New evidence of the nature of the variable elements and of their numerical range has given a different aspect to the problem.

In three wild populations of *C. lectularius*, including the type previously considered to be a sub-species², 13 autosome pairs are constantly present and behave normally, also observed by Darlington³. They divide reductionally at the first meiotic division and equationally at the second, forming an equatorial ring at metaphase. Within this ring lies a group of elements which have divided equationally at the

first division. Variation in chromosome number is due to variation within this group. A continuous series of modal values from 8 to 16 has been found in different individuals, with a maximum deviation from the mode of ± 3 in any one individual.

This central group contains the sex chromosomes, one of which, distinguished by its shape, staining capacity and position, is present in every second metaphase complement. From the frequent secondary pairing of this chromosome with two others of the central group, I am of the opinion that the male *C. lectularius* has an XXY sex mechanism. Comparison with the karyo-type of *C. rotundatus* supports this view, for in this species all the nuclei which have been examined invariably showed 14 pairs of autosomes and three sex chromosomes, with no other central elements.



SECOND METAPHASE FIGURES OF (a) *C. lectularius*,
(b) *C. rotundatus*.

In *C. lectularius* the variations in chromosome number that have been observed seem to be due to unequal division at first anaphase and unequal segregation at second anaphase of a group of inert chromosomes, possibly related to the sex chromosomes. The first division results in variation of chromosome complements in the same individual, the second division produces variations between individuals. From counts of two nuclei there is evidence that the female possesses a similar chromosome constitution. These phenomena I intend to analyse in greater detail in a future publication.

H. D. SLACK.

Zoology Department,
University of Glasgow.
Dec. 2.

¹ Slack, H. D., *NATURE*, **142**, 358 (1938).

² Darlington, C. D., unpublished.

Irritant Exudation from a Centipede

MR. E. BURT's experience¹ with the East African millipede *Spirobolus* reminds me of an incident with the Melanesian centipede, *Scolopendra*, in the Solomon Islands.

An individual about seven inches in length was picked up with a pair of entomological forceps, care being taken to see that none of the poison from the large mandibles reached the skin. Some of the twenty or so pairs of legs did touch my hand, as a consequence of which the back of the hand had a painful numbness for the rest of that evening and during the same night. Although this irritation was clearly not comparable in intensity with that caused by the

repugnatorial glands of the millipede, it seems worth recording, as F. G. Sinclair¹ refers only to the mandibular poison in the Chilopoda, which would seem to have, at least in the genus *Scolopendra*, a strong irritant in the paired appendages.

R. A. LEVER.

Suva,
Fiji.
Nov. 28.

¹ NATURE, 148, 796 (1938).

² "Cambridge Natural History", vol. 5 (1905).

• Soil Erosion in England

DURING the past few years, the possibilities of soil erosion in Great Britain have been in question owing to the immense loss of good farmland in large areas of the United States, Canada, and many tropical countries as the result of the exhaustive systems of farming carried on during past years. The very heavy rainfall of exceptional intensity on two days this autumn in Devon has enabled us to obtain some idea of the possible intensity of soil erosion under the systems of cultivation of south-west England.

On August 4, 3.90 in. of rain were recorded at Totnes between 2.30 a.m. and 9 a.m. G.M.T., and on November 26, 1.24 in. were recorded between 6.15 p.m. and 7.35 p.m. G.M.T. and a further 1.67 in. between 11 p.m. (26) and 9 a.m. (27) G.M.T. The exact duration of the second storm is not known, although it probably lasted only about 1½ hours. Robinson¹ states that the rate of erosion of soil by running water depends principally on four factors, namely: (1) the amount and intensity of the rainfall; (2) the angle of slope; (3) the presence or absence of a vegetative cover, and, if present, its character; and (4) the nature of the soil itself. Under the conditions experienced in Devon, sheet erosion alone took place on most slopes up to about 1 in 10, while no gully erosion was found on slopes of less than about 1 in 6. The amount of possible erosion was restricted owing to the high proportion of grassland in this part of the country. Very good protection was also given by thick and high cover crops, such as wheat, oats and marrow-stem kale. Even a thin covering of weeds afforded quite good protection from erosion; but root crops gave little or none, and even appeared in some places to encourage gullying.

Severe gullying occurred on farms on the fringe of Dartmoor, while the most marked instances of soil erosion off the Moor were found on the red conglomerate soils derived from Permian breccia in the Paignton district and on a dark soil derived from Middle Devonian shales and tuffs.

The work of Bennett in the United States² tends to show that soils the clay fractions of which have high $\text{SiO}_2/\text{R}_2\text{O}_3$ ratios are erosive, and that there is a critical ratio at 2. The $\text{SiO}_2/\text{R}_2\text{O}_3$ ratios of the clay fractions of the surface horizons of the two Devon soils mentioned are 1.98 and 1.90 respectively. The average ratio for most of the cultivated surface soils in Devon is about 1.6, which tends to show that most of them have been eroded in past times and have now settled down under cultivation to a comparatively stable condition, as have those of North Wales, where the climate is very similar to that in south Devon. The recent observations, however, seem to show that this state is due largely to the

type of agriculture practised in the region, and that a return to predominantly arable conditions in the hilly country might result in the impoverishment of soils by erosion.

J. B. E. PATTERSON.

The Laboratory,
Dartington Hall Trustees,
Totnes, S. Devon.
Dec. 15.

¹ Robinson, G. W., "Soils: Their Origin, Constitution and Classification" (Second edition. Murby 1936) p. 63.

² Bennett, H. H., *Soil Sci.*, 21, 349 (1936).

³ Robinson, G. W., *J. Agric. Sci.*, 20, 618 (1937).

A School of Whale Sharks in the Bahama Islands

FOR years I have received newspaper clippings and second-hand verbal recitals of whale sharks seen off the west side of the Bahamas. Much effort was made to verify these, but for a long time I had no evidence of scientific value. However, in July 1938, there came to me authentic data concerning a specimen seen off Bimini, and shortly thereafter I published a faunal record for *Rhinochondrion* in the Bahamas¹.

In my studies of the distribution of the whale shark, I have long had the aid of the U.S. Hydrographic Office. It has asked ships' officers for reports of their observations all over the world of this great shark. These reports can be very definitely made because of the great size of the shark, its broad head and terminal mouth, and the chequer-board arrangement of bars and spots on the sides makes its identification easy. The latest report to the Hydrographic Office was from Mr. E. R. Fenimore Johnson of Camden, New Jersey, U.S.A.

On June 3, 1938, Mr. Johnson, in his ketch *Elsie Fenimore*, ran into a school of about twelve whale sharks in lat. $24^{\circ} 32' \text{ N.}$ and long. $77^{\circ} 37' \text{ W.}$, about four miles east of Sugar Cay, in the "Tongue of the Ocean". The school was under observation for nearly an hour and, the sea being fairly smooth and the sharks close to the boat, Mr. Johnson made careful notes of the behaviour of the fish and took some 200 ft. of moving-picture film of various individuals as they swam around the vessel.

Being without fear, these sharks swam so close to the boat that "We could easily have jumped astride their backs"—an observation which parallels Dr. William Beebe's off Cape San Lucas, Lower California. Mr. Johnson adds, "We ran into one fish, but he did not seem greatly upset, and his efforts to get clear were quite sluggish". This also is what has been reported by many others. The fish has no enemies, and is not afraid of a man or a boat.

The school was made up of a dozen individuals ranging in length from about 18 ft. to about 31 ft. The school had no formation, but was spread out irregularly over an area of about a quarter of a mile square. The fish did not seem to be going anywhere, and an individual shark would swim over a small area and would turn and go over it again as if hunting for something. Mr. Johnson courteously loaned me the film showing this behaviour. Close study of it convinced me that the fish were feeding by swimming about with their wide terminal mouths partly open. When asked about this, Mr. Johnson gave me definite information.

These were engaged in feeding. A fish would swim for an interval of one or two minutes with its mouth open and with its upper jaw about even with the

surface of the water. It always had its dorsal fin and the upper lobe of its tail fin well out of water. Then the fish would dive to a shallow depth for a short interval and would come to the surface and repeat the manoeuvre. The water was examined by naked eye, but was found to contain only scattered jelly fish about 15 mm. in diameter.

I have long conjectured that *Rhincodon* feeds by swimming at the surface of the water with open mouth, that small organisms are strained out by the sieve-like gill structures and that the water passes out through the gill-openings. Mr. Johnson is fortunate in being the first observer to witness this manner of feeding and to photograph the fish in the act.

E. W. GUDGER.

American Museum of Natural History,
New York.
Nov. 29.

¹ *Science*, 84, 227 (1936).

Sound Absorption of Snow

THE impressive and all-pervading quietness following a fall of snow is a commonplace experience, though, so far as we are aware, no measurements of the sound absorption of snow have been published. The recent cold spell provided a suitable opportunity to make such measurements in the reverberation chamber of the National Physical Laboratory.

Two specimens of freshly fallen snow were tested, each measuring 10 feet square, one approximately 1 inch thick, the other approximately 4 inches thick. The measurements were necessarily conducted somewhat hurriedly, and the results which are given in the accompanying table for various frequencies from 125 to 4000 cycles per second (that is, virtually the speech range), can only be approximate.

Thickness of snow	Absorption coefficients for the following frequencies:					
	125	50	500	1000	2000	4000
1 inch	0.15	0.40	0.65	0.75	0.80	0.85
4 "	0.45	0.75	0.90	0.95	0.95	0.95

It will be seen that freshly fallen snow is highly absorbent, its effectiveness being equalled by few known materials of corresponding thickness. In particular, a 4-inch layer absorbs as much as 90 per cent or more of the intensity of medium and high-pitched notes; and greater thicknesses would no doubt present equally striking figures for low-pitched notes. Thus, apart from the muting of impact noises, the 'deadening' effect of a layer of snow can be well understood.

G. W. C. KAYE.

Physics Department,
National Physical Laboratory,
Teddington, Middlesex.
Jan. 8.

E. J. EVANS.

Points from Foregoing Letters

PROF. W. L. BRAGG discusses the recent communications by Dr. D. Wrinch and Prof. E. H. Neville in which it is claimed that a new method of interpreting the Patterson X-ray diagrams enables the identification of the structure of the insulin molecule. He points out that the method suggested is essentially the same as that previously used by several investigators, but the assumption that the insulin diagram can be explained by a certain concentration of scattering matter in a simple way at a few typical points in the molecule, appears risky.

Writing on the same subject, Prof. J. D. Bernal criticises the suggestion of Prof. Neville that points may be substituted for peaks in the Patterson vector map. He claims that the scattering centre model derived from the cyclol hypothesis fails completely to account for the X-ray evidence for insulin and that the cyclol model itself leads to results incompatible with that evidence.

Finally, Dr. J. M. Robertson considers that fifty-nine relative measurements of amplitude cannot define a structure consisting of several thousand atoms; he suggests that by the introduction of heavier mercury atoms in place of the zinc atoms present in the insulin molecule it may be possible to obtain diagrams that would throw some light on the structure of the molecule.

Photographs of Laue X-ray diffraction patterns obtained with aluminium at 20° and 550° C. are submitted by G. D. Preston. Certain spots and streaks which are only faintly marked at 20°, become considerably intensified at 550°, and the author considers that the effect is to be attributed to the thermal agitation of the crystal lattice.

A flavo-protein extracted from the heart muscle tissue with dilute alcohol and salt solution is found by Dr. F. B. Straub to contain 0.65 per cent of flavin phosphate. Its non-protein group can replace quantitatively the co-enzyme of the δ -amino-acid oxidase and is probably the same compound.

An artificial antigen which, when injected into rabbits, yields sera that agglutinate Type III pneumococci, has been prepared by Dr. W. F. Goebel by combining the diazonium derivative of the *p*-amino benzyl glucoside of cellobiuronic acid with horse serum globulin. The cellobiuronic acid antisera confer passive protection on mice against virulent Types II, III and VIII pneumococci.

New evidence of numerical variation in the chromosomes of *Oimex* spp. and of the nature of the variable elements has led Dr. H. D. Slack to modify his former concept of the polyploid origin of the genus, since the different numbers form a continuous series derived from the irregular distribution of a specialized group of chromosomes.

R. A. Lever writes that contact with some of the legs of the melanesian centipede, *Scolopendra*, produced numbness of the back of the hand, so it appears that the irritant exudation already referred to by Mr. Burt is not confined to the mandibles.

Observations following upon two heavy rainfalls, in August and November, in Devon, show, according to J. B. E. Patterson, that gully erosion takes place on slopes greater than 1 in 6 and that sheet erosion occurs on most slopes up to 1 in 10. Weeds afford quite good protection from erosion but root crops appear to give little or none.

Research Items

Stone Age Culture from Kenya Colony

A STONE age culture, for which the name 'Kombewa culture' is suggested from the name of the locality in which it occurs, is described by the Venerable Archdeacon W. E. Owen in *Man* of December 1938. Kombewa is the name of a subsection of the Location of Senle in the Central Kavirondo District of the Nyanza Province, Kenya Colony. It lies about half-way up the escarpment on the north of the Kavirondo Gulf and about eight miles from it. Between 1932 and 1938, four workshop sites were discovered, and single specimens have been found over a wide area. Three sites were hill-top sites and showed no stratification, but stratified rubbles, carrying both rolled and unrolled hand-axes of Acheulean type, flakes and cores, were found at Aringo and Ng'ira in Karungu on the east coast of Lake Victoria, and subsequent search revealed the fourth workshop site on the slopes of Nyandwat Hill, near Ng'ira. The raw material in every instance is the local rock, large, medium or small flakes being struck from a selected block. In the majority of instances care had been taken to prepare the area from which the butt of the flake tool was removed, so that many tools show a faceted or trimmed butt. The peculiarity of the tool is its perfectly plain upper surface. The struck cores are classified under four heads with reference to the butt area into natural butts, faceted butts with central ridge, faceted butts with trimmed ridge, and rounded butts. The majority of cores show only one tool removed. Finished tools are small in number compared with cores. The outline is approximately rectangular with rounded corners, ovate and nearly round to semicircular. The butts are generally as wide as the widest part of the flake. Some of the cores seem to have been used as scrapers. One large flake seems to have been a chopper, and two hammer stones were found. The suggested date is Middle Stone Age; but at the present stage it suffices to remember that at Ng'ira specimens occur in a horizon carrying rolled and unrolled Acheulean tools.

Formation of Pronephric Duct

Two views have been put forward regarding the method of formation of the pronephric duct in the urodele Amphibia. First, that it is produced by a backward growth from the pronephric rudiment, and secondly that it is a composite structure resulting from the fusion of a series of segmental units. By means of *intra vitam* staining with Nile blue sulphate and by means of operative interference, R. J. O'Connor has thrown light on this problem (*J. Anat.*, Oct. 1938). The types chosen were *Ambystoma tigrinum* and *Triton cristatus*. It was shown that when the caudal end of the rudiment of the duct is stained and then development allowed to proceed, the stain is carried on by the growing rudiment right down to the cloaca in the walls of the duct when formed. Also that if a piece of some other tissue is interposed caudal to the end of the rudiment, it prevents the backward extension of the rudiment and so prevents the formation of a pronephric duct. From this, it is concluded that the duct is developed from a backward extension of the pronephric rudiment.

New Type of Hereditary Behaviour in Fishes

Mollienisia is a genus of cyprinodont fishes. *M. sphenops* occurs around the Gulf of Mexico from Florida to northern Mexico. *M. latipinna* is found in southern Mexico and Central America. Where these species overlap is found an intermediate form known as *M. formosa*, which is evidently of hybrid origin but occurs exclusively as females. This peculiar situation has been investigated by Mr. Henry Meyer (*J. Genetics*, 36, No. 3). When *M. formosa* is mated to either species, the offspring are all females of maternal type. But this is not parthenogenesis, since unmated females produce no young. The two species and the laboratory hybrid between them all had 36 chromosomes, and nuclear size suggests that the *M. formosa* females are also diploid. There was no differential death-rate either before or after the birth of the young which would account for the absence of males. There is no tendency to hermaphroditism, and sex reversal is improbable. To account for the purely matroclinal inheritance, the following explanation is suggested. The eggs of *M. formosa* are fertilized by the other two species, but the paternal chromosomes remain inactive in the foreign cytoplasm. In maturation of the eggs of the hybrids, the paternal chromosomes are all eliminated into the polar body. This condition is compared with meiosis in *Oenothera* hybrids and in the homopteran *Pseudococcus nipae*. Further cytological investigation should settle whether this explanation is correct.

Double-grafted Apple Trees

THE ancient problem of the reciprocal influence of scion and stock is further complicated by the increasing use in various parts of the world of fruit trees with two or more graft unions and composed of more than two varieties. Trees are frequently built up *ab initio* with a third variety used as an intermediate stem piece between stock and scion, whilst it is a common practice with established trees to graft shoots of a new variety on to the framework branches of an existing scion. M. O. Vyvyan (*J. Pom. and Hort. Sci.*, 16, 251; 1938) has investigated the effect on a given scion of stock varieties used both as rootstock and intermediate stem piece. The scion was always Stirling Castle, the stocks and intermediate pieces being *M* IX and *M* XII combined in all four possible ways, namely, XII/XII, IX/XII, XII/IX and IX/IX. The trees of type XII/XII were largest and those of type IX/IX the smallest. IX/XII trees, that is IX as intermediate and XII as rootstock, were intermediate in size, whilst XII/IX trees were only slightly larger than IX/IX trees. Trees with vigorous (XII) root systems or intermediate pieces produced more wood growth and fewer fruit buds per metre of wood than those with dwarfing (IX) root systems or intermediates, and in this respect the root system tended to have a greater influence than the intermediate piece. Swellings at some of the graft unions indicated that obstruction at the union may be in part responsible for some of the effects observed, but it is noted that an unworked *M* IX tree becomes dwarfed and precocious though no graft union is present.

Theory of Coacervation

AN interesting paper by Dr. Irving Langmuir (*J. Chem. Phys.*, 6, 873; 1938) deals with a new theory of coacervation. Unipolar coacervation results from micelles of similar charge, and bipolar coacervation from micelles of unlike charge. The formation of tactoids from thixotropic sols, of Schiller layers from ferric oxide sols, the separation of tobacco virus solutions and bentonite sols into two liquid layers, and the crystallization of proteins are regarded as being typical of unipolar coacervation, and involve attractive forces. The previous ideas about Coulombic attraction are shown to give an excessive attractive force between micelles and oppositely charged ions which must be compensated by repulsive forces and by the dispersive action of thermal agitation. Long-range van der Waals forces are discarded and a new theory of coacervation, based on the Debye-Hückel theory of the osmotic pressure of electrolytes, is developed mathematically. The limitations of the Debye-Hückel theory are discussed. A theory of relaxation of birefringence has also been worked out in which dilute thixotropic sols of bentonite are assumed to be arranged normally in a cubic lattice, and temporary shear in the liquid orients the micelles and produces birefringence although the lattice remains cubic. In bipolar coacervation, the electric fields and the charges on the micelles increase as the molecular concentration increases until at a certain concentration the field attains a value so high as to cause increased hydration which keeps the micelles apart and confers stability to the coacervate.

Wind Speed by Kites

THE considerable altitudes to which Japanese humming kites can ascend without their notes becoming inaudible on the ground seemed to provide a convenient method of determining the speed of the wind at these altitudes, and S. Suzuki and Z. Miduno of the University of Hukuoka have investigated the effects of wind speed on the pitch and amplitude of the stretched ribbon which hums (*Proc. Physico-Math. Soc. Japan*, Nov. 1938). The ribbon used was of metal about 80 cm. long, 0.3 cm. broad and 0.011 cm. thick stretched horizontally in a wind tunnel and its motion determined by light reflected from a small mirror. The wind stream was parallel to the breadth of the ribbon. The oscillations are principally torsional and their fundamental frequency is that of the transverse oscillation, a thin round wire of the same length and mass per unit length under a stretching force exceeding that used by $16\pi^2 b^2/a$, where n is the rigidity of the material of the ribbon, a half the breadth and b half the thickness. The speed of the wind has very little effect on the pitch of the fundamental note but a considerable effect on the amplitude and on those of the harmonics, and it is these effects which the authors hope to use as means of measuring the wind speed.

Corpuscular Eclipse of October 1, 1940

A RECENT paper (*Mon. Not. Roy. Astro. Soc.*, 98, 9, Supplementary Number, Oct. 1938) gives a description of the application of the occultation machine in the Nautical Almanac Office to the prediction of the corpuscular eclipse. The velocity of the corpuscles emitted from the sun is about 1,000 miles a second and large 'aberration' terms are necessarily introduced into the positions of the sun and moon, the values corresponding to corrections representing

'light-times' of 1.0706 days and 221 seconds for the sun and moon respectively. There is some doubt regarding the manner in which the corpuscles leave the sun. If they are expelled radially it is obvious that the sun must be treated as a point-source, but this assumption does not accord with observation. There are no reliable data, however, to show the most suitable diameter to adopt, though it is certain that it must be considerably less than that of the visual sun, and about the order of one fourth of its apparent diameter. A table supplies the corrected times of beginning and end of the corpuscular eclipse at all points in the network covering South Africa. A map shows the track of the corpuscular eclipse for a height of 300 km.—the height of the upper ionized layer of the atmosphere, from which wireless waves are reflected. There is very little difference in the times of beginning and ending between the 300 km. height and the 100 km. height at which the lower ionized layer exists, except, as might be expected, near the end and edges of the track. In addition to the assumed speed of 1,000 miles a second, Bosscher elements have been computed and predictions made for a speed of 1,100 miles a second. The general effect of this increased speed of propagation is to displace the track towards the south and west and the times are later by 10–16 minutes. It is hoped that much useful information will be derived from this corpuscular eclipse. The paper is communicated by the Astronomer Royal.

Polar Aurora and Night-Sky Light

PROF. H. H. PLASKETT has recently published a paper with the above title (*Occas. Notes, Roy. Astro. Soc.*, No. 2, Oct. 1938), in which he gives a summary of the methods for studying these two phenomena. It may be mentioned that the object of these *Occasional Notes* is to provide a fairly simple and non-technical description of various astronomical matters which can be followed by the general astronomical reader, and for this reason many non-astronomers will find the paper very interesting. Dufay's night-sky photometer, described very briefly in the paper, has been found the most satisfactory for the study of the night-sky light, and Brunner has accomplished some valuable work by means of this apparatus. He has found that the increase of surface brightness with zenith distance to a maximum at 70° can be represented if two main sources are postulated—a low-lying layer at a height of 5 km. which contributes more than half the surface brightness, and upper layers at heights of 1,000 km. or more, the contribution of the latter being variable with time: on the average it is the equivalent of one first magnitude star every 66 square degrees. Brunner attributes the low-lying component to diffuse reflection by the lower atmosphere of light already reflected off the surface of the earth. The origin of the upper component and also of the aurora is discussed and a brief reference is made to the various theories which have proved acceptable for a time but which are open to serious objections. Hulburt and Maris have recently abandoned the solar-stream hypothesis, and they believe that the charged particles responsible for the aurora are produced in the earth's atmosphere from ionization by the ultra-violet light of the sun. The theory has not, however, been generally accepted, and more research is necessary before it is possible to make any definite pronouncement on the causes of the night-sky light and of the aurora.

Discriminatory Effect of Ultra-violet Rays on Mutation in *Drosophila*

By Dr. H. J. Muller and Dr. K. Mackenzie,

Institute of Animal Genetics, University of Edinburgh

THE discovery that rearrangements of genes in *Drosophila* produce 'position effects' like the effects of 'gene mutations', and that such rearrangements may be so minute as to be practically indistinguishable cytologically or genetically from gene mutations¹ has raised the question whether there is any essential distinction between so-called gene rearrangements and gene mutations, or whether the latter are to be regarded merely as special cases, at the extreme lower limit of size, of the former. This question, fundamental both to problems of genetics and of the biological action of radiation, has recently become more acute since it has become known that, although gross rearrangements vary in frequency as the $3/2$ power of the number of ions produced by X-ray irradiation^{2,3,4} (indicating that they commonly involve the reunion of chromosomes broken at two or more separated points by separate ionizations or activations), minute rearrangements, like 'gene mutations', vary directly as the number of the ions^{4,5} (indicating that two breaks near together may result from one ionization or activation).

If, now, an agent could be found which discriminated between either gross or minute rearrangements and 'gene mutations', producing the latter but not the former (even when used in sufficient strength and in such circumstances as to have allowed an appreciable number of the gross rearrangements to be formed according to the $3/2$ exponential rule, provided the points of genetic change had really represented effective breakages), then there would be *prima facie* evidence that the breakages giving rise to these rearrangements were in some way different from the changes resulting in the gene mutations. After some earlier negative results it had been convincingly demonstrated by Altenburg⁶ (1930, 1931) and corroborated by Reuss⁷, who obtained more intense effects (the results of Geigy⁸ and of Promptoff⁹ in 1931 and 1932, concerning this question were rather inconclusive), that ultra-violet light produces gene mutations in *Drosophila*. Shortly after his first positive results on ultra-violet gene mutations, Altenburg (1931, 1936) made some rather extensive tests for gross rearrangements (both inversions and translocations) but did not obtain any⁶. These results were, however, admittedly insufficient for a decision, since part of the treatments were of cells (embryonic) in which the chromosome conformation is unfavourable to the reunion of widely separated breakage points, even when produced by X-rays, and since the rest involved treatments which, in the light of our exponential rule, we now know to have been of too low a strength as judged by the frequency of the gene mutations produced, to have allowed an appreciable production of gross rearrangements (in view of the latter's resulting from two independent ionizations or activations).

Not long after Altenburg's findings, it was proved by Noethling and Stubbe¹⁰ (1934) that ultra-violet light produces gene mutations in pollen of *Anthr-*

rhinum; Stadler and Sprague¹¹ soon afterwards (1936) obtained similar results with maize pollen. Stadler and Uber¹² then attacked the problem of the relative effectiveness of ultra-violet in producing gene mutations, gross rearrangements of the translocation type, and other changes in maize pollen. Using a sufficiently strong dose, as shown by the frequency of induced gene mutations, they succeeded in demonstrating that in this material the genetic effect of ultra-violet light is qualitatively different from that of X-rays in that the former produces gene mutations without translocations, or with a far lower frequency than the latter. It has remained necessary, however, to test this question on *Drosophila* also, not only because this organism, standing almost at the opposite pole of the organic world from the plant material, might, *a priori*, present fundamental differences, but also because the known differences in genetic reactions (especially the lack or dearth of 'position effect' in the plants and the apparent occurrence of single-break chromosome changes in them) indicated that the hereditary material might be differently constituted, in that, for example, as Brink¹³ had suggested, the genes in the plants might conceivably be grouped in batches having differing connexions between, from those within, the latter.

In the present experiments, adult male *Drosophila* were irradiated with ultra-violet light, since in the mature spermatozoa, with their crowded chromosomes, rearrangements are produced far more readily than in other cells. To allow maximal treatments, they were held immobile by the pressure of the quartz cover glass so as to allow irradiation through their ventral surface, according to Reuss's technique, with modifications, and young 'yellow-white' flies with the minimum of pigmentation were used. To reduce the 'burning' action and so to allow a greater dose of wave-lengths of 280–310 m μ , which both Stubbe and Noethling¹⁴, and Stadler and Uber¹² had found to be genetically very effective, a 2-mm. filter (either Schott and Gen. 'U.G.2', melt 4924, or Chance 'Uviol') cutting off wave-lengths shorter than 280 m μ and most of those longer than 400 m μ was used. The source was a water-cooled capillary mercury arc of the type of Daniels, Farrington and Heidt¹⁵, consuming about 500 watts. After the lethal dose had been determined by experimentation, a dose 50–80 per cent as strong as this was applied to the flies to be bred. Total ultra-violet dose applied was determined by a Weston photronic cell, standardized against oxalic acid-uranyl sulphate solution; it varied from 2.0×10^{10} to 4.0×10^{10} quanta with the U.G.2 filter to 3.0–5.5 for the Chance filter, this being given by 20 minutes' exposure at 7 cm. from the source. The lots of flies (of about forty each) were divided at random after treatment, about one third being tested for lethals (representing gene mutations) by the 'CIB' method, and the rest tested for translocation of all major chromosomes, by crosses to females with attached X's and the 'markers' yellow brown

ebony eyeless, followed by back-crosses of the F_1 males to flies of the same stock.

In a preliminary experiment (irradiation of March 15) 165 of the F_1 cultures tested for lethals yielded 4 lethals (2.4 per cent), while 125 tested for translocations yielded none. Irradiations of April 19-21 led to 213 cultures with 7 lethals (3.3 per cent) and 305 cultures, from flies irradiated with half this dose, with no translocations. The later irradiations have given a total of 1,070 CLB cultures with 22 lethals, or 2.1 per cent, and 2,449 cultures tested for translocations, with not one case of the latter. 579 control cultures (not treated) gave only one lethal, and infra-red rays, in semi-lethal dose, gave 1 lethal in 252 F_1 cultures. The latter results show that the great majority of the lethals in the treated series had resulted from the ultra-violet irradiation.

Our tests with X-rays⁸ have shown that the above represents a frequency of lethals such as is produced by about 600 r. and that with this dose there are some 0.8 per cent of translocations produced in spermatozoa (more exact tests are in progress). With the above numbers of F_1 cultures tested for translocations, then there would have been some 13 to 26 translocations in all, instead of none, had X-rays of the same gene-mutation-inducing dose been used. The difference between this and the result obtained (0) is statistically significant. Moreover, 28 of the ultra-violet lethals, tested for crossing over, showed none to involve gross rearrangements, although the same number of lethals, if it were produced in spermatozoa by X-rays giving the same mutation frequency, would usually include several rearrangements. All in all, then, there can be no question of the difference in the genetic action of ultra-violet and X-rays in *Drosophila*, or of the existence of a difference in the mechanism whereby the 'point changes' leading to gene mutations and gross rearrangements, respectively, are produced.

Spectrometric determination of relative intensities of different spectral regions in the case of the two

alternative filters indicated that approximately the same amount of genetic effect was produced by the two filters when the dosage between wave-lengths 280 and 300 m μ was held constant, even though in that case the Chance filter transmitted (during the total time it was used) 50 per cent more of the longer wave-lengths than the U.G.2. If confirmed, this would mean that wave-lengths longer than about 300 m μ were relatively ineffective genetically (cf. Noethling and Stubbe^{10,14} and Stadler and Uber¹⁵). This question is being investigated further.

It will be of especial interest to know whether or not ultra-violet light, as compared with X-rays, discriminates between the production of minute rearrangements and gene mutations. Work on this problem is now in progress.

The assistance of the Scottish Cancer Control Organization in furnishing funds for this investigation is acknowledged with thanks.

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The Mathematical Association Annual Meeting

THE annual meeting of the Mathematical Association was held at King's College, London, W.C.2, on January 2 and 3. At the business meeting, Mr. W. C. Fletcher was elected president for the ensuing year and officers were elected as follows: *Treasurer*: Mr. K. S. Snell; *Secretaries*: Mr. G. L. Parsons and Mrs. E. M. Williams; *Librarian*: Prof. E. H. Neville; *Editor of the Mathematical Gazette*: Mr. T. A. A. Broadbent. Special reference was made to the work done for the Association by Miss M. Punnett, who retired from the office of secretary after twenty-seven years. Miss Punnett was elected a vice-president of the Association. A revised set of rules, proposed by Prof. E. H. Neville, was carried.

The report of the Council gives the number of members as 1,714 and refers to the activities of the branches. A new branch at Sheffield has recently been formed. Several sub-committees of the Teaching Committee are at present working on different aspects of mathematical teaching, including one on trigono-

metry and another on mathematics for evening technical students. The report further refers to the recently issued "Second Report on the Teaching of Geometry", to the Library and the Problem Bureau, and to the decision of the Council to recognize approved student societies as junior branches. A student society at Cambridge has already been recognized under this rule.

The presidential address was given by Mr. W. Hope-Jones of Eton College, who chose as his subject "Simplicity and Truthfulness in Arithmetic". His first plea was for 'checkability', and he claimed that a well-done piece of work is easier to check by reading it than by doing it again. He also criticized some current practices such as 'cancelling', undue use of improper fractions, loose wording notation in percentage examples and the 'unitary' method. He claimed that teachers were to blame for these defects, since boys have not enough ingenuity to invent their own bad methods, and he attributed

his own progress in arithmetic to avoidance of dodges for making easy things difficult. Finally, he dealt with tables, with special reference to difference-columns, and gave an instructive comparison of the relative accuracy of different methods of constructing and using these tables. The address was delivered in an extremely witty and amusing style, and was greatly appreciated by the crowded audience.

The next address was by Prof. W. L. Bragg, on "Crystallography". Prof. Bragg first dealt with the symmetry of patterns in two dimensions, and, having explained the division of two-dimensional patterns into cells, proceeded to enumerate the seventeen different types of symmetry, of which illustrations were given. He then considered space lattices in three dimensions and illustrated the fourteen distinct types, which give rise to 230 different varieties of three-dimensional symmetry. He illustrated this by reference to one particular group, namely, the space-groups of the orthorhombic lattice. Prof. Bragg concluded by explaining how these types of symmetry enter into crystal structure so as to give rise to the thirty-two classes of crystal symmetry. The lecture was illustrated by slides and was keenly followed by a good audience.

The proceedings of the second day were opened by Mr. A. Buxton, who spoke on "The Teaching of Applied Mathematics in Technical Colleges". He used the term 'applied' in its widest sense, as the students in such institutions require to learn mathematics in order to apply it to engineering, physical chemistry, optics, architecture, etc. The limited previous experience of these pupils and the small amount of time at their disposal (evening students outnumber day students by three to one), means inevitably that the content of the syllabus has to be reduced to a minimum. 'Short cuts' have to be developed wherever possible and formal proofs to a large extent have to be omitted. Mechanics has proved especially difficult, but Mr. Buxton showed how some of the difficulties can be overcome by the use of accurate graphical work and concluded with an interesting example of the use of a velocity diagram to find the velocity of a carried point.

Mr. H. W. Newton gave an interesting illustrated lecture on "Greenwich Observatory: some Aspects of its Work". He showed by a short historical sketch how the work of the Observatory has been mainly concerned with positional astronomy in accordance with its original charter and referred to the discovery of aberration as a result of this work. Illustrations were shown of the older buildings and instruments and also of the instruments now in use, especially those used in the determination of time by observing the transit of a star, a process which Mr. Newton described in some detail, and in stellar photography. He concluded his lecture by a reference to some of the work which has been done in observing the surface of the sun and in photographing, in hydrogen light, bright eruptions and other markings upon it.

The principal speakers in the discussion on the "Second Report on the Teaching of Geometry" were Mr. A. W. Siddons, Miss W. M. Lehfeldt (deputizing for Miss M. A. Hooke) and Mr. H. Beardwood. In the main, all these speakers commended the report. Mr. Siddons referred to some points with regard to the use of small letters to denote angles and to the method of distinguishing the cases of congruence. He also recommended that the idea of similarity should be introduced at an early stage. Miss Lehfeldt

emphasized the necessity of a knowledge of geometrical facts rather than their proofs, and also referred to the need for partnership between the teacher and the class in 'rider' work. She referred to the section on the relation between geometry and geography, a region in which valuable chances of illustrating mathematical principles are frequently missed. Mr. Beardwood criticized the omission of any reference to the inter-relation of geometry and trigonometry, and the absence of any special suggestions for the geometry desirable for very weak pupils. In the subsequent discussion, valuable points were raised by Messrs. Kenworthy-Browne, Inman, Sheppard, Hope-Jones, Kearney, Snell, Roebuck, Broadbent and W. C. Fletcher.

The afternoon session was opened by Mr. W. L. Ferrar, who spoke on "Algebra in the Higher School Certificate". He stated that the ideas of general convergence of series and sequences are, in his opinion, introduced too early in the course, a procedure which leads to an excessive reliance on the 'ratio test'. The principal use of convergence at this stage should be in connexion with the series for $\log(1+x)$, e^x and $(1+x)^n$, and for these series *ad hoc* methods involving integrals should be used. He next referred to defects in the understanding of the logic of algebra, as, for example, the distinction between theorem and converse, and muddled ideas on the nature of proof by induction, a process in which the fundamental principles are easily obscured by the manipulations involved. He also dealt with some points concerning difference equations. The present situation in regard to higher algebra is, he said, becoming difficult, especially for the examiner. The casting out of some of the old items in the syllabus and the introduction of some new ones have reduced the syllabus to a collection of odd and unrelated scraps. He suggested the formation of a committee to put forward the views of the Association in this matter.

At the final meeting, Lord Stamp spoke to a large and interested audience on "Education and the Statistical Method in Business, with Special Reference to Railway Statistics". Lord Stamp considers that education can do more to prepare the student for business life, and gave a valuable list of topics of a statistical nature which might with advantage be introduced in the ordinary teaching of mathematics. He first referred to averages—with their adjuncts the standard deviation, the mode, the median and the quartiles—and to moving averages, in regard to which he made some useful suggestions about the choice of a scale, and to percentages, urging the use of examples from social and economic sources. He next considered various graphical methods to which pupils might be introduced, with some cautions as to possible errors. The ideas involved in the use of samples and of index numbers might also be introduced and explained. He referred also to price levels, correlation coefficients, graphical methods for eliminating short-period fluctuations, and units of cost and performance. A number of interesting examples were quoted in connexion with some of the above items, such as weighted averages and operating ratios. Lord Stamp concluded with some remarks on the difficulty of choosing a useful unit in which some types of performance could be measured, and illustrated his remarks by a further reference to railway problems.

A fuller account of the proceedings of the meeting will appear in forthcoming issues of the *Mathematical Gazette*.

The Physical Society Annual Exhibition

YEAR by year the Physical Society holds an exhibition of scientific instruments and apparatus, which has now grown so that this year—the twenty-ninth—111 individuals and firms describe their exhibits in a catalogue of more than two hundred pages. The exhibition is divided into two sections, one a Trade Section where various physical instruments may be inspected, and the other a Research and Experimental Section.

The Trade Section is of great value to the prospective purchaser of physical apparatus, since it gives him the opportunity of comparing alternative makes of instrument at one time. This aim would be facilitated by a better index to the catalogue so that, for example, gas-analysis apparatus and carbon dioxide and oxygen meters came under a common heading. One reflection that must strike the visitor to this assemblage of instruments is the immense variety of uses to which electronic devices are now put in commercial and industrial instruments. British industry also responds quite rapidly to new needs imposed by legislation or by the political situation, and A.R.P. is mentioned in several of the catalogue descriptions. The Factories Act of 1937 has led to a spurt in the output of photometric equipment, much of which utilizes photo-electric cells, thereby obtaining rapid response and the advantage of a wide range; one instrument can read from extremely low values, of the order of 0.001, up to 100 ft.-candles. The photo-electric cell finds application also in temperature control. For this purpose, the pointer of the instrument which indicates the temperature to be controlled casts a shadow on a selenium cell, and any deviation from its pre-selected position operates the cell and hence a control to restore the temperature to its original value.

The report of the Ministry of Transport Committee on traffic noise is doubtless a contributory factor to the activity shown in the production of noise-meters and other acoustic instruments, of which many were on view. The high-vacuum pump has long been an important tool both in the physical laboratory and in technical processes, and it was interesting to see a new diffusion pump in which the oil or mercury had been replaced by an organic fluid of very low vapour pressure, and means had been provided for continuous self-purification of this fluid, thus avoiding the accumulation of condensable vapours in the pump system, and permitting the attainment of very high vacua, whatever the composition of the gases being removed.

Turning attention now to the Research Section, it is impossible to deal in detail with all the exhibits, which range over almost the whole field of pure and applied physics. Some of the best, such as the calorimetric equipment of Dr. W. D. Wright and Mr. H. V. Walters, and the investigations on dielectrics by the staff of the British Electrical and Allied Industries Research Association, were of rather specialist character. An exhibit of more general interest was provided by the Physics Department of the National Physical Laboratory, and illustrated forcibly the great variety of problems dealt with at the Laboratory. The acoustics exhibit in-

cluded the analysis of noise, where visitors could see the intensities of the various frequency components in a complex sound as a linear spectrum in a cathode ray oscillograph, as well as the wave-form of the same sound in a neighbouring cathode ray tube; models also demonstrated how the transmission of noises in a building can be diminished. Other exhibits showed the work on radium and X-rays, whilst a set of illuminated models of crystal lattices was attractive, even if it conveyed little new information.

Many visitors were attracted by the exhibit organized by the Scientific Computing Service, Ltd., where in addition to a display of calculating machines, there was a new 135-character typewriter, and an interesting survey of the whole history of the production of a mathematical table, from the first calculations to the final printing. Pure mechanics is somewhat out of fashion, but Messrs. W. and T. Avery, Ltd., showed that it still has points of interest, in an exhibit which showed various little-known statical principles which find application in weighing mechanisms. Messrs. H. A. Boot and A. H. Knight showed a small model of the electrostatic generator used in nuclear research by Prof. van de Graaff, which operates by collecting charges from a moving insulated belt and allowing these to accumulate within a metal sphere. The generator shown could furnish a current of 30 μ a., the maximum voltage being 250,000.

Two ingenious experiments for the school laboratory were shown by Mr. W. O. Clarke, in one of which Planck's constant is determined with apparatus no more complicated than a commercial photometer and an incandescent lamp with electrical measuring instruments, and the other enables the specific heat of air to be measured by using a hot-air blower as the basis of a continuous-flow calorimeter.

Among the many novelties shown by the Research Laboratories of the General Electric Co., Ltd., was an apparatus for measuring the mean strength of a magnetic field by amplifying the alternating E.M.F. obtained when a small coil is rotated in the field. They also demonstrated a method by which the intensity of the light from a photo-flash lamp (which reaches its maximum in only 0.05 sec. from ignition) can be studied in detail as a function of time.

In a demonstration by Drs. E. E. Widdowson and S. J. Gregg, multi-molecular layers of barium stearate were being built up by the successive deposition of mono-molecular layers. A striking feature is the vivid colours, changing rapidly with the number of layers, which are seen when the multi-molecular film is viewed by polarized light. The behaviour of lamp filaments and their mountings under vibration must be important to the designer and manufacturer, and many visitors found a stroboscopic picture of this behaviour to be both attractive and informative. This was one of several items included in the exhibit of the Research Laboratories of the British Thomson-Houston Co., Ltd. Finally, many lecturers will be grateful for the simple method demonstrated by Prof. J. D. Bernal, whereby the relation between the Laue diagram and the Bragg reflection patterns can be shown visually.

Exhibition of Scottish Art

VISITORS to the present exhibition of Scottish painting, sculpture, furniture and other work of art, on loan from various public and private sources, at the Royal Academy, London, are likely to feel the force of the complaint that Scotland was not adequately represented in the exhibition of British art held some winters ago. Certainly men of science should find much there to interest them in the healthy realism displayed in many fields.

The exhibits, which exclude the work of living artists, range mainly over the seventeenth, eighteenth and nineteenth centuries, and dealing largely with Scottish subjects, clearly reflect national character, customs and influencing geographical environment. There are portraits of a small number of men of science, including Murray's "Edmond Halley" (21), Raeburn's "Professor John Robison" (84), an early secretary of the Royal Society, Shannan's "Lord Kelvin" (395) shown bare-headed in academic robes, and Walton's "J. G. Bartholomew, LL.D." (538) in doctor's robes with hand on globe. But amid the vast array of portraits by Raeburn, Ramsay and others, attention may well be directed, also, to Raeburn's magnificent rendering of "Sir Walter Scott" (83) sitting outside Hermitage Castle with the mountains of Liddesdale in the background, to Macnee's huge canvas "The Rev. Ralph Wardlaw, D.D." (196), outstanding as a study in force of character and ministerial type, and to the near-by fine portrayal of Macnee's own daughter "Lady in Grey" (199). In group portraiture those who look for expression of what is typical in national culture will appreciate Lorimer's "Ordination of Elders in a Scottish Kirk" (545).

Landscape, which notwithstanding its prominence in literature, arose in art rather later in Scotland than in England, is quite well represented in the collection, and shows an interesting association with group portraiture. Of this association there are two outstanding examples: one, Guthrie's large canvas "A Highland Funeral" (513), where the assembly appears in snow-clad moorland outside a stone cottage; the other, the same painter's "Schoolmates" (525), wherein two girls and a boy, of quite striking physical beauty, are wending their way to school in a late autumn landscape. William McTaggart, perhaps the most original of the Scottish landscape painters, has almost a gallery to himself: "Away o'er the Sea", "The Storm", "The Wind in the Grass", "The Wave", "Blithe October", "April Snow" and "Spring" being a few of his contributions. A characteristic of this artist is his habit of putting a group of children in the foreground of his rural or seashore pictures, and, though in some cases the figures are not very successfully delineated as elements in the landscape, in others the effect is admirable. Thus in "Spring" (384), the blue range of hills in the background, the cottage with trees in the middle distance, the sheep, and the children plucking wild flowers in front, are all in perfect relationship, constituting a typical scene of the Lowlands of Scotland. In this characteristic, McTaggart shows himself in spirit a true Wordsworthian. David Farquharson's "River Road, Strathdon" (295) is a summer scene showing shepherd and flock and pouring rain over a distant range of mountains, whilst Joseph Farquharson's "Stormy Blast" (296), one of this painter's famous snow scenes, is a fine piece of impressionism, illustrating the

smothering effect of snow upon a moorland flock of sheep. The omission of a few pictures of the type of "Stormy Blast" from any exhibition of Scottish landscape would be unthinkable, for the imagery of snow is somewhat obtrusive in the literature of Scotland and deeply rooted in one's sense of the wild beauty and romantic history of that rugged northern land.

In pure landscape, however, at any rate as regards Scottish scenery, the masterpieces are McCulloch's famous "Glencoe" (177) and Peter Graham's "Wandering Shadows" (238). In "Glencoe" there is massiveness both of mountains and of mountainous cumulo-nimbus clouds so closely interlocked that in one place the painter rightly leaves the spectators in doubt to which element a dark rugged outline belongs. Pine trees stand at intervals down the glen, there are stags in the foreground, and in the left-hand corner, half hidden in a gloomy ravine, lies a sullen tarn. In "Wandering Shadows" the painter of the "mountain and the flood" has left us a superb piece of chiaroscuro. The nearer mountain flank is gloriously lit in contrast with the farther range, which is steeped in intense blue-black shadow. Mists are coursing the mountain sides so realistically that one almost sees them driving—a sure indication of good work. In the foreground a man is fishing in the torrent, and there are sheep grazing amid lichen-crusting boulders showing just the right amount of detail.

In sculpture, mention may be made of a "Symbol Stone" from Orkney with a design the meaning of which is lost, but known to date from Early Christian times, and also of a kid standing on a rock—reflecting a Highland background. In the vestibule, the visitor is greeted, symbolically, by a statue of John Knox with Bible in hand.

L. C. W. BONAOMA.

Science News a Century Ago

The Institution of Civil Engineers

At the annual general meeting of the Institution of Civil Engineers held on January 15, 1839, the president, James Walker, being in the chair, the report for the year was presented. At this time no fewer than nine members of the Council were fellows of the Royal Society, J. Walker, W. Cubitt, Bryan Donkin, Joshua Field, H. R. Palmer, I. K. Brunel, Joseph Locke, George Lowe and John Macnail. One of the problems the Council had considered was that of qualification for membership. "The objects of the civil engineer," the Council said, "were defined by charter and in guiding them in their task they had adhered closely to the two following conditions: (1) that the party should have been regularly educated as a civil engineer according to the usual routine of pupillage, and had had subsequent employment for at least five years in responsible positions, resident or otherwise, or (2) that he should have practised on his account in the profession of civil engineer for five years and have acquired considerable eminence therein. In earlier days the force of genius alone was sufficient to place the individual in that position of professional eminence which commenced with a Brindley and a Smeaton, and was in our own time exemplified in a Rennie and a Telford." To such, of

which there are many illustrious examples still living, the second condition was strictly applicable."

The Interior of the Earth

At a meeting of the Royal Society held on January 17, 1889, W. Hopkins read his second paper on the state of the interior of the earth, entitled "The Phenomena of Precession and Nutation, assuming the Fluidity of the Interior of the Earth". For the purpose of his investigation Hopkins assumed the solid shell of the earth to be bounded by a determinate inner spheroidal surface of which the ellipticity is equal to that of the outer surface and the shell and fluid to be homogeneous and of equal density. Having given the results of his inquiries as affecting precession, and lunar and solar rotation he said that "the pole of the earth would have a small circular motion, depending entirely on the internal fluidity. The radius of the circle thus described would be greatest when the thickness of the shell should be least; but the inequality thus produced would not, for the smallest thickness of the shell, exceed a quantity of the same order as the polar nutation, and for any but the most inconsiderable thickness of the shell, would be entirely inappreciable to observation."

English Medical Society in Paris

THE *Lancet* of January 20, 1889, contains the following information: "An English medical society has recently been established in Paris and already includes on its list between 90 and 100 members. At one of the last meetings Sir R. Charnside was elected president and J. Godfrey, Esq., vice-president for the present year. The Society holds weekly meetings at which papers are read upon medical subjects and discussions take place in the *English language*. These meetings are peculiarly interesting, as medical men from London, Edinburgh, Dublin and different parts of America join in the proceedings, as well as some of the 'externes' and 'internes' of the Parisian hospitals. The Society has established a reading room for the English and French periodicals, and the nucleus of a permanent library is already in existence."

Geodetical Work at the Cape of Good Hope

In his "Autobiography", under the year 1839, Airy wrote, "I had much work in connection with the Cape of Good Hope Observatory, chiefly relating to instrumental equipment and to the geodetical work. As it was considered advisable that any base measured in the Cape Colony should be measured with compensation bars, I applied to Major Jervis for the loan of those belonging to the East Indian Survey, but he positively refused to lend them. On Jan. 20th I applied to Col. Colby for the compensation bars of the British Survey, and he immediately assented to lending them. Col. Colby had suggested to the Ordnance Department that Capt. Henderson and several sappers should be sent to use the measuring bars and it was so arranged. It still appeared desirable to have the command of some soldiers from the Garrison of Cape Town, and this matter was soon arranged with the Military authorities by the Admiralty."

The geodetical work at the Cape included the remeasurement and extension of Lacaille's arc, and it was carried out by Sir Thomas Maclear, the Astronomer Royal at the Cape, the results being published in 1866, edited by Airy.

Societies and Academies

London

Royal Society (*Proc. A*, 169, 149-289; 1938).

O. K. INGOLD: Structure of benzene (Bakerian Lecture).

W. F. HILTON: Photography of airscrew sound waves.

D. H. EVERITT and W. F. K. WYNN-JONES: Dissociation of the ammonium ion and the basic strength of ammonia in water.

H. S. W. MASSY and R. A. BUCKINGHAM: Low temperature properties of gaseous helium.*

J. N. AGAR and F. P. BOWDEN: Kinetics of electrode reactions (1 and 2).

R. G. ATOMIK, N. S. BAYLISS and A. L. G. REES: Effect of solvents on the continuous absorption spectrum of bromine.

T. E. ALLIBONE and J. M. MEEK: Development of the spark discharge (2).

S. O. CURRAN, P. I. DINE and V. PETRÁŤKA: Excitation of γ -radiation in processes of proton capture by light elements.

Paris

Academy of Sciences (*C.R.*, 207, 1137-1268, Dec. 12, 1938).*

H. BRUCK: Extension of the $1^1P_1 - m^1S_0$ of zinc.

M. PARODI: Spectra of some derivatives of methane in the far infra-red.

L. MONTAUDO: Absorption and fluorescence spectra of pigments from the St. John's wort of the Mediterranean basin (*Hypericum crispum*). The *Hypericum* from Tunis, which often poisons animals, has different pigments from the European *Hypericum*.

J. DUBREUIL: Absorption spectra and chemical constitution of Sauton's liquid cultivated in tubercle bacilli B.C.G.

G. EMBRECHT: Production of iodic anhydride by photo-oxidation of organic oxides; photo-oxidation of iodoform and of solid carbon tetraiodide.

H. HUTUBET, MILLE, Y. CAUCHON and MME. S. COTELLE: Spectroscopic determination of the atomic number of polonium. The investigation shows that the detection of elements by their X-ray spectra is much more sensitive than was believed; the radiations detected in this case are those to be expected from an element of atomic number 84.

A. CLAUDE: Fluorescent tube-lamps functioning with the usual distribution voltage.

M. BRUTZOUS: A thermochemical constant and its relations with electronic energy values.*

R. ENGELAND: A new form of stereo-isomerism and an unknown form of glycooll: attempt at a theoretical interpretation.

V. AUGER: Two new molybdic acids.

R. CHAUVENET: Combinations of zinc nitrate and of alkaline nitrates.

A. MORETTE: The system iodine-vanadium: vanadium di-iodide and tri-iodide.

G. COURTOIS: Preparation of anhydrous sodium sulphide.

O. DUFRASSE and M. GERMAN: Study of the mechanism of dry extinction by dusts; nitrate, chlorate, perchlorate of potassium and other bodies which support combustion as extinguishers of flames.

*Continued from page 89.

P. GRAMMATIKAKIS: Action of organomagnesium mixtures on the benzylamines: preparation of secondary amines of the type $\text{Ar}(\text{R})\text{CH}_2\text{NH}(\text{CH}_2)_n\text{C}_6\text{H}_5$.

D. DUVEN and A. WILHELM: Synthesis of tetraphenyl-2, 6, 10, 12 bis-(diphenyl)-9, 11-naphthacene and its photo-oxide.

M. TUOT: Interpretation of secondary reactions observed in the course of the condensation by organomagnesium of ketones and of esters of the aliphatic series: theory.

Mme. R. DUBREUIL, L. DONCEUX, H. VAUTRIN and L. DUBREUIL: The nummulitic of the eastern slope of the Anti-Libanon (region of Damascus, Syria).

Mme. A. VASSY and E. VASSY: Daily variations of the mean temperature of the atmospheric ozone.

G. LEMOIN: Post-glacial forest history in Lower Normandy after pollen analysis of the peat-bogs.

J. MOTTE: Evolution of the nuclei of the inter-nodal cells of *Chara foetida*.

Mme. I. MICHALSKA and F.-X. SKUPNIECKI: Ecological researches on *Polysphondylium pallidum* Olive, *Polysphondylium violaceum* Bref., *Dictyostelium mucoroides* Bref.

Mlle. J. MANUEL: Formation of the ascus of *Nematosporea Coryli*, after a sexual phenomenon.

P. RIQU and G. DELORME: Distribution of manganese and of iron in the ashes and elms of the Province of Quebec.

R. ULRICH: Variations of the reactions to superficial lesions as a function of their surface (fruits of *Iris pallida* Lam.).

V. VINCENT and P. BOISCHOT: Nature and composition of the organic matter of the phosphates of North Africa: the phosphate of Gafsa.

J. GEORGEVITCH: *Sphaeractinomyxon danicos* n.sp., an actinomyxidial parasite on an oligochaete of Lake Ochrida.

RAYMOND-HAMET: Major hypotensor and sympathetolitic effects of hydrocinchonidine.

Mlle. P. BEETHIE: Coefficient of magnetization and electric sign of solutions of haematin and of acethaemin.

B. LUYET and G. THORNES: Revival of muscle fibres vitrified in liquid air.

M. RANGIER and P. DE TRAVERSE: Mode of formation and constitution of urinary scatole red.

G. RAMON: Some methods for the rapid and intensive production of diphtheria and tetanus antitoxins in the horse.

A. SARTORY, J. MEYER and D. SCHMUTZ: Conditions favouring bacterial growth by preliminary introduction of vitamins B₁ and B₂ combined and in varied doses, into the culture medium.

J. RIGNIER and Mlle. S. LAMBIN: Study of microbial growth as a function of the quantity of nutritive substance in culture media.

J. CHAUSSIN and L. LEBONNE: Study of the variations of phthalein and formol acidities of urine during 24 hours of eight diabetics.

Sydney

Royal Society of New South Wales (*J. and Proc.*, 72; 1937-38).

S. B. COHEN and F. M. QUODLING: An X-ray examination of chillagite. From oscillation and powder photographs (copper $K\alpha$) chillagite has been found to have cell dimensions in close agreement with those of wulfenite and stolkite and the same

number of molecules per cell (4). Chillagite is regarded as a mixed crystal of these two substances, not as a distinct mineral species.

J. G. CHURCHWARD: Studies on physiological specialization of the organisms causing bunt in wheat, and the genetics of resistance to this and certain other wheat diseases. (2) Genetical studies. In a wheat cross, Federation $\times$ Hope, studies were made in the field and greenhouse on the inheritance of resistance to bunt, to flag smut, to two races of stem rust, and certain morphological characters. In addition to the single factor for resistance to bunt, there are several modifying factors acting in this cross. With two exceptions, the inheritance of the remaining characters is explained by simple Mendelian hypotheses.

S. W. CARRY and W. R. BROWN: Review of the carboniferous stratigraphy, tectonics and palaeogeography of New South Wales and Queensland. A scheme of subdivision is proposed for the Lower and Middle Carboniferous of New South Wales, embodying recognition of the fact that freshwater and marine sedimentation proceeded simultaneously in Viséan time. Many, if not all, the known occurrences fit into this scheme. Correlations are also instituted with Queensland. The earth-movements which determined loci of sedimentation and affected the sediments after deposition are enumerated—the late Devonian Kanimbla, the epi-Burindi Drummond and the late Permian Hunter-Bowen orogenies, with minor vertical movements at the close of Lower Burindi and Upper Kuttung times.

ADOLPH BOLLIGER and A. L. CARRODUS: Changes in and around the pouch in *Trichosurus vulpecula*, as occurring naturally and as the result of the administration of oestrone. The sexually immature Australian opossum (*Trichosurus vulpecula*) shows no pigmentation in its undeveloped pouch, and the hair on its ventral aspect is usually white. Injections of oestrone bring on development of the pouch, mammary glands become evident, and the nipples undergo hypertrophy. Simultaneously a pigment is secreted within the pouch and forms a dark brown deposit, while the hairs within the pouch as well as those around it become stained from a yellow to a dark golden brown. Similar changes were observed to occur under natural conditions, and they are considered to be connected with the sex life of the animal.

Washington, D.C.

National Academy of Sciences (*Proc.*, 24, 497-523, Nov. 15, 1938).

R. A. BRINK and D. C. COOPER: Partial self-incompatibility in *Medicago sativa*. Pollen is less efficient in self-pollinations than in cross-pollinations, while ovules containing inbred embryos show a greater tendency to collapse than those from cross-fertilization.

J. G. CARLSON: Mitotic behaviour of induced chromosomal fragments lacking spindle attachments in the neuroblasts of the grasshopper.

O. STOCK: A titanothere from the type Sespe of California.

BARBARA S. BURNS: Autosomal linkage in man: the recombination ratio between congenital tooth deficiency and hair colour.

R. COURANT: Remarks on Plateau's and Douglas's problem.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Monday, January 16

UNIVERSITY OF LEEDS, at 5.15.—Dr. J. Hammond, F.R.S.: "Fertility and Growth in Domestic Animals" (Oliver Behrens Lectures. Succeding lectures on January 30, February 20 and 27 and March 13).*

Tuesday, January 17

EUGENIC SOCIETY (at the Royal Society), at 5.15.—Dr. Felix Tietze: "Eugenic Measures in the Third Reich".*

UNIVERSITY COLLEGE, LONDON, at 5.30.—Sir Ambrose Fleming, F.R.S.: "History of the Thermionic Valve at University College".*

ILLUMINATING ENGINEERING SOCIETY, at 7.—Discussion on "Lighting in Relation to Air Raid Precautions".

Wednesday, January 18

ROYAL MICROSCOPICAL SOCIETY, at 5.30.—J. E. Bernard, F.R.S.: "Towards the Smallest Living Things" (Presidential Address).

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Dr. B. A. Keen, F.R.S.: "What Happens to the Rain?"

ROYAL SOCIETY OF ARTS, at 8.15.—H. L. Kirke: "Recent Progress in Television".

Thursday, January 19

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY (ROYAL SCHOOL OF MINES), at 5.30.—Dr. J. Hammond, F.R.S.: "Animal Breeding" (succeding lectures on January 26 and February 2 and 9).*

Friday, January 20

ROYAL INSTITUTION, at 9.—Dr. Fraser Darling: "North Rona: a North Atlantic Island".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

LECTURER IN CHEMISTRY at the Kingston-upon-Thames Technical College—The Principal (January 14).

CHEMIST at the Royal Gunpowder Factory, Waltham Abbey or the Royal Ordnance Factory, Irvine—The Under-Secretary of State (O.S.), War Office, London, S.W.1 (January 20).

ASSISTANT CIVIL ENGINEER at the Royal Ordnance Factory, Bishopston, Renfrewshire—The Superintendent, Royal Gunpowder Factory, Waltham Abbey (January 20).

UNIVERSITY READER IN METEOROLOGY in the Imperial College of Science and Technology—The Academic Registrar, University of London, Senate House, W.C.1 (January 20).

ASSISTANTS (grade III) in the Meteorological Office—The Under-Secretary of State, S.S.B. (Met.), Air Ministry, Admiralty House, Kingsway, W.C.2 (January 31).

LECTURER IN BIOLOGY in the Central Technical College, Suffolk Street, Birmingham, 1—The Chief Education Officer (January 31).

LECTURER IN MINING in the University of Sheffield—The Registrar (February 4).

LECTURER IN BIOCHEMISTRY in the Otago University Medical School—The High Commissioner for New Zealand, 415 Strand, W.C.2 (March 23).

LECTURER IN ENGINEERING in the Swansea Technical College—The Director of Education, Education Department, Guildhall, Swansea.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Memoirs of the British Astronomical Association. Vol. 24, Part 1. Who's Who in the Moon; Notes on the Names of all Lunar Formations adopted in 1935 by the International Astronomical Union. Pp. 180+2 plates. (London: British Astronomical Association.) 4s. 6d. [1412]

Department of Scientific and Industrial Research. Forest Products Research Records, No. 27 (Mycology Series, No. 2): Decay of Timber and its Prevention. By W. P. K. Findlay. Pp. 11+15+5 plates. (London: H.M. Stationery Office.) 6d. net. [1412]

Publications of the International Tin Research and Development Council. No. 89: Electrodeposition of Tin from Alkaline Solutions. By S. Baier and R. M. Angles. Pp. 11+30. Free. No. 83: The Electrodeposition of Tin from Acid Sulphate Solutions, II. By A. W. Hothernall and W. N. Bradshaw. Pp. 11+18. Free. (Greenford: International Tin Research and Development Council.) [1412]

Friends of the Hebrew University of Jerusalem. Annual Report, 1937-8. Pp. 28. (London: Friends of the Hebrew University of Jerusalem.) [1512]

Association of Special Libraries and Information Bureaux. Report of Proceedings of the Fifteenth Conference, 1938. Pp. 125. (London: A.S.L.B.) 6s. [1512]

Royal Technical College, Glasgow. Annual Report of the One Hundred and Forty-second Session. Pp. 93. (Glasgow: Royal Technical College.) [1512]

British Association for the Advancement of Science. Norman Lockyer Lecture, 1938: The Atmosphere of the Planets. By Dr. H. Spencer Jones. Pp. 14. (London: British Association.) 1s. [1512]

Royal Horticultural Society. Lily Year-Book, 1938. (No. 7.) Pp. 1v+181+vii+25 plates. (London: Royal Horticultural Society.) 5s. [1512]

Medical Research Council. Special Report Series, No. 232: Medical Uses of Radium; Summary of Reports from Research Centres for 1937. Pp. 48+2 plates. (London: H.M. Stationery Office.) 1s. net. [1512]

Rotun Talmahdheachta (Department of Agriculture): Brainse Isaacagh (Fisheries Branch). Report on the Sea and Inland Fisheries for the Year 1937. Pp. 25. 9d. Statistics of Salmon, Sea Trout and Bels captured during each of the Years 1937, 1935, 1933, 1931, 1929, 1927. Pp. 19. 4d. (Dublin: Stationery Office.) [1512]

Science Museum: Board of Education. Hand-List of Short Titles of Current Periodicals in the Science Library. Part 1: Alphabetical. Edited by Dr. S. O. Bradford. Fifth edition. Pp. 302. (London: H.M. Stationery Office.) 9s. net. [1512]

Other Countries

League of Nations: Advisory Committee on Social Questions. The Placing of Children in Families. (Official No.: O.390.M.155.1938. IV). Vol. 1: Fundamental Concepts, Historical Development, Characteristic Features in Differing Systems, Principles and Procedures in the Organization of Services. Pp. xvi+154. 3s. Vol. 2: Various Systems of Placing of Children in Families. Pp. xvi+241. 5s. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) [1512]

Miscellaneous Publications of the Royal Alfred Observatory. No. 19: The Cyclone Season 1925-26 at Mauritius. By M. B. McCurdy. Pp. 5+23 plates. No. 20: The Cyclone Season 1926-27 at Mauritius. By M. B. McCurdy. Pp. 8+29 plates. 60 cents. No. 21: Air Temperature and Humidity Data at Mauritius from Observations taken at the Royal Alfred Observatory 1876-1935. By M. Hirschmudrer. Pp. 46+15 plates. 1 rupee. Annual Report of the Royal Alfred Observatory for the Year 1937. Pp. 8. (Port Louis: Government Printer.) [1512]

Commonwealth of Australia: Bureau of Meteorology. Results of Rainfall Observations made in Victoria. Supplementary Volume, including all Available Annual Rainfall Totals from 1825 Stations for Years 1911-1936 inclusive, and Monthly and Yearly Totals from 239 Representative Stations for the Entire Periods for which Records are available up to the end of 1935, with Maps and Diagrams; also Appendices, presenting "Monthly and Yearly Meteorological Elements and Normals of Melbourne, Ballarat, Bendigo and Geelong", "Table showing Monthly and Annual Normals of Pressure, Temperature and Humidity at Selected Stations in Victoria". Published under the direction of W. S. Watt. Pp. 253+8 plates. Bulletin No. 22: Australian Rainfall in Sunspot Cycles. By H. T. Quayle. Pp. 56. Bulletin No. 23: Australian Rainfall in District Averages. Published under the direction of W. S. Watt. Pp. 56. (Melbourne: Government Printer.) [1512]

Annual Report of the Imperial Council of Agricultural Research for 1937-38. Pp. v+168. (Delhi: Manager of Publications.) 12 annas; 1s. [1512]

Nigeria. Annual Report on the Geological Survey Department for the Year 1937. Pp. 11+26+7 plates. (Lagos: Government Printer; London: Crown Agents for the Colonies.) 2s. 6d. [1512]

Catalogues, etc.

Books on Bibliography, Medicine, Science. (Catalogue No. 17.). Pp. 22. (London: David Low.)

Volpar Contraceptive Preparations: Volpar Gels and Volpar Paste. Pp. 14. (London: The British Drug Houses, Ltd.)

The "Promovac", a New High Vacuum and Pressure Pump. Pp. 2. (London: W. Edwards and Co.)

Fifty Years, 1889-1939: Calendar for 1939. (Newcastle-on-Tyne: C. A. Parsons and Co., Ltd.)

Mercury in Steel Thermometers, Dial Type. Pp. 4. (London: Negretti and Zambra.)

Catalogue of Books offered at Greatly Reduced Prices. (Catalogue No. 634.) Pp. 68. (London: Frances Edwards, Ltd.)

Calendar for 1939. (Belgrade: Anglo-Yugoslav Review.)

The Wild-Barfield Heat-Treatment Journal. Vol. 8, No. 19, December. Pp. 26-38+v. (London: Wild-Barfield Electrode Furnaces, Ltd.)

Zelus-Aerograph Calendar for 1939. (Jena and London: Carl Zeiss, Ltd.)

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No. 3612

Planning for Constructive Defence

THE stress rightly been laid in recent months upon moral rearmament is essentially the recognition that there must be some underlying moral basis and explicit code of values upon which we can take our stand in working towards a more tolerable human society. In addition, however, we have been brought to realize the importance of visualizing the national economy and resources as a whole. The defence policy which is now imperative cannot be limited to the negative aspect of armaments and naval, military or air force organization. In addition, it must embrace positive effort devoted to removing causes of international friction and improving international relations, and also much of the work now directed to improving industrial efficiency, national health, social and economic conditions generally. It involves essentially industrial, social and economic strategy and tactics no less than naval or military strategy and tactics.

The dominant factor in determining this profound change has, of course, been the development of air transport as a weapon of war. In the face of this threat, the industrial cities of to-day have to develop the appropriate defensive measures in much the same way as the fortified city of the Middle Ages was developed to meet the military dangers of those days. The essential problem is indeed that of so planning our industrial, social and economic life as to secure adequate protection against sudden aggression, while preserving, under normal conditions, the maximum freedom of enterprise and activity consistent with rapid adjustment to the demands of a time of national emergency. We have to develop under the conditions of to-day a society that can mobilize in response to the threat of war as instantly and effectively as the burghers of the medieval town.

This aspect of planning was frankly recognized in the recent presidential address to the Town Planning Institute delivered by Mr. J. E. Acfield, who stressed the significance of the necessity of considering not only the risks of air attack but also those questions of location of industry, transport and the like which have to be taken into account in planning and may be equally determined by defence policy. He pointed out that the recent emergency had decisively emphasized the necessity for a National Advisory Board recommended in the report of the Town Planning Institute, and directed attention to the importance of recognizing trends in population occasioned not only by location of industry but also by changes in age distribution and the like due to the declining birth-rate. Similarly, a resolution on the planned control of the growth of London was moved by Sir Raymond Unwin at a conference of the Garden Cities and Town Planning Association. The resolution contemplates an authority which would control the location of new industries, preserve the remaining country within reach of London, guide development to existing smaller towns or well-designed new towns in the region and create a long-term plan for re-development in the centre. In discussing the project, Sir Raymond referred to the added urgency given to such problems by the necessity of protection from air raids, and the way in which planning could minimize risks.

The need for concerted policy in this matter of defence has been significantly enforced by investigations in widely different fields. Evidence submitted from time to time during the past year to the Royal Commission on the Distribution of the Industrial Population has indicated the necessity for some State control in this matter from the

point of view of the most effective utilization of national resources, no less than from considerations of defence, and the report when it appears may well be expected to make some emphatic pronouncement on this point. The appointment of this Commission itself was largely due to the recommendation of Sir Malcolm Stewart's third report as Commissioner of the Special Areas, that the further expansion of industry in Greater London should be controlled to secure a more even distribution of production in which the Special Areas might share.

The same point of view has been taken by Sir Malcolm's successor, Sir George Gillett, who in his first report* insists that consideration of the social as well as of the economic effects of the transference of industries lies near the root of the problem of the Special Areas. In his view, the Government cannot, especially since the introduction of tariffs and quotas, evade all responsibility for the location of industry. Social and strategic, as well as economic, causes are fast impelling the abandonment of the *laissez-faire* doctrine in this matter.

Even more emphatically, however, have the events of the recent national emergency endorsed Sir Malcolm Stewart's argument about control of the location of industry in Greater London. The Committee on Evacuation was appointed in May 1938, but the report itself was only published in November†, when the state of emergency was over. No reader of this report can be in any doubt as to the desirability of planning industrial location in future so as to diminish its vulnerability, or of the dangers to which unrestricted development in the past has now exposed us.

The difficulties with which evacuation is attended are made perfectly plain by the Committee, which considers that, none the less, the whole issue in any future war may well turn on the manner in which the problem of evacuation from densely populated areas is handled. Evacuation plans are no substitute for measures of active and passive defence, designed to enable production to be maintained in time of war in the industrial areas, but some measure of evacuation of non-essential persons from the principal industrial areas must be faced both on the grounds of humanity and to relieve the situation in congested industrial areas.

Indeed the country will not be fully prepared against attack until the necessary organization has been established and schemes of evacuation worked out.

In a covering memorandum to the report, the Home Secretary, Sir Samuel Hoare, indicates the Government's approval of the recommendations of the Committee and particularly its concurrence in the principle of voluntary but organized evacuation, as well as in that of accommodation of refugees under powers of compulsory billeting. While, however, the report clearly shows that a scheme based on these lines is perfectly practicable and that adequate transport facilities appear to exist, on many points of detail very much remains to be done, particularly in regard to billeting, if the anomalies and even absurdities exposed during the crisis of September last are to be avoided. Something more than a mere count of houses or population is required if billeting is not to become farcical or even have alarming repercussions on the health of the community. Again, evacuation can only be regarded as a palliative, and the recognition of its present necessity should stimulate efforts directed to eliminate that necessity in future, whether by wiser location of industry or by the planning of towns and industrial areas so as to render them less vulnerable.

It should not be forgotten, moreover, that evacuation plans cannot be drawn up in isolation. They must form part of a considered and co-ordinated plan for national defence. Unless, for example, plans conceived in peace-time take into account the probable effect of emergency demands upon the population, not merely of the areas to be evacuated but also of those into which evacuation is to take place, the whole plan may break down at important points, or place intolerable strain upon particular localities or communities. Evacuation, in fact, must be considered with the Government's plan for a national register, whether voluntary or otherwise, which undoubtedly should yield important evidence to test the soundness of the evacuation plans in regard to district details. Moreover, man-power policy must involve more than the institution of a system even for securing the best utilization of the available resources in special skill and training or professional and technical knowledge. It must also have regard to measures which will ensure the continuance of the supply and that its quality is maintained.

From whatever angle therefore this question of national defence is approached, the supreme

* Report of the Commissioner for the Special Areas in England and Wales for the Year ended 30th September, 1937. (Cmd. 5593.) Pp. xii+209. (London: H.M. Stationary Office, 1938.) 3s. 6d. net.

† Report of the Committee on Evacuation: with a Covering Memorandum by the Secretary of State for the Home Department. (Cmd. 5837.) Pp. iv+29. (London: H.M. Stationary Office, 1938.) 9s. net.

importance of a definite and co-ordinated national policy which takes account of all the factors involved and transcends sectional interests or prejudiced views is unmistakable. The danger at the present moment is that the impulse towards effective planning provided by the recent emergency may die out before it has been turned to tangible purpose. Further, in the absence of the elaboration and enactment of a definite policy of defence, private or sectional interests may embark on courses or policies which are inconsistent with the public good; while public authorities left without adequate guidance, whether they do nothing but continue along existing lines or follow some unsatisfactory line, may increase unwittingly the obstacles to the execution of a boldly conceived national plan.

In the face of this complex and difficult situation with its urgent call for a national plan, the opportunity which a defence policy affords for constructive effort should not be overlooked. National defence has qualitative as well as quantitative aspects. It must not merely provide against external threats to the existence of the nation. It must make positive contributions to its welfare. A policy for defence must take account of social welfare as well as of armament production and civil defence. National fitness in the widest sense is an indispensable element in national defence. Wisely conceived, a policy for defence will take account not only of physical training, nutrition, overcrowding, unemployment and other factors affecting the health of the nation. It will have regard also to many of the amenities of life which determine the mental and moral as well as the physical fitness of the people. Planning, whether

civic or industrial, must be conceived not merely to provide more effective protection against attack and more efficient use of the man-power and material resources of the nation, but also to preserve the amenities of countryside, flora and fauna. It involves a land policy which will safeguard no less against the blunders of the past which have increased vulnerability than against the further destruction of national assets and amenities. It may well involve, too, an examination of the functions of local government and national administration and of the size of operating areas, if causes of inefficiency are to be eliminated and obstacles to a national policy overcome.

Nothing would indeed be more short-sighted than a policy for defence which restricted or warped educational development or those ideals of individual freedom of thought and criticism which are rightly cherished in a democracy. A defence policy must appeal to the highest ideals if it is to claim support, and for this reason alone it will be inadequate unless it offers also constructive effort towards international peace and good will, by working towards the removal of causes of international friction. Here indeed is work for education both within and without the frontiers of a State. The development of a national defence policy on such lines under the stress of the recent emergency may give us the stimulus to a plan and a concentrated effort which will overcome alike the obstacles and the threats which sectional or private interests have so long opposed in such diverse fields as road transport, building, town planning, national parks, nutrition and health to measures the desirability of which in the national interest has long been beyond dispute.

British Agriculture

British Agriculture:

the Principles of Future Policy. A Report of an Enquiry organized by Viscount Astor and B. Seeböhm Rowntree. Pp. xx+469. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1938.) 15s. net.

THIS book is the report of an inquiry, organized by Viscount Astor and Mr. Seeböhm Rowntree, into the economic structure of British agriculture. It deals comprehensively with the

main aspects of the agricultural problem, and although its chapters are rather unequal in quality, it provides a valuable addition to agricultural literature.

The volume is divided into five parts. In the first of these the authors examine the possibility of increasing agricultural production by curtailing imports. After considering the issues involved, they consider that protective measures should be limited so far as possible to securing reasonable stability for home producers and to averting

disastrous price fluctuations. In their opinion the future development of the industry should depend on increased production of 'health foods'; such as milk and vegetables, for which farmers in Great Britain enjoy natural protection. They also consider that the industry should be assisted by the State in ways likely to promote the supply of these foods, to increase efficiency in both production and marketing, and to preserve the fertility of the soil. They then examine the economic causes underlying the changes which have occurred in agricultural production in Great Britain during recent years.

Part 2 discusses in detail the economics of crop production, and contains chapters on grass, grain crops, roots and sugar policy, feeding stuffs, potatoes and hops, vegetables and fruit. Part 3 is concerned with livestock and livestock products. In this section there are chapters on cattle, sheep, pigs, poultry, milk production, and milk marketing. Part 4 deals with the personnel and organization of the industry, and discusses the problems of agricultural labour, smallholders, farmers, agricultural credit, landlords, and research, education and advice. Each of these chapters is packed with interesting information, although sometimes they are marred by wrong emphasis and factual inaccuracies.

In this respect, the chapter on milk is particularly unfortunate. For example, the effects of depreciation on milk production costs are considerably exaggerated, and the question of increasing the herd life of the cow, on which great emphasis is placed, is less important than that of increasing its general health. Of course the first condition is likely to follow from the second; but, owing to the more rigorous selection necessary in an attested herd, it is improbable that depreciation will be reduced, at least in the early stages of a cleaning-up policy. Moreover, depreciation at the moment represents only some 10 per cent of the total costs of milk production, or 1d. per gallon of milk produced. Again, there is no sound evidence to suggest that in ordinary farming practice high herd mortality is positively correlated with high yields. In fact the Cambridge investigation quoted in the report indicated that there was little difference in wastage between high- and low-yielding herds.

Further, when the authors state that there has been over-much propaganda in favour of high yields, it must be remembered that the yield of 3.5 gallons per day, or nearly 1,300 gallons in the year, at which they claim the dairyman obtains highest economic efficiency, is reached by comparatively few cows, while more than half the herds in Great Britain have an average yield of less than half that amount. In practice, therefore,

the choice is not between yields of, say, 1,300-1,500 gallons but probably between yields of 600-800 gallons. It would also be difficult to substantiate the statement that, on the average, milk yields fall by two-thirds following an outbreak of contagious abortion, while it is surely incorrect to measure the trend in yield per cow by two sets of figures so different as the agricultural returns for 1908 and the Oxford Report on Milk Production Costs for 1938.

Part 5 contains the conclusions. Stated briefly, these are as follows. As the State, through its system of social services, accepts responsibility for the education and health of the people, so also should it accept responsibility for their nutrition. A policy of improved nutrition would enable a large increase in the production of health-protective foods, and particularly of milk, to be undertaken by the British farmer. The milk industry would, in fact, form the central feature of the suggested new policy.

The report recommends that the milk industry be removed from producer control, and organized in some form of public utility; that retail prices should be decontrolled, and that steps should be taken to improve methods of production and distribution. The authors also emphasize the need for propaganda to increase consumption, and the continuation and increase of subsidies from the State in order to supply milk to special categories of consumers. They have been impressed by the increasing inability of landlords to supply the industry with long-term credit, and in consequence recommend the formation of regional land improvement commissions empowered to buy agricultural land requiring long-term capital improvement. By this method the State would gradually extend its function as landowner and would be in a position to influence the evolution of agricultural holdings in directions which seemed desirable.

Emphasis is also laid on the need for schemes of livestock and crop improvement, for agricultural research, and for improved social conditions in rural areas. The authors recognize the necessity of subsidizing British agriculture, but they prefer, and rightly, that the principle of comparative advantage should be adopted within the framework of State subsidies, and that public money should be spent on the production of commodities which will most benefit the community as a whole. They also believe that any form of price guarantee should be designed to limit loss rather than to ensure profit.

Although many of their conclusions are likely to prove unpopular with the farming community of Great Britain, the authors are to be congratulated on their courageous handling of a very complex problem.

Advances in Analytical Chemistry

(1) Qualitative Analysis by Spot Tests:

Inorganic and Organic Applications. By Prof. Fritz Feigl. Translated from the latest German edition by Dr. Janet W. Matthews. Pp. ix+400. (Amsterdam: Nordemann Publishing Co.; London: Crosby Lockwood and Son, Ltd., 1937.) 30s.

(2) Mikroanalytische Nachweise anorganischer Ionen:

Ausführung und Reaktionsbilder. Zusammen- gestellt von Gerhard Kramer. Pp. viii+36+8 plates. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1937.) 5.60 gold marks.

(3) The Analytical Chemistry of Tantalum and Niobium:

the Analysis of their Minerals and the Application of Tannin in Gravimetric Analysis. By Dr. W. R. Schoeller. (Published under the auspices of the Society of Public Analysts and Other Analytical Chemists). Pp. xvi+198. (London: Chapman and Hall, Ltd., 1937.) 21s. net.

(4) Quantitative Analysis:

By Prof. W. C. Pierce and Prof. E. L. Haenisch. Pp. xi+412. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937.) 15s. net.

ALTHOUGH 'spot' methods of analysis are beginning to find their way into text-books, yet Prof. Feigl's treatise is still the standard work on the subject, and by far the most complete exposition of it. Consequently, it is a matter for congratulation that the practical section of the latest (1935) edition (reviewed in *NATURE*, 136, 89; 1935), has been translated into English. The theoretical portion is to be published separately in the future. This English edition is, in some measure, an advance on the original, for it has been brought up to date both by revision and by the inclusion of the most recent work of the author and his collaborators. The majority of these new tests relate to the detection of organic compounds or groups, so that this section now covers a wide field.

Dr. Matthews has succeeded admirably in her role as translator, and one would scarcely have detected that it was a translation but for the use that is made of certain German forms, such as iron (III) chloride instead of our ferric chloride, and that the various publications cited are abbreviated as in the *Chemische Zentralblatt*. The text

contains a number of errors and misprints, some of which have been carried over from the original, while others have been introduced during translation. Fortunately, it is only occasionally that mistakes are found in the actual description of the methods of carrying out the tests, and these are fairly easily detected from the accompanying discussion or from the lists of reagents.

The simplicity of 'spot' tests and the ever-widening range of their usefulness are such as to render this treatise worthy of study by all English-speaking investigators who have anything to do with chemical analysis.

(2) Dealing also with qualitative micro-analysis, this little volume describes tests which are suitable for carrying out with the aid of a microscope. The author has confined himself to the detection of the more common ions, and has chosen reactions that give rise to crystalline forms easily detected or having distinctive colours. He has carefully described the best method of performing these tests in order to secure definite results, but, for this purpose, he has employed pure chemicals and, in many cases, in given concentrations; whether such favourable results are obtainable under the variable conditions to be expected in ordinary analytical work is doubtful.

The tests described by the author are carried out after the usual group separations have been made and, even so, many of them require further separations inside the groups. Thus cadmium is identified either as oxalate or as the double chloride with rubidium chloride: in each case a prior removal of copper is necessary. Similarly, antimony must be separated from arsenic, manganese from zinc, nickel from cobalt and calcium from strontium. The tests are, therefore, mostly confirmatory ones, and are neither so specific nor so elegant as those carried out on filter paper or spotting plates. Nevertheless, there is great scope for the use of the microscope in qualitative analysis, and this monograph, which is well illustrated with many photomicrographs, will serve as a useful introduction to what can be a most fascinating study.

(3) The quantitative separation of tantalum and niobium has been attempted by many chemists during the past hundred years, but it is only recently that Dr. Schoeller and his co-workers have succeeded in achieving acceptable results. The monograph under review describes the methods they have adopted, not only in estimating these elements in the presence of each other, but

also in effecting separations from other metals, particularly those which occur in mineral association with them. The difficulties of the problem have been due partly to the chemical similarity of niobium and tantalum but more particularly to the ease with which their hydroxides, as well as those of certain other earths, can lose their specific behaviour when in admixture, by adopting the properties of the major constituent of that mixture. This phenomenon is attributed by the author to the structural similarity of the hydrated oxides when produced by hydrolytic precipitation, so that the primary sol particles of the colloidal precipitate are heterogeneous, being formed in a manner not unlike that of a mixed crystal.

The volume is well produced and excellently written. The various methods are clearly and concisely described and are illustrated by numerous tables indicating the results obtained by the author in the different separations. There are also interesting chapters on those compounds of tantalum and niobium which are analytically important, on the chemical composition of minerals containing earth-acids and on the use of tannin in other analytical investigations. In addition, there is a section on the qualitative analysis of these metals, and a summary of the original papers on which the text of the monograph is based.

(4) This text-book, although compiled for first-year university students, covers a wide field, while some of the theoretical matter is quite advanced. The work is divided into four sections, the first of which deals with the usual fundamental principles, the use of the balance and the errors and precision of chemical analysis. The second part deals with volumetric analysis, this being treated at some length and in a very comprehensive manner. The different procedures are simply and clearly described, while often there are appended notes which connect theory with practice or emphasize the precautions that must be observed.

The part on gravimetric analysis, introduced by an excellent chapter on the theory of precipitation, contains comparatively few exercises, the intention of the authors being to illustrate the various types of methods rather than to provide schemes for the analysis of many elements. This section concludes with a description of the complete analysis of limestone. Part 4 deals briefly with special methods such as electrodeposition, electrometric titrations, colorimetry and the use of physical methods in analysis. There are the usual tables, while the text is also liberally besprinkled with questions and problems. Like many other American publications, it is excellently printed and attractively bound.

G. R. D.

Exploring in Central Asia

The Silk Road

By Sven Hedin. Translated from the Swedish by F. H. Lyon. Pp. viii+322+31 plates. (London: George Routledge and Sons, Ltd., 1938.) 18s. net.

IN 1935, towards the end of the journey chronicled in this volume, Dr. Sven Hedin marked the fiftieth anniversary of his departure on his first journey in Asia, to the exploration of which he has devoted his whole life. In congratulating him on the unimpaired energy and courage which enabled him to endure the hardships and dangers of Sinkiang in a state of civil war, we add our felicitations on the confidence and respect for his character and achievement shown by the Chinese, notoriously suspicious of foreign men of science, which induced their Government to entrust him with a mission of, to them, signal importance.

The expedition into Sinkiang here recorded started in the autumn of 1933. It was the outcome of certain suggestions made by the author in relation to the position in Sinkiang, the last remaining of the outlying provinces of the Chinese Empire. In consequence, he was invited by the Chinese Government at Nanking to plan and survey

motor roads into the heart of Sinkiang across the Gobi Desert, one of the measures he had suggested to preserve and consolidate the influence of the Chinese Government in the province.

Dr. Hedin's decision as to the most suitable route fell upon the old Imperial road across the Central Asiatic tract, the so-called "Silk Road"—the title apparently is modern, and due to von Richthofen—which had been first traversed more than two thousand years ago, and in its total length of six thousand miles from China to Tyre, had been, as the author puts it, "from a cultural-historical standpoint the most significant connecting link between peoples and continents that has ever existed on earth". By adopting this route it was calculated that a journey to Urumchi, which took a caravan three months, could be accomplished in ten to twelve days.

Of the author's adventurous journeys, this latest was the most dangerous and nerve-racking. The outward journey to Etain-göl was not without its incidents; but although they caused delay, and also anxiety, they were such as might be expected to happen on a journey by car and lorry

in early winter over rough tracks and frozen rivers. When, however, the party crossed into Sinkiang, which, so far as they had been able to ascertain, was reported 'quiet', they found themselves involved in the struggles of two opposing forces, of which one, that of the Mahommedan Tungan leader, was at the point of defeat. They were imprisoned by both forces in turn, and came within even less than the proverbial hair's breadth of being shot. They were detained so long at Urumchi, the turning point of their journey, that an expedition, which had been planned to take eight months, was prolonged to eighteen. The return from Urumchi, including time which was spent in surveying the "Silk Road" and at other

necessary halts on the way, occupied only fifty-three days.

Dr. Hedin describes the outward and return journeys with his customary attention to relevant detail, but his reflections on the general situation, illuminating in their bearing on its development since his book was first published in Sweden in 1936, tend to overshadow the interest of his topography. In view of the Russian economic and political predominance in the province, the author thinks that Sinkiang will be the field of the struggle between Russia and Japan for predominance in the East. China, which has endured for four thousand years without any outstanding military achievement, will, he holds, survive present trials.

An Exposition of Marxism

The Marxist Philosophy and the Sciences

By Prof. J. B. S. Haldane. Pp. 183. (London: George Allen and Unwin, Ltd., 1938.) 5s. net.

PROF. J. B. S. HALDANE is, by his own confession, a recent convert to the philosophy of Marx, and with the characteristic zeal of the convert wishes others to share his faith. If it is necessary or useful for scientific workers to have an explicit philosophy, Marxism is certainly more stimulating than the various brands of positivism that have been popular. It does at least suggest that scientific knowledge is important. Prof. Haldane begins with a brief general sketch of Marxism. He then discusses a number of present-day problems, mathematical, physical, biological and sociological, on this basis. He quotes a number of excellent comments that were made by Engels on the science of his day and are still relevant and illuminating.

As usual, Prof. Haldane displays an astonishing encyclopædic knowledge of science, and is interesting and lucid—except for one point. He does not succeed in dispelling the fog that surrounds the uses of the term 'dialectic'. The mildest use seems only to imply that in any complex system of things, people, or thoughts, opposing forces or tendencies are at work, so that processes are likely to oscillate first one way then another between extremes. The fiercest use seems to mean that Marxist opinion is always right, even if it is wrong, because it is dialectical, and everyone else's always wrong, even if it is right, because it is not dialectical.

Hegel's dialectic, taken as a description of the psychology of thinking in terms of a Heraclitean 'strife of opposites', is not without value. As a

statement of what is logically valid for thought it rests upon a misuse of such terms as 'contradiction' and 'negation' and therefore is confused, if not entirely wrong. Hegel tried to display the universe as a product of thought and this was, as many suppose, a fatal error. Marx tried to correct the error by inverting the Hegelian method. He treated thought as a product of human activity within a universe that is in itself other than thought. This may be an improvement: but he took over the Hegelian dialectic, inverted but retaining its inherent confusions. Heraclitus, who lived before logic had been invented, may be pardoned for stating his doctrine of 'the strife of opposites' without regard for logical rules, but his modern followers ought not to claim so much licence. In particular, the advocates of dialectic ought not to use the logical fact that every proposition has one contradictory and one only, to infer that in any situation there can be only two opposed tendencies or processes, whereas there may be many. The doctrine that the course of human history can be predicted rests on this assumption, and might be true if it were valid. In some instances the assumption may be harmless, but it is at best an over-simplification and a hindrance to clear thinking. Another source of difficulty is the notion that double negation has some mysterious virtue unknown to strict logic.

This is perhaps less a review of Prof. Haldane's book than an attack on dialectic. But while its dialectical confusions remain, the Marxist philosophy can scarcely be as helpful to scientific workers, or anyone, as the author would wish it to be. Possibly he is the man to put them right.

A. D. R.

A Catalogue of the Ammonites of the Liassic Family Liparoceratidae in the British Museum (Natural History)

By Dr. L. F. Spath. Pp. ix + 192 + 26 plates. (London: British Museum (Natural History), 1938.) 30s.

THIS work has a much wider significance than might be inferred from the fact that it deals with only one family of ammonites, and that a comparatively short-lived one. Unlike most writers on ammonites, the author attaches but little importance to phylogeny which is based on the evidence of ontogeny. Previous work on the family Liparoceratidae has been done by Hyatt, Buckman, and Trueman, and their conclusions rest mainly on the assumption that the phylogeny of an ammonite may be seen in its ontogeny. According to these authors, the evolute capricorn Liparoceratids were ancestral and gave rise, through the dimorphs, to the involute spherocoones.

In the view now put forward by Spath this order of evolution is entirely reversed. He maintains that the more or less involute (closely coiled), often spherocoone, Liparoceratids are ancestral to the more evolute (dimorph) forms, and that these in turn gave rise to the capricorns, which are the most evolute Liparoceratids. This order of evolution is borne out by the stratigraphical succession which, owing largely to the work of Dr. W. D. Lang, is now known in much greater detail than hitherto, and shows that there are no capricorns among the early Liparoceratids.

In his systematic and phylogenetic work, Spath relies mainly on resemblances in the characters of the adolescent and adult stages, on the existence of passage forms, and particularly on the order of appearance in time of different ammonites. He considers that the value of small differences in the suture line has been greatly over-rated; that the position of the siphuncle in the early stages of development is too variable to be of importance; and that too much stress has been laid on the configuration of the earliest whorls. He shows that new characters often appeared in the younger stages of development, and, as evolution proceeded, spread to later whorls.

The numerous and excellent illustrations will enable readers to follow in some detail the author's views on the evolution of the Liparoceratidae, and the glossary of technical terms will be of value to those who have not made a special study of this group of fossils.

Fernsehen:

die neuere Entwicklung insbesondere der deutschen Fernsehtechnik. Vorträge von M. von Ardenne, Dr. F. Banneitz, Dr. E. Brüche, W. Buschbeck, Prof. Dr. A. Karolus, Dr. M. Knoll, Dr. R. Möller, Prof. Dr. F. Schröter. Herausgegeben von Prof. Dr. Fritz Schröter. Pp. vi + 260. (Berlin: Julius Springer, 1937.) 21 gold marks.

IN the autumn of 1936 the German Society of Electrical Engineers (Elektrotechnischer Verein) and the German Post Office arranged a course of lectures on

television at the Technische Hochschule, Berlin. These lectures were intended to give to a technical audience an introductory survey.

The present book is based on this course and contains the contributions of the various lecturers (most of them well-known specialists in their subjects) in abstracted form. The book covers the ground very well. It deals not only with the electron optical systems of television, but devotes also adequate space to the mechanical systems. It pays special attention to the problem of transmitting television signals by radio or by cable and also contains a chapter on large-screen television.

The treatment of the subject by the various contributors is as a rule clear, though naturally concise; and the essential points are well brought out. The only notable exception is the discussion of the optical efficiency of mechanical scanners, where some vague statements are made.

The book is a valuable addition to the few existing text-books on the subject, though its main use to English workers will be as an account of German tendencies and the state of development reached by the end of 1936.

A. B.

The Principles of Soil Science

By Prof. Alexius A. J. de Sigmond. Translated from the Hungarian by Prof. Arthur B. Yolland; translation edited by G. V. Jacks. Pp. xiv + 362 + 4 plates. (London: Thomas Murby and Co., 1938.) 22s. 6d. net.

PROF. DE SIGMOND'S "Általános Talajtan" has been translated into English and adapted by omitting the sections on soil physics and microbiology from the agronomy section, and other material of only local interest.

Part 1 deals with soil genetics. The chemical composition of rock-forming minerals is not given, the author stressing the point that it is the chemically weathered part that is of particular significance in soil formation and the development of soil character. The relative influence of soil-forming factors is fully discussed and the effect of climate on soil development well portrayed. In the agronomy section the chemical properties of soils are described and their method of presentation leads logically to the system of classification adopted.

The main section of the book—soil systematics—is treated from a novel aspect, as the classification is based on the results of leaching experiments. It is fully comprehensive, is based on the characteristics of the soil and in addition is claimed to depict the genetic and dynamic character of the soil. Twenty-five soil orders are described and each is subdivided into main types of which the eight in soil order XI largely cover the range of useful soils.

Part 4—cartography—contains useful suggestions for the mapping of small areas and the dissemination of useful advice to farmers in the form of practical soil maps showing one variant each, for example, need for lime, pH values, manurial requirements, etc. Four well-produced plates are included in an appendix to this section.

J. W. B.

Physics and the Physicists of the Eighteen Seventies*

By Sir Ambrose Fleming, F.R.S.

IN 1874 the Physical Society of London was founded by a well-known physicist, Prof. Frederick Guthrie. The first meeting of the Society was held on March 21, 1874, in Guthrie's lecture room in the Science Schools, South Kensington, and by his great kindness I had the privilege of reading the first paper to the members, the subject being "The New Contact Theory of the Galvanic Cell".

Let us then take a glance backward at the state of physics in the years 1870-1880, and the men who were foremost in advancing it. We may divide them into two broad classes. There were first a few who were highly competent mathematicians and conformed to the model of Newton in being able not only to wield the powerful weapon of mathematical analysis but also were competent experimentalists. In Great Britain at that time this class was chiefly represented by Sir George Stokes, Lucasian professor of mathematics in the University of Cambridge, by Sir William Thomson, who had held the chair of natural philosophy in the University of Glasgow since the time when he was twenty-two years of age, and by his enormous knowledge, brilliant experimental researches and practical inventions held a foremost place in universal opinion as a physicist. Then next by James Clerk Maxwell, who, even as an undergraduate, had made notable contributions to mathematics and physics. He had translated Faraday's physical conceptions into mathematical language, explored the phenomena of colour, laid firm the foundations of the kinetic theory of gases and made important measurements of the viscosity of air. He had held professorships of natural philosophy at Aberdeen and King's College, London. In 1865 he had resigned this latter appointment and retired to his Scottish estate at Glenlair to engage in writing his great treatise on "Electricity and Magnetism".

Peter Guthrie Tait was then professor of physics in the University of Edinburgh. As a mathematician he had inherited the mantle of Sir W. R. Hamilton, the inventor of quaternions, but Tait also made many very important contributions to experimental physics. Then in the same rank of great mathematical physicists, we had in Germany Helmholtz and Kirchhoff; in France, Cornu, and in the United States, Willard Gibbs. On the other hand, there were many eminent physicists who,

like Faraday, had not much mathematical knowledge, but attained their results purely by experimental work. Among these in the eighteen seventies, John Tyndall was one of the most popular. He had very great abilities as an exponent of science. J. P. Joule had made the most valuable contributions to physical measurements by his proof of the so-called Joule's law in electricity and in his determinations of the mechanical equivalent of heat. A reprint of Joule's scientific papers was issued by the Physical Society in 1884.

Very prominent in this group was William Crookes. He had, like many of the experimental physicists, begun as a chemist. Crookes discovered by spectrum analysis the element thallium, and had isolated the metal and determined its atomic weight. Crookes had then turned to research on electrical discharge in high vacua. He had improved methods of vacuum technique and had rediscovered many important facts concerning electric discharge in high vacua noticed by Hittorf, Pöluj and others. Finally he devised the light-mill or radiometer.

Another of this group was J. H. Gladstone, the first president of the Physical Society, and he also was first of all a chemist and latterly an experimental physicist. His work on refractive indices was of special importance. Neither must we omit to mention in this group the name of Frederick Guthrie, who made several very important additions to physical knowledge. Other experimental physicists of that date were R. B. Clifton at Oxford, W. Grylls Adams and G. Carey Foster in London, Balfour Stewart in Manchester. Prior to about 1866, there were in Great Britain scarcely any laboratories properly equipped for research or teaching in physics.

The necessity for quantitative work, especially in electricity, had been emphasized by the technical advances in telegraphy. In 1856, a far-seeing man, Cyrus Field, had conceived the idea of a trans-Atlantic submarine cable to unite Great Britain and the United States, and had formed a company in 1856 to undertake it. But the question at once presented itself whether signals could be sent through such a long cable quickly enough to enable a sufficient income to be earned to pay the interest on capital and also the working expenses. Faraday had been consulted, and pointed out that such a submarine cable was a large condenser or Leyden jar, but he thought signals might be sent through it sufficiently quickly to make it pay..

* From an address delivered before the Physical Society on January 12.

Here we see the immense power of mathematical analysis guided by correct physical ideas. In 1855 William Thomson, then a young professor, sent a paper on the theory of the electric telegraph to the Royal Society. Assuming the cable to have certain resistance and also electrostatic capacity per mile, he proved that when a steady electromotive force was applied at one end the outgoing current at the other rose up gradually according to a certain curve of arrival. The time taken to reach a certain current strength was directly proportional to the square of the length of the cable and directly as the product of the resistance and capacity per mile of the cable. This showed that the right method for signalling was to have as sensitive a detector as possible at the receiving end and to use the lowest possible applied electromotive force at the sending end. Thomson had meanwhile invented and made his sensitive mirror galvanometer for cable signalling.

By 1865, three Atlantic cables had been laid and lost. But in 1866 success finally crowned the efforts of the promoters and a fourth cable was made and laid and the 1865 cable raised and repaired. Thus two complete Atlantic cables effected communication between England and the United States, which were worked with Thomson's instruments. In 1870, Thomson invented his remarkable syphon recorder to receive and print cable messages, and this has remained to this day the standard instrument for all cable reception.

Thus the year 1870 saw the practical achievement of submarine telegraphy accomplished and the invention of the instruments needed for working. From that time the making and laying of submarine cables became a particularly British industry.

But the same year (1870) witnessed another event of great importance with regard to physical research, namely, the founding of the Cavendish Laboratory at Cambridge. Although some attempts had been made to foster physical research there, the University was without means to provide for it. In October 1870, the seventh Duke of Devonshire, then Chancellor of the University of Cambridge, sent a letter to the Vice-Chancellor offering to defray the cost of erecting and equipping a physical laboratory in the University. This munificent offer was gratefully accepted. In March 1871, Maxwell was elected as the first Cavendish professor of physics. The building of the Laboratory was completed early in 1874. A year before, in 1873, Maxwell had published his great treatise on "Electricity and Magnetism", and physicists everywhere were trying to master the new ideas he had introduced into the subject. He had embodied in it his earlier work of expressing in mathematical language Faraday's ideas of lines of electric and magnetic force and of the dielectric

as the true seat of the energy involved. He had also included in the second volume a reproduction and exposition of his great paper sent to the Royal Society in 1864 on "A Dynamical Theory of the Electromagnetic Field". In this paper he had shown that electric and magnetic effects are propagated through space with a velocity equal to that of light in the medium and had foretold the existence of the electromagnetic waves now utilized to give us radio-telegraphy and telephony.

After Maxwell's death in 1879, I remember that an eminent mathematician, Sir W. D. Niven, said to me that he regarded this paper with its wonderful originality and power to be one of the greatest productions of the human mind.

In his introductory lecture given by Maxwell in October 1871 on his installation as Cavendish professor, he had expressed his ideas of the aim and functions of the Laboratory. He did not contemplate its main use to be that of training undergraduate students in the repetition of experiments described in text-books, but that its principal object should be quantitative measurements and the production of new knowledge by research by post-graduate or other students. Very magnificently has this ideal been held in view by Maxwell's successors in the chair.

Another event in the year 1870 which had an influence on physical research was the taking over by the State of the telegraph system in Great Britain. Up to that time, land telegraphy had been conducted by several public companies each with its special area of operations. This of course greatly limited the use of the electric telegraph.

The Government of that day passed Acts of Parliament in 1868 and 1869 entitling it to buy out, take over, and place under the General Post Office all telegraphic work in Great Britain. At the same time, it was greatly extended and the country overlaid with a network of telegraphic wires enabling communications to be made between all places where there was a post office. This called for the production of practical standards of the electrical units such as the ohm, the volt, the ampere, the farad, and accurate methods of electrical measurement. A British Association Committee had constructed a number of coils of wire of various alloys the resistance of each of which was asserted to be at certain marked temperatures equal to 10° absolute units of resistance on the electromagnetic system. These had been deposited in the Cavendish Laboratory.

When I went up to Cambridge in October 1877 to work in the Cavendish Laboratory, Maxwell suggested to me to undertake the work of comparing these coils and ascertaining from them their resistances at certain temperatures and hence the most probable value of the B.A. Unit.

For this purpose I devised a special form of Wheatstone's bridge which was described to the Physical Society in 1880. I prepared, as the result of about two years work, a chart showing the variation of resistance with temperature of each of the coils. The true absolute values of these were determined later on (after Maxwell's early lamented death in November 1879) by Lord Rayleigh, who was Cavendish professor until 1884. This B.A. Unit proved to have an electrical resistance of 0.9887×10^9 centimetres per second or less than a true ohm of 10^9 cm./sec.

Part of Maxwell's work during the last years of his life comprised the editing for publication of the unpublished electrical researches of the Hon. Henry Cavendish (1731-1810). Cavendish was an experimentalist of great ingenuity, and with the most rudimentary apparatus carried out important researches. Maxwell repeated with similar apparatus all Cavendish's results. Among other things, Cavendish anticipated Faraday's discovery of specific inductive capacity and made researches to find out if the law of electrical attractions or repulsions varies in any sensible degree from the inverse square of the distance. Maxwell carefully repeated these with improved apparatus and found that the index deviated from 2 by not more than $\frac{1}{1000}$ either way. Cavendish made measurements of the comparative electrical resistance of various materials by taking the shock of a Leyden jar through a certain length of each material and adjusting the lengths until the shocks were estimated to be about equally painful. Most of the workers in the laboratory were called upon at various times to act as 'shock meters' in Maxwell's repetition of Cavendish's experiments.

Maxwell's lecture experiments were always marked by great ingenuity, and he could give copious new information on even the most familiar scientific facts or discoveries. In conversation he was often difficult to understand by reason of a certain paradoxical and humorous mode of speech.

No mention of Maxwell's work would be complete without a brief reference to his other writings, written in the eighteen seventies. He published a treatise on the "Theory of Heat" which had all the characteristics of lucidity and novelty which marked his authorship. In it he gave the elements of the science of thermodynamics and the contributions to it made by Carnot, Clausius, Willard Gibbs, Rankine and W. Thomson. His other small book "Matter and Motion" was a delightfully interesting small treatise on dynamics. It was re-edited with some additions after Maxwell's death by Sir Joseph Larmor. In addition to this he wrote many articles for the ninth edition of the "Encyclopædia Britannica", and in 1878 gave a memorable lecture on "Molecules" to the British

Association at Bradford, parts of which have been often quoted.

We must now return to consider the work of Sir W. Thomson (later Lord Kelvin) during the decade 1870-80 under consideration. He was at this time engaged in improving the mariner's compass. As a yachtsman and the owner of the *Lalla Rookh*, he took an extreme interest in all things connected with navigation, and left his improvements on everything. In 1874, he was asked to write an article on the magnetic compass for *Good Words* and at once took note of the defects of the then used type. Little by little he brought it to a state of perfection in which it was adopted all over the world. He gives a full account of it in the third volume of his popular "Lectures and Addresses". At the same time he vastly improved the method of deep-sea sounding by using steel pianoforte wire instead of hemp rope. The depth was measured by the degree to which the air in a glass tube open at the bottom but closed at the top was compressed when the sea floor was reached. In 1876 he made known his enormously ingenious machines for recording, analysing, and predicting the tides at any port, and in a lecture at Glasgow in 1875 he gave a most instructive account of methods of determining the position of a ship at sea by Sumner circles. His knowledge of everything connected with navigation, tides and waves was vast and accurate, and he touched nothing he did not elucidate and improve.

The decade we are considering was remarkable also for the completed invention of two important electrical appliances, namely, the speaking telephone and the incandescent electric lamp, the achievement of which had long been objects of physical research.

Without reference to early attempts, it is well known that Alexander Graham Bell was the first to produce a simple speaking telephone which was publicly exhibited in 1876 at the Philadelphia Exhibition. Sir W. Thomson saw and used it there and on return to England described it enthusiastically to an audience at the British Association meeting at Glasgow. Bell was actually engaged in trying to effect multiple telegraphy when he stumbled across the principle of his magneto-telephone.

The Bell telephone was a good receiver but poor transmitter. T. A. Edison had meanwhile invented his carbon button transmitter, in which the motions of a sound-actuated diaphragm compressed a button of lamp-black and varied its resistance and therefore the current in the circuit. D. E. Hughes, the inventor of a printing telegraph, then came into the field in 1878 with his discovery of the effects of slight pressure on a loose contact between two pieces of graphitic-carbon. This in time gave

us the modern microphone transmitter. Bell had suggested meanwhile the idea of a telephone exchange, and the Edison and Bell interests in England had to unite to provide the most effective transmitter and receiver.

The problem of incandescent electric lighting had occupied attention for thirty years or more in the endeavour to provide a small unit of light for domestic illumination. J. W. Swan solved the problem early in 1880 of producing a carbon filament by carbonizing a cotton thread which had been parchmented by sulphuric acid and mounting a loop of this carbon filament in a glass bulb exhausted of its air. Edison about the same time carbonized slender filaments of bamboo in horse-shoe shape and also produced an effective carbon filament lamp.

The early lamps gave a light of about sixteen candles at a power expenditure of about sixty-four watts. From that date electric illumination by incandescent lamps became practicable.

In conclusion, it may be useful to attempt to sum up briefly the achievements in physics during the decade 1870-1880. Broadly speaking, it was an age of practical invention in which well-ascertained scientific principles were applied in some way to create new industries or useful arts. In telegraphy there were many very important additions. Wheatstone automatic, quadruplex and high-speed printing telegraphs came into use. The speaking telephone and telephone exchanges added to the convenience of life. Electric incandescent lamps and the invention of the dynamo had made possible public electric supply stations and domestic electric illumination.

In 1873 the reversibility of the dynamo was discovered; that is, that it could act as a motor when current was put into it, and some degree of progress had been made in the use of electric motors and possible electric transmission of power.

In relation to physical theories, the period we are considering was essentially mechanistic and deterministic in ideas. The conception of a universal ether having elasticity and density was widely held and numerous mechanical ether theories proposed. Atoms in vibration were supposed to agitate the ether and produce waves in it, but no one had explained how the vibrating atoms got a grip on the ether seeing that the ether offers no resistance to the motion of the earth and planets through it.

Theories of atomic structure were in a very vague and nebulous state. Thomson's theory of atoms as vortex rings in the ether had not explained anything of importance. The science of thermodynamics had, however, been well developed and much progress made by the writings of Clausius, Rankine, W. Thomson and Willard

Gibbs. The foundation stone of the science of thermodynamics was laid by the publication in 1824 of the remarkable essay by Sadi Carnot on the "Motive Power of Heat" in which he gave the Carnot cycle. This essay was, however, then known to very few. W. Thomson made acquaintance with it when as a young graduate he went for a year to Paris to work with the great experimentalist, Regnault. Thomson published in 1849 a paper in which he made known and expounded Carnot's work. Carnot's essay in French was republished in 1878, having been thus lost sight of for many years, but Thomson's paper in 1849 had by that time brought it to the notice of physicists of that day. Based on the Carnot cycle, Thomson afterwards suggested his absolute scale of temperature independent of any working substance. He also enunciated his Law of Dissipation of Energy. The fact that heat is the kinetic energy of atoms was fully understood and that the whole of any amount of mass kinetic energy could be converted into heat at a certain rate fully appreciated. But it was not so generally realized that the whole of any quantity of heat energy cannot be converted into mass kinetic energy. There was a widely diffused belief in that day that the physical theories corresponded closely to reality and that such words as size, time, mass and energy denoted actualities independent of any observer. Not every physicist, however, shared this view. Maxwell once said in my hearing, "Because we can imagine a mechanism which can achieve some result we find in Nature, it does not in the least follow that it is done in that way."

The physical theories of 1870-1880 were looked upon as well-established explanations of facts. Not ten years later, however, the first of the events occurred, namely, the Michelson and Morley experiment, which was to undermine and destroy this confidence and show that our interpretation of physical phenomena involves the observer as well as the thing observed.

When we come to look back then on the work of physicists during the eighteen seventies, what we find is that their inventions, discoveries of fact, and ascertained principles remain with us to-day of permanent value, forming part of our useful knowledge. But their theories and speculations as to underlying causes and nature have nearly all passed away. Perhaps it will also be the same with our present-day work. If some sixty years hence a fellow of the Physical Society gives a talk on the physics of the nineteen thirties, he will have to record the great additions then made to knowledge of physical facts. But he may also have to say that our explanations and theories concerning them have all vanished, or at least been replaced by others also destined in turn to pass away.

Progressive Education

The Spens Report*

THE publication of what has already become known as the Spens Report is of great significance for the educational system in England and Wales, and its complete or even partial adoption will be of far-reaching importance.

The Consultative Committee responsible for the Report, under the chairmanship of Sir Will Spens, master of Corpus Christi College, Cambridge, was a strong one. Its terms of reference were to examine the organization and so forth of schools other than those administered under the Elementary Code which provide education for students beyond eleven plus years, "regard being had in particular to the framework and content of the education of pupils who do not remain at school beyond the age of about 16". In view of the potent criticism aimed at present-day secondary school education in that, as the Report points out, it generally seeks to satisfy the curricula inspired by the various school certificate examinations, the latter part of the Committee's aim is well timed and of the utmost importance, because it is only a small percentage of secondary school students who eventually proceed to the universities.

To-day, the Board of Education recognizes nearly one thousand four hundred secondary schools, and these contain altogether nearly half a million students. That is, nearly 12 per cent of the child population of secondary school age in the country receive a secondary school education.

The Committee adopted a liberal point of view by considering education "in terms of activity and experience rather than of knowledge to be acquired and facts stored". It was appointed in March 1935 and since that date has examined one hundred and fifty witnesses, while various sub-committees have examined twenty-two witnesses. These witnesses can be taken as widely representing educational thought since they have been drawn from the Board of Education, directors of education and members of local education authorities, associations representing those officials, organizations representing teachers, other organizations, and many individuals including school inspectors, professors of education, psychology and physiology, and head masters and head mistresses of public, secondary, technical and senior schools.

* Report of the Consultative Committee on Secondary Education with Special Reference to Grammar Schools and Technical High Schools. Pp. xxviii+475. (London: H.M. Stationery Office, 1939.) 3s. 6d. net.

GENERAL RECOMMENDATIONS

One of the outstanding features of the Report is the revolutionary changes suggested in secondary school organization and classification, to be outlined in the next section. This is doubtless due to the realization that the aim of secondary education is now not to train children "to work with their heads rather than with their hands", for conditions have now changed: democracy is challenged and "the duty of citizenship in a democracy renders it essential that all should be taught to understand and to think to the best of their ability". Those children who are capable of thinking best in abstract terms would undoubtedly derive greatest benefit from the academic training of the Grammar and Technical High School. But it is equally as important that many children, some of them of marked ability, would profit best by a Modern School education. This being so, careful allocation of children at eleven plus years from the primary schools to these schools is a matter for serious consideration.

In view of this, the Committee directs attention to the unfortunate fact that Grammar and Modern Schools are at present administered under different codes and often by different authorities. Differentiation goes even further in the scales of teachers' salaries, types of buildings, quality of equipment, size of classes and so forth. To eliminate this, it is suggested that all secondary schools—Grammar, Modern and Technical High Schools—should be placed on an equal footing so far as these conditions are concerned. The maximum size of classes should be thirty, and (with special permission of the Board of Education) should never exceed thirty-five. It is suggested, too, that all fees should eventually be abolished as soon as the financial condition of the State renders this possible.

SCHOOLS AND THEIR CURRICULA

A revolutionary change in the organization of schools offering a secondary education is visualized in the Report. It should be possible for children of eleven plus years to be transferred to one of three types of secondary school, namely, the Grammar School, the Technical High School or the Modern School (at present known as the Senior School—a term used by the Board of

Education to designate both selective and non-selective Central Schools). Transfer between these schools should be possible at thirteen plus years, but attendance should be compulsory at one or the other of them up to sixteen years. Transfer at thirteen plus years should also be possible to technical schools, which include Trade, Junior Technical, Home Management and Junior Commercial Schools: but here also, attendance up to sixteen years should be compulsory. In all types of schools, education should be brought into closer contact with the practical affairs of life, and the first two years of all schools should have a common curriculum.

Education in the Grammar School should be suitable for students passing on to the universities: but reconsideration of the curriculum in these schools is now essential. There is, at present, a grave tendency to over-work and over-strain the adolescent students, especially in girls' schools.

The curriculum in Grammar Schools should allow for the teaching of all subjects allowed at present, so far as this is possible. Proposals have already been made for a greater unification of the subjects, but these should be treated with the utmost caution. It is not certain, for example, that geography, if combined with history, could retain the distinctive character which it has achieved in the hands of modern scholars. Yet, there is much to be said for the intimate alliance between subjects, provided the essential autonomy of each is preserved. The teaching of physics and mathematics, for example, suffers much from a separation which Newton would have found incomprehensible. Subjects are also needlessly subdivided—a subdivision which in some cases, for example, mathematics (the separation of plane from solid geometry, of elementary calculus from algebra), physics and biology (for example, neglect of zoology compared with botany), tends to distort rather than bring out the characteristic architecture of the subject.

The curiosity of children of secondary school age about the practical concerns and activities of the world is frequently so strong as to amount to a passion. Advantage should be taken of this in order to bring the studies of the secondary school into closer contact than at present with the practical affairs of life. In mathematics, physics and chemistry, for example, the 'problem method' should be the standard mode of procedure—practical questions of wide interest and utility being made the occasion for the introduction of new mathematical or scientific knowledge and technique. If the utility phases were adequately developed in all subjects, everything which those concerned about 'education for citizenship' rightly demand would probably be granted.

Important defects in the teaching of mathematics are emphasized in the Report. This is ascribed to an imperfect synthesis between the idea that some parts of mathematics are useful to the ordinary citizen or to certain widely followed vocations and should therefore be taught to everybody, and the old idea that when mathematics is not directly useful it has indirect utility in strengthening the process of reasoning and in inducing a general accuracy of mind. It is suggested that mathematics can be put on a sound footing only when it is taught as other subjects should be taught, since it is one of the main lines which the creative spirit of man has followed in its development.

The approach to science, too, needs readjustment. It should not be by way of a systematic study of particular sciences, as is the method adopted in most schools. This feeling has already led, in some schools, to the provision of courses in general science as an alternative to courses in particular sciences. This general science tends to relate science to everyday experiences. It avoids what is of a purely academic nature and illustrates laws and general principles by special reference to practical applications drawn from the physical and biological worlds. In this way, general science makes more direct contact with life and creates real interests.

The teaching of science has lost close touch with life itself, and for this reason has often failed either to give the knowledge required or to stimulate the student's interest. The Committee believes that there is a general body of knowledge, not confined to either the physical or biological sciences as they are generally considered, which ought to be known by the average citizen. In boys' schools especially, science is too often restricted to the physical subjects. It is now suggested that in science teaching the pupils should be given some knowledge of the natural laws which operate in the universe. It should reveal the influence of scientific thought and achievement on the evolution of our present-day civilization, and it should show the possibilities (for good and for evil alike) in the future of the human race. The appeal here is to social interest and social utility.

Therefore, in physical sciences should be included astronomy (since the earth is only a very small portion of the whole), physics, chemistry and possibly some geology. Some astronomy is considered to be essential. In chemistry, a certain amount of organic studies, such as fermentation and saponification, should find a place, as they do in most American schools. The approach to biology should be through natural history, with primary emphasis on plants. This should merge later into the general characteristics of living organisms, taking examples from plants, and animals, including man.

In country Grammar Schools full advantage should be taken of the rural environment. Though the reforms suggested for the urban Grammar Schools apply also to rural Grammar Schools, it must be realized that the latter have special difficulties and special advantages. The resources of the countryside are at the disposal of the teacher. Rural schools enjoy unrivalled opportunities for framing syllabuses which have a high practical value derived from their close affinity to the world outside the school, and at the same time should develop in the student an inquiring and critical mind and the power of independent judgment.

Among the features prominent in the curriculum of a rural Grammar School should be the local survey and the school garden. A general local survey could be the basis of much geography and history teaching. The school garden, apart from its intrinsic merits as a means of teaching biology and agriculture, could be an agent in agricultural research such as the testing of new fertilizers. Sir John Russell stated that this has already been done in certain schools in connexion with the Rothamsted Experimental Station, and the pupils realized that they were being employed in a joint enterprise by a great scientific institution and that this was not an exercise book problem but "something which mattered". Bee-keeping and poultry husbandry should be encouraged in the rural schools. Elementary mathematics should be based on the farm and the local survey; material and statistics should be taken from them. Science should have a biological bias, and domestic science should include training in the utilization and conservation of farm and garden produce.

The technical schools of the Report include Trade Schools, Junior Technical Schools, Home Management and Junior Commercial Schools. These have developed their curricula on a broad scientific, utilitarian and vocational basis, and thus offer appropriate courses for a certain type of pupil. In this they are justified, but the Committee does not consider that they offer a real alternative to the Grammar School, and therefore it has suggested the institution of a new type of school, namely, the Technical High School.

The Technical High School should provide good intellectual discipline apart from the more purely technical training. Therefore, during the first two years, teaching should be of a general secondary school type. In other words, this school should develop a curriculum designed to provide a liberal education, with science and its applications as the core of inspiration. The subject material should include English, history, geography, mathematics, science, engineering drawing, handicrafts, physical education, aesthetic subjects, and a foreign language (preferably German) where the

student shows special capability of profiting by it. The method of teaching science in the Technical High School will clearly be different from that adopted in the Grammar School. The Technical High School should also offer a new type of leaving certificate having the same status as the first school examination, that is, fulfilling first conditions for matriculation.

FIRST SCHOOL CERTIFICATE EXAMINATION

The present first school certificate examination is subjected to severe criticism in the Report. It is remarked that the examination should follow the curriculum, not determine it. Profound changes in the syllabus are recommended, and it is suggested that greater use be made of school records.

In its present form, the school certificate tends to enforce uniformity in the curriculum. This is probably due to the fact that it is used as a test of education received and as a means of exemption for matriculation into the universities. It should not be used as a substitute for the matriculation examination, but should be a conditional first step towards the latter.

Greater freedom of choice of subjects should be allowed. There should be a reduction in content of the syllabus, and a candidate should be required to pass in at least five subjects, including English and either a foreign language or science (including mathematics). Thus, no candidate would be prevented from obtaining a certificate solely by reason of lack of linguistic or mathematical or scientific ability. The recommended reduction in content of the mathematics course and a simpler course in science would involve greater variation and some lightening of the syllabus; but no lowering of the standard of marking is implied.

Post-certificate work in the sixth form, possibly leading to the higher school certificate examination, should be encouraged for the benefit of students about to enter the universities.

PHYSICAL AND PSYCHOLOGICAL PROBLEMS

Physical and psychological problems receive due consideration in the Report. For example, physical training and physical fatigue and strain are of paramount importance in any school, and to ignore them would necessarily involve serious consequences. The physical growth of the child at puberty and adolescence must be considered in relation to such problems as posture, self-control, etc.

No adolescent, until calcification of the bones is complete, should be allowed to do heavy continuous

muscular work, either in or out of school, particularly if it involves postural fatigue. Risks of spinal curvature must be avoided, and the importance of adequate rest in a suitable position should receive careful consideration.

The onset of puberty must be recognized by the authorities through the characteristic well-marked physical and mental changes, and due allowances made for it. During this period, especially in girls, ample provision should be made for a liberal dietary and well-balanced periods of exercise, rest and sleep.

It is a matter for regret that some authorities do not provide for medical inspection and treatment in Grammar Schools. The practice of medical inspection and treatment should be made universal, and medical officers should be encouraged to undertake a wider scope of inquiry. Meals should be available at all schools, and in arranging

the dietary, the school medical staff should be consulted.

The psychological factors influencing the pupil in his mental development and his education should be studied continuously by the school teaching and school medical staff. These include the general characteristics of puberty and adolescence, mental and intellectual abilities, individual differences and special intellectual capacities, sensory capacities, attention, memory, imagery, reasoning, emotion, social impulses, self-assertion and submission, and so forth. In fact, the application of psychology to the study of the school child is of a special character, and therefore cannot be ignored. All trained teachers have received special instruction in this aspect of their careers, and this should make these problems less formidable than they would otherwise be, but it does not detract from their importance.

The Weather in Great Britain during 1938

By E. G. Bilham

SIR NAPIER SHAW, in the delightful Christmas card which his friends have been privileged to receive, describes the year 1938 as *annus memorabilis*. The description is a happy one, for the year was memorable in many respects. The amount of material available at the moment for the purpose of summing up the features of the year as a whole is relatively small, and we cannot here attempt anything in the nature of a detailed discussion. It has been thought, however, that a retrospect of the more striking meteorological events would be of interest.

The year began with a mild, wet and stormy January. In many parts of England and Wales no temperature below 32° F. was recorded, and in most districts the mean for the month was about three degrees above normal. Gales were numerous, and that on January 14-16 was exceptionally severe. A gust of 101 miles per hour was recorded at St. Ann's Head on January 15. A similar velocity was reached at the Liverpool Observatory on January 29, and 100 miles per hour was also recorded in the Orkneys on January 23. A magnificent display of the aurora occurred on the night of January 25-26.

Conditions in respect to warmth and wind were less abnormal in February, but it produced one of those coincidences of tidal and meteorological conditions necessary for the occurrence of floods on the east coast of England. Such flooding occurs when a wind-induced deepening of the waters of the North

Sea, due to strong winds from the north-west quadrant, coincides with a high-predicted tidal level. These conditions prevailed on the evening of February 12, when the sea burst over the low-lying coastland between Winterton and Palling in Norfolk and flooded an area of the order of fifteen square miles. Later, on April 3, the sea broke through the defences at Horsey and caused a further extensive inundation. The rainfall of February was very deficient except in parts of Scotland, the general fall over England and Wales being about half the normal.

The shortage of rainfall south of the Border was accentuated in March, when the general fall for England and Wales was only 27 per cent of the normal. It was the driest month of that name at many stations. On the other hand, parts of Scotland had excessive rainfall, as much as 50 inches being recorded at Loan (Loch Quoich). The month will also be remembered for its remarkable warmth. Previous records of mean temperature were exceeded by a substantial margin. For example, at the Radcliffe Observatory, Oxford, where records on a comparable basis are available back to 1815, March 1938 gave a mean value exceeding the previous highest (1822, 47.3° F.) by as much as 2.6° F.

April continued the sequence of dry months. For the British Isles as a whole, it was the driest April on record, and probably the driest month of any name. The total rainfall of the three months

February to April 1938 was less than that of any similar period back to 1785. Some rural districts experienced an acute shortage of water. Severe frosts during the periods April 9-11 and again about April 18-19 caused much damage to the blossom and buds of fruit crops.

There were further damaging frosts in the early days of May, the reading of the screened minimum thermometer being as low as 18° F. on May 8 at Thetford, Norfolk. A week later a temperature as high as 79° F. was registered at Norwich and Canterbury. June was rendered noteworthy by the great gale on June 1-2, during which the gusts recorded on the south coast were comparable with those of severe winter storms. This storm produced a remarkable discoloration of foliage of trees in the south of England, due probably to the combined effects of buffeting and salt spray borne inland by the wind.

July was a wet month, with a very marked deficiency of sunshine. A very heavy rainfall occurred in the English Lake District on July 29; the reading amounted to 5.95 in. at Watendlath Farm and to 5.60 in. at Borrowdale.

The first day of August was the warmest of the year, 87° F. being recorded in London on that day. Thunderstorms were frequent and severe during August. During one of these the remarkable rainfall of 6.39 in. occurred at Torquay on Aug. 4.

The early autumn was relatively uneventful, but November was remarkable for exceptional warmth in all districts. On November 5, 70° F. was registered in many parts of east and south-east England. The mean temperature of the month, 49.3° F., was the highest in November at Oxford since 1818. A very severe gale occurred on November 23, the gust velocity reaching 108 miles per hour at St. Ann's Head; 98 miles per hour was registered at Stornoway on November 18.

The abnormal warmth was maintained during the first half of December. There was an abrupt change on December 17, when Great Britain began to be affected by very cold air spreading eastward from the continent of Europe. The wintry conditions lasted over the Christmas holiday period and the southern districts thus experienced the unusual phenomenon of a 'white Christmas'. At Manston, Thanet, during the period December 17-24, temperature remained continuously below freezing point for 147 hours, and at Lympne, Kent, similar conditions persisted for 222 hours, apart from a break of a few hours on December 24. At the latter station the maximum temperature on December 20 was no higher than 22° F. Although the period was certainly the most severe since February 1929, the extreme minimum temperatures were not specially remarkable, the lowest so far reported being 7° F. at Dalwhinnie on December 19.

Obituary Notices

Prof. George Barger, F.R.S.

THE sudden death on January 6 of Prof. George Barger, at the early age of sixty years, has come as a shock to all those, in many countries, who were his friends. Barger was born in Manchester in 1878, his father being Dutch, his mother English; and his childhood in a bilingual home, followed by schooling in Holland, laid the basis of that easy fluency in many languages which so distinguished him in later life. He returned to his native England for his university courses, entering King's College, Cambridge, with a scholarship in natural science, after a year at University College, London. In 1904 he was elected a fellow of King's College.

The fact that Barger was placed in the first class in both botany and chemistry in Part II of the Natural Sciences Tripos seemed to leave the direction of his life's work in doubt; but, though his first appointment was as demonstrator in botany in Brussels, under the late Prof. Errera, the researches which he there began were essentially chemical, and included an ingenious and useful method of determining molecular weights on very small samples, by the comparative measurement of the vapour pressures of solutions. His next appointment was as chemist to the Wellcome Physiological Research Laboratories,

where he had already begun some chemical fractionations of the constituents of ergot, when I became associated with him, in 1904, in a collaboration extending over five active and happy years.

The first stage culminated in 1906 with the isolation by Barger, with F. H. Carr, of the alkaloid ergotoxine, which cleared the subject of a confusing competition of impure 'principles', and opened the way to the discovery by others of a series of related alkaloids, extending over the intervening years to the present day. Then came the recognition in ergot extracts of a series of simple, active amines derived from amino acids; tyramine first, and Barger's synthesis of a series of 'sympathomimetic' amines leading from tyramine to adrenaline; and later histamine, which Barger also first isolated from an animal (intestinal) extract, thus opening the way to important chapters in physiology and pathology. Another simple base which has recently figured prominently in physiological conceptions, acetylcholine, was found a few years later in an ergot extract by Barger's former pupil and co-worker, A. J. Ewins, after Barger himself had gone to an academic appointment in chemistry at the Goldsmiths' College, Lewisham, from which, after some years, he passed to the chair of chemistry at the Royal Holloway College, London.

Barger and I became intimate colleagues for a second period, starting in July, 1914, when we joined the staff of the National Institute for Medical Research, then newly projected by the Medical Research Committee. The outbreak of war a month later deferred all normal plans, sent us into temporary quarters, and absorbed our activities in various urgent and largely separate problems. On some of these Barger did work of the highest national importance, which he would have wished to remain unrecognized. Our direct collaboration came to an end with Barger's appointment in 1919 to the chair of chemistry in relation to medicine, then founded in Edinburgh. Circumstances prevented the full realization of the scheme, which was to have put Barger in charge of the chemical aspects of teaching and research in all the medical sciences; but he retained the chair for eighteen years, and made his department an important centre of research in chemistry, often with a medical or biological outlook, to which workers came from most parts of the world.

Of achievements by those who had been Barger's pupils and collaborators in this period, mention may be made of Harington's work on the structure and synthesis of thyroxine, of which the concluding stage was published jointly with Barger; of Stedman's work on the structure of physostigmine, on artificial analogues of that alkaloid, and on the enzyme, cholinesterase, by depressing the function of which physostigmine and its allies produce their physiological effects; and of the work of Todd and his collaborators, on the structure and the synthesis of the vitamin B₁ (aneurine).

Barger, by himself, and with various collaborators from a number of countries, carried on, in the same period, a series of fundamental researches on the structure of certain alkaloids—carpine, galegine, calycanthine and others—and synthesized the amino acid methionine. Though his interests in biology and medicine, and his contacts with workers in those fields, were wide and numerous, he always regarded himself as a chemist, and was especially gratified by recognitions of the importance of his work for chemistry as such, as by the Longstaff Medal of the Chemical Society in 1936, and by the Davy Medal of the Royal Society, awarded less than two months before his death. His position among leading British chemists had been fitly recognized by his appointment, in 1937, to the Regius professorship of chemistry in the University of Glasgow; but he has not lived to show what he would have made of this wider opportunity.

Apart from the numerous scientific papers published in his own name, and by pupils whom he guided and inspired, Barger published two important monographs, both dealing with interests which he acquired during our early association, and later extended. The smaller of these dealt with "The Simpler Natural Bases"; the larger and later one, based on the Dohme Lectures which he gave in Baltimore in 1928, and dealing with "Ergot and Ergotism", is a masterly piece of work, embodying much patient and scholarly historical research, and

showing an unrivalled scientific grasp of the problems presented by a many-sided and fascinating subject.

Barger received many degrees from foreign universities, and was member of a number of foreign academies; but these honours do not in any way indicate the degree to which he became a truly international figure in science. His acquisition of several languages in boyhood made it easy for him to learn others, and he continued throughout life to perfect his command of those he had, at every opportunity of practice, and to seize every excuse, whether of holiday or congress, to add another to his equipment. He had a mind avid for new information and experience, and travelled often and widely, making friends in all countries. He was eager to become familiar not only with the languages, but also with the historical backgrounds and habits of thought of other peoples, and was constantly active to promote international understanding and good will. He gave and received staunch friendship, but, widely beyond the circle of those who enjoyed his intimate confidence, his loss will be mourned in many countries as that of a great figure in science, and of a generous and understanding colleague. There will be widespread sympathy with his widow, his two sons and his daughter, in their tragically sudden bereavement.

H. H. DALE.

Prof. Ferdinand Hueppe

We regret to announce the death in Dresden at the age of eighty-six years of Geheimrat Ferdinand Hueppe, honorary senator of the Technical School of Dresden, who was not only one of the founders of modern bacteriology but also an eminent authority on public health, biology and the medical aspects of athletics.

Hueppe was born on August 24, 1852, at Heddendorf near Neuwied on the Rhine. He qualified in Berlin in 1876 with a thesis on ovarian and abdominal pregnancy, and for the next nine years served as a medical officer in the army, during which period he paid special attention to systematic physical exercise. In 1885 he left the army and founded a Department of Hygiene and Bacteriology in the Chemical Institute of Fresenius at Wiesbaden. In 1889, he was made professor of hygiene in the German University at Prague and held this appointment until 1912, when he settled in Dresden. In 1903 he delivered the three Harben lectures in London before the Royal Institute of Public Health on the etiology of infectious diseases, hygiene and serum, and tuberculosis respectively.

Hueppe was a prolific writer. In addition to a work on the methods of bacteriological research, and another on the forms of bacteria, he wrote on milk, water, typhoid fever, cholera, alcoholism, vegetarianism, and social and racial hygiene. J. D. R.

We regret to announce the following deaths:

Dr. F. P. Burt, M.B.E., reader in stoichiometry in the University of Manchester.

Prof. A. W. Porter, F.R.S., emeritus professor of physics in the University of London, on January 11, aged seventy-five years.

News and Views

Sir Ambrose Fleming, F.R.S.

At the meeting of the Physical Society held at the Imperial College on January 13, Sir Ambrose Fleming delivered an address on "Physics and Physicists of the Eighteen-Seventies", the substance of which appears elsewhere in this issue (p. 99). At the time of the jubilee of the Society in 1924, five of the ninety-nine original fellows were living; now, in his ninetieth year, and enjoying remarkably good health, Sir Ambrose is the sole survivor. Mr. O. J. (now Sir Oliver) Lodge became a fellow in 1875, the year after the foundation of the Society, and was its president from 1889 until 1901. At the inaugural meeting of the Society, the first paper "On the New Contact Theory of the Galvanic Cell" was read by Mr. J. A. Fleming at the invitation of the founder, Prof. Frederick Guthrie. That paper will be reprinted in the Society's *Proceedings*, together with the address he has now delivered after an interval of nearly sixty-five years. This is an event that must surely be unique in the history of learned societies. In addition to his many other honours, Sir Ambrose received the Duddell Medal of the Physical Society in 1930.

M. Bernard Lyot

THE Gold Medal of the Royal Astronomical Society has been awarded to M. Bernard Lyot, of the Meudon Observatory, France, for his observations and photography of the solar corona in the absence of a total eclipse. In 1868, Lockyer and Janssen showed that prominences could be observed when the sun was not eclipsed. In 1882, Huggins attempted the more difficult problem of observing the corona without an eclipse, and both Hale and DeLandres in 1893 designed apparatus for the chromatic isolation of the green line. These efforts were entirely unsuccessful. M. Lyot went much more thoroughly into the optical conditions necessary to eliminate the diffused sunlight. The light of the sun is a million times that of the corona, and at Meudon the scattered sunlight at 1' from the sun's limb cannot be reduced to less than twenty or thirty times that of the corona, but on the Pic du Midi, after a fall of snow, the stray light on occasions is not of greater intensity than the light of the corona at 1' from the limb. But a very large amount of stray light is incidental in the optical systems usually employed, which M. Lyot has analysed into diffraction round the edge of the objective lens, scratches and bubbles on the lens, and reflected light from the back of the lens. By arranging screens to cut off the light from these several sources, he has succeeded in photographing the inner corona, obtaining a spectroheliogram in light 5303 Å., and measuring the polarization all around the limb; in addition, he has obtained accurate wave-lengths of a number of the emission lines of the corona, as well as the width of the lines.

Prof. H. H. Read

PROF. H. H. READ, who has just succeeded Prof. P. G. H. Boswell in the chair of geology at the Imperial College of Science and Technology, London, received his early training in the Royal College of Science under Prof. W. W. Watts. He was appointed to the Scottish branch of H.M. Geological Survey in 1914, but his career was almost immediately interrupted by the outbreak of the Great War. During 1914-17, he was absent on military service in Egypt, Gallipoli and France. In 1917 he was invalided out of the army and resumed work in Scotland, where he remained until 1931. During this period, Dr. Read spent much time in surveying in the central and northern Highlands, and in Shetland, and as a result developed a special interest in igneous and metamorphic geology. In 1929-30, he served as president of the Edinburgh Geological Society. In 1931, he resigned from the Geological Survey on appointment as George Hardman professor of geology in the University of Liverpool. During the last twenty years, Prof. Read has published a number of important papers, mainly on problems connected with the igneous and metamorphic geology of the north of Scotland and Shetland; and in 1935 he was awarded the Bigsby Medal of the Geological Society of London for these researches. He has been chosen as president of Section C (Geology) for the meeting of the British Association in Dundee this year, an appointment which is peculiarly appropriate, in view of his interest in Scottish geology.

Dr. R. L. Smith-Rose

THE Radio Department of the National Physical Laboratory is, as were the two organizations by the fusion of which it was formed in 1933, occupied almost wholly on work within the programme of the Radio Research Board, and Dr. R. L. Smith-Rose, whose appointment as superintendent of the Department was announced in these columns last week, has been associated with the work of the Board from its formation. Dr. Smith-Rose, who was born in 1894, studied at the Imperial College of Science and has, alone and in collaboration with departmental colleagues, published an impressive array of important papers, some seventy in number, on radio direction-finding, the propagation and attenuation of radio waves, the properties of ultra-short waves, the screening of radio circuits and the measurement of radio field-intensity. His principal work has been in the laying of the scientific foundations of radio direction-finding, alike as an aid to navigation by sea and air and as an essential element in studying the properties and propagation of radio waves in general. From the first adequate survey of the accuracy of closed-coil direction-finding, when the

instrument was the main contributor to the quite serious inaccuracies found, he and his co-workers have continued over the greater part of twenty years an advance which has brought them now, using "the most perfect direction-finder in the world", to the estimation of the natural (propagational) limits to the accuracy of practical direction-finding. The greatest individual landmark on this road was the re-discovery and extension of the Adcock system for the reduction of errors due to horizontal electric forces in the received wave front. The National Physical Laboratory may justly be proud of the fact that the principle embodied in every good direction-finding installation in the world to-day is due initially to one member of its staff, Adcock, and owes its great development to two others, Smith-Rose and Barfield.

DR. SMITH-ROSE, whose D.Sc. (London) was conferred for a thesis on direction-finding, was awarded a Student's and a Wireless Premium of the Institution of Electrical Engineers for contributions to its Journal. He is a member of the British National Committee for Scientific Radiotelegraphy, to which he was appointed by the council of the Royal Society, and has been a prominent participant in all the General Assemblies of the Union Radio Scientifique Internationale, save the first. He participated with the British delegation in the Bucharest meeting of the International Consultative Committee for Radiotelegraphy, is a member of the Wireless Section committee of the Institution of Electrical Engineers, and has rendered valued services as vice-chairman (chairman of the staff side) of the Departmental Whitley Council of the Department of Scientific and Industrial Research.

Geological Society: Medal and Other Awards

THE following awards of the Geological Society have recently been made: Wollaston Medal to Prof. F. D. Adams, emeritus professor of geology and palaeontology in McGill University, for his researches on the Pre-Cambrian rocks and on the influence of high temperatures and pressures on the properties of rocks at great depths in the earth's crust; Murchison Medal to Dr. H. Jeffreys, in recognition of the value of his researches on the constitution and physics of the earth's interior, and in particular of the deductions he had drawn from the analysis of records of distant earthquakes; Lyell Medal to Prof. W. N. Benson, professor of geology in the University of Otago, in recognition of the wide range and excellence of his geological researches, particularly in New Zealand; Prestwich Medal to S. Hazzledine Warren, in recognition of his researches on the geology and archaeology of East Anglia, particularly of the Lea Valley; Bigsby Medal to Prof. A. E. Trueman, professor of geology in the University of Glasgow, in recognition of his outstanding contributions to the knowledge of palaeontology and stratigraphy, particularly of the Coal Measures and the Lias; Wollaston Donation Fund to I. S. Double, for his work on the petrology of sedimentary rocks, especially the Tertiary rocks of the east of England, the Glacial deposits, the Chalk and the Trias; Murchison Geological Fund to Dr.

A. L. Coulson, in recognition of his geological work in India, especially that concerned with earthquakes and meteorites and the survey of Rajputana; a moiety of the Lyell Geological Fund to Dr. W. Q. Kennedy, for his petrological work, especially in connexion with the Tertiary complexes of the Hebrides and the metamorphic rocks of the Western Highlands; a second moiety of the Lyell Geological Fund to Dr. A. Raistrick, for his researches on the minute structure and constitution of coal, and on the past floras of Britain as revealed by the study of peats.

Sir Isaac Newton's Prisms

IT is reported from Italy that three optical prisms formerly belonging to Sir Isaac Newton have now found a permanent resting place in the Museum of Treviso. The prisms in question were originally in the possession of Newton's step-niece, Mrs. Conduitt (1680-1739), who spent some fifteen years looking after Newton's house; until her marriage in 1717, to Mr. Conduitt, Newton's successor at the Mint. They were acquired from Mrs. Conduitt by Count Francesco Algarotti, a Venetian nobleman and a prominent figure in London society during the middle eighteenth century. After many changes of ownership the prisms were deposited some years ago in the Treviso Museum, to which institution they were recently bequeathed by the late Prof. Luigi Bailo. Although there seems little doubt that these prisms were at some time associated with Newton, it is not easy to assess what part they played in the fundamental discoveries and subsequent work of Newton on the dispersion of white light. Signor Algarotti was a great admirer of Newton and was the author of "Sir Isaac Newton's Philosophy explained for the Use of Ladies". In the English translation, published in 1739, we learn (vol. 2, p. 70) that Algarotti had found that the prisms available in Italy were unsuitable for repeating Newton's experiments, but that he had been fortunate enough to receive from England some which proved excellent. Later in the same volume (p. 129) we read "I have myself seen the first telescope [Newton's reflecting telescope] . . . preserved in a city of England . . . with this are treasured up those prisms which the first time differently refracted the rays of light in the hands of our great philosopher. . . ." There is no doubt that from about 1664 onwards Newton used many prisms in his experiments and fortunately one of these, at least, is preserved in Great Britain; it was presented in 1927 to the British Museum by the Rev. H. T. Inman, who in a private publication has very carefully traced its descent from Newton. It is made of flint glass, and confirmatory evidence of its date has been adduced from the nature of the glass.

Science and National Defence

THE Association of Scientific Workers, 28 Hogarth Road, London, S.W.5, has had under consideration the position of science in Great Britain in relation to problems of national defence, and has issued a statement defining its attitude. While the Association regards war as the supreme perversion of science, it

is nevertheless prepared to assist in measures for defence against anti-democratic movements. To this end, it stresses the importance of the immediate formation of an organization to see that the most efficient use is made of scientific knowledge; the following points are put forward for consideration:

"(1) It is in the best interests of the country that scientists should be utilized in scientific work, and that the organization and control of scientific work should be in the hands of scientists.

"(2) The professional organization of scientists should play an important part in drawing up and operating any scheme of organization and also be represented on scientific advisory committees to the defence departments.

"(3) In any scheme of registration, scientists should be grouped on a laboratory basis, no matter whether university, special research or industrial. It is particularly important that scientific workers in industry should be included in any such scheme and not left at the disposal of individual employers. Further, scientists should be consulted now with regard to such organization, firstly on the grounds of efficiency and secondly to secure its democratic working.

"(4) Some machinery should be provided whereby scientists, including those in service departments, may exercise a right of criticism on purely scientific and technical matters.

"(5) It is important that scientific and technical as well as medical education should be maintained in time of war."

New Chancellor at the University of Leeds

On January 17, with appropriate ceremony, the University of Leeds installed the Duke of Devonshire as chancellor in succession to his father, who had occupied that post for nearly thirty years, having succeeded the first chancellor of the University, the Marquess of Ripon, in 1909. The proceedings commenced with a lunch to the honorary graduands and to the representatives of other universities and of local education authorities, given by the Court of the University, in the fine new Civic Hall rendered available through the courtesy of the Lord Mayor of Leeds. The ceremony of installation took place in the Town Hall, in the presence of representatives of all sections of the University, and other universities, of local authorities in Yorkshire, together with other dignitaries. His Grace was received by the vice-chancellor, Mr. B. Mounat Jones, who presented him with the scroll recording his admission to the honorary degree of doctor of laws of the University, and then installed him as chancellor, delivering a brief address of welcome. After the chancellor's response, a number of honorary degrees were conferred. Earl Baldwin of Bewdley and the Right Hon. W. S. Morrison, Minister of Agriculture and Fisheries, were presented for the degree of LL.D. The degree of D.Sc. was conferred upon Sir Arthur Eddington, Plumian professor of astronomy and director of the Observatory, Cambridge, upon Sir John Ledingham, director of the Lister Institute, and upon Dr. J. S. B. Stopford, formerly professor of anatomy and now vice-chancellor of the University of Manchester. In the evening, the Chancellor and the Duchess of Devonshire received the guests at a reception in the University, when

many scientific and technological departments were thrown open, special demonstrations being on view. These exhibits remained open for inspection by the general public throughout the following day.

Botanic Gardens of the World

We have received the second edition of the list of botanic gardens of the world compiled under the direction of Dr. Stuart Gager, director of the Brooklyn Botanic Garden ("Botanic Gardens of the World: Materials for a History". *Brooklyn Bot. Rec.*, 27, No. 3, July 1938. Price 2 dollars 50 cents). Apart from its intrinsic value to botanists, the list will prove helpful to research botanists and teachers of botany who may require information or material from definite localities. In this way, the list forms a sure guide. But there are inconsistencies in the information given concerning each individual garden. This is due to the fact that the compiler has been at great pains to make the information authoritative by obtaining it from the source, namely, the gardens themselves. In this, Dr. Gager experienced certain difficulties, since, though most garden officials supplied all the necessary information, some made no or scant reply to the questionnaires sent. Where the information can be considered complete, it is of great utility. For example, under the Royal Botanic Gardens, Kew, are listed date of establishment, area, list of directors, organization, source of income, library, herbarium, arboretum and fruticetum, plantations, publications, museums, etc. The list is not intended to be simply a guide to existing botanic gardens, but as material for a history of botanic gardens, existing or defunct, and "thus as a contribution to one of the most important phases of the history of the organization and administration of botanical science, from the time of Aristotle to the present". Such a history would receive a warm welcome from all botanists, since we believe no such comprehensive history exists at present. We would suggest one slight improvement in the next edition of this list, which would undoubtedly render reference more easy. The gardens are arranged alphabetically under each country, and the latter in turn are arranged alphabetically. There are, however, no page headings (except page number). It would be a distinct advantage if the name of the country were placed at the top of each page.

Folk-lore and Medicine

At a meeting of the West London Medico-Chirurgical Society on January 13, Dr. J. D. Rolleston read a paper on "Folk-lore and Medicine". He said that since the publication in 1927 of the late Dr. Dan McKenzie's work entitled "The Infancy of Medicine: an Enquiry into the influence of Folk-lore upon the Evolution of Scientific Medicine", the subject of folk-lore in connexion with medicine has attracted little attention in Great Britain, in marked contrast with the enthusiasm which it has provoked on the Continent. The various prophylactic and therapeutic measures in folk-lore medicine, in which the curative methods far outnumber the preventive, can be ranged under one or more of the following headings: (1) trans-

ference of the disease to other persons, animals or inanimate objects; (2) animal, plant or mineral remedies; (3) religious influences, including the invocation of special saints; (4) the healing power attributed to water in the form of wells, springs, fountains and streams; (5) the mystical power of odd numbers; (6) repellent and disgusting remedies, including coprotherapy, for the purpose of drawing out the evil spirit supposed to be the cause of the disease; (7) miscellaneous causes, such as the doctrine of signatures, constriction by rings, charms connected with death or the grave, etc. The diseases and symptoms for which the largest number of folk-lore remedies and preventive methods have been applied are whooping cough, 'ague', including not only malaria, but also as its etymology indicates, any acute fever, epilepsy and convulsions of any kind, rheumatism, consumption, eye diseases, skin diseases, especially warts, cattle diseases, headache, toothache, jaundice, hæmorrhages of any kind, and bites of snakes and scorpions. After giving numerous examples of folk-lore medicine in whooping cough, epilepsy, rheumatism and jaundice, Dr. Rolleston concluded by saying that, though many folk-lore remedies have become obsolete, some are still practised, not only by the inhabitants of remote country districts, but also by educated persons in large cities.

The New Deal in Education in the United States

THE Federal Government of the United States seems likely, in future, to play an increasingly important part in the education services of the States. A summary has recently been published ("The Federal Government and Education". Washington, D.C.: Superintendent of Documents. Price 10 cents) of certain findings and proposals of the President's Advisory Committee on Education relating to present conditions with special emphasis on inequalities of educational opportunity, the national interest in education and proposals for federal grants amounting in 1939-40 to 72 million dollars and increasing gradually to 202 millions in 1944-45. The Committee found that "glaring inequalities characterize educational opportunities throughout the nation" and it is argued that federal aid is the only way of adequately remedying this evil. It is pointed out that while the abilities of the States and local communities to provide education have always been unequal, recent changes in social and economic conditions have magnified this inequality and at the same time education has become increasingly important. Fundamentally the inequality is largely due to drainage of wealth, through migration and modern methods of organization of manufacture, commerce and finance, from all parts of the country into the towns and cities and particularly the great metropolitan areas. Hence such glaring contrasts as that between a farm population in the south-eastern States responsible for $4\frac{1}{2}$ million children, with only 2 per cent of the national income, and a non-farm population in the north-east with $8\frac{1}{2}$ million children, and 42 per cent of the national income—21 times as much income from which to educate only twice as many children.

The Josiah Macy, Jr. Foundation

IN a six-year review of the activities of the Josiah Macy, Jr. Foundation, New York, 1930-1936, Dr. Ludwig Kast, president of the Foundation, reports that up to December 31, 1936, the Foundation made 324 grants, amounting to 806,681 dollars, to thirty-four different universities and twenty-seven other agencies for research in the United States, Belgium, Czechoslovakia, France, Germany, Hungary, Netherlands and the U.S.S.R. Special reference is made in the report to the interest of the Foundation in psychosomatic problems, including a survey of the relation of emotion to disease, to its support of investigations upon growth, development, maturation and ageing, the bearing of which upon the changing age distribution of population in the United States and the problems arising from that trend are stressed, as well as in social research concerning health and sickness and medical education. The Foundation in 1933 published the results of a review of the available data and immediate problems in human arteriosclerosis in a volume entitled "Arteriosclerosis: a Survey of the Problem", and the report emphasizes that, in view of the tendency for the age distribution of population to change towards a predominantly older group with a smaller population less than twenty years of age, the problems associated with the ageing of individual men and women are not merely medical problems but also require study by workers in other branches of science, such as economics and sociology. A chronological list of grants is included in the report.

Steam Boilers for Electric Power Stations

CONSIDERABLE progress has recently been made in developing the type of boiler used in electric power stations. It is now generally recognized that considerable economies can be effected by the use of larger steam-generating units, higher steam pressures and higher temperatures. The average capacity of boilers now being installed in power stations has risen to nearly 200,000 lb. of steam per hour. These work in conjunction with alternating current generators giving 30,000-50,000 kilowatts. In the *Electrical Times* of November 24, a description is given by Mr. V. Walker of a number of the latest types of boilers recently installed. Attention is also directed to the alterations made necessary when pulverized fuel is used. Messrs. Babcock and Wilcox have developed some of their boilers so as to take advantage of the economies inherent in the use of high rates of heat release per square foot of furnace now obtainable. They have designed a boiler for the Brighton Corporation so as to have a normal evaporation of 175,000 lb. per hour at 675 lb. pressure per square inch and 875° F. To overcome the difficulties of natural circulation, forced circulation has been developed. Two other types of boiler, the La Monte and the Loeffler, are also being installed in Great Britain.

Recent Additions to the British Museum (Bloomsbury)

AMONG the additions of archaeological interest reported at the meeting of the trustees of the British Museum (Bloomsbury) on January 14, was a

collection of bronze age pottery from Cyprus, which had been excavated by Mr. J. R. Stewart from two graves at Vounous in that island. The pottery belongs to the periods Early Cypriote Ia and Ib, dating from about 2800-2700 B.C., and Early Cypriote IIa, which is placed at approximately two hundred years later. Lieut.-Colonel H. H. R. Deane has presented a collection of examples of Buddhist art, consisting of twenty pieces, mostly small stone figures, belonging to the Gandhara School, dating from the second to fourth centuries A.D. These were collected in the North-West Frontier Province by the late Lieut.-Colonel H. A. Deane.

Recent Appointments in the Colonial Service

THE following appointments in the Colonial Service have recently been made: *Colonial Forest Service*, W. B. Collins, Gold Coast; D. F. Davidson, Cyprus; M. T. Horwood, Gold Coast; F. C. Hummel, Uganda; T. W. Hussey, Nigeria; D. M. M. Kallas, Gold Coast; D. A. Lane, Gold Coast; H. M. Maughan-Brown, Sierra Leone; W. A. Miller, Gold Coast; J. M. Ramsay, Gold Coast; G. G. K. Setton, Fiji; P. G. Shillitoe, Tanganyika. *Colonial Agricultural Service*, C. Harvey (agricultural officer, Tanganyika Territory), senior agricultural officer, Fiji; F. L. Squibbs (director of agriculture, Seychelles), agricultural officer, Gold Coast. *Colonial Geological Survey Service*, J. B. Alexander (geologist, Nyasaland), geologist, Federated Malay States; H. Service (geologist, Gold Coast), geologist, Federated Malay States. *Colonial Veterinary Service*, W. G. Beaton (senior veterinary officer), deputy director of veterinary services, Nigeria; H. J. Lowe (senior veterinary officer), director of veterinary services, Tanganyika Territory; Captain W. L. S. Mackintosh (veterinary officer), senior veterinary officer, Uganda; R. J. Simmons (senior veterinary officer), director of veterinary services, Uganda. *Other Branches*, W. R. Chanmugam (assistant Government analyst), deputy Government analyst, Ceylon; Miss R. M. Henderson, bacteriologist, Veterinary Department, Kenya; G. P. C. Lewis, inspector of plants and produce, Gold Coast.

Announcements

M. L. CLAYMEX, member of the Paris Academy of Sciences and honorary professor of geology at the Collège de France, has been awarded the Paul Fourmarier Prize and gold medal by the Royal Academy of Belgium.

THE Council of the Institution of Naval Architects has awarded the Gold Medal of the Institution for the year 1938 to A. P. Cole, for his paper "Destroyer Turning Circles"; and the Premium to Dr. F. H. Todd and J. Weedon for their joint paper "Further Resistance and Propeller Experiments with Models of Coasters". The Wakeham Prize for 1938 has been awarded to I. C. Bridge for his paper "Structural Stresses in an Oil Tanker Under Service Conditions". These awards will be presented at the annual general meeting on March 29 at the Royal Society of Arts, John Street, London, W.C.2.

THE Gold Medal of the International Faculty of Sciences, which is awarded annually in recognition of outstanding contributions to scientific progress, has been awarded for 1938 to Mr. J. J. Denton, secretary of the Television Society, and vice-president of the Institution of Electronics. The award is in recognition of nearly fifty years' continuous devotion to scientific and technical education.

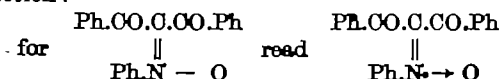
THE herbarium and library of the Botanical Museum of the Academy of Sciences of the U.S.S.R. are being transferred from Leningrad to Moscow. It is not expected that the new museum in Moscow will be ready for another five years. The Botanical Gardens in Leningrad will be retained.

WE have received a new schedule of fees for tests on volumetric glassware at the National Physical Laboratory which came into operation on December 1, certain modifications in the method of charging being introduced. The tests available and the methods used are described in a pamphlet entitled "Tests on Volumetric Glassware" which, together with the schedule of fees, may be obtained on application to the Director, National Physical Laboratory, Teddington, Middlesex.

THE Educational Advisory Board of the British Social Hygiene Council is holding a Summer School, dealing with "Biology in Human Life", probably at Cambridge, on July 28-August 4. The School will include courses on social biology, and the place of the teacher with regard to the teaching of sex, and lectures by experts on recent developments in the biological field. The course is intended for all teachers, particularly those in senior and secondary schools, who are interested in biological problems as they affect human life and society. Further particulars can be obtained from the Education Officer, British Social Hygiene Council, Tavistock House South, Tavistock Square, London, W.C.1.

THE fourth biennial Child Guidance Conference will be held at the British Medical Association House, Tavistock Square, W.C.1, on January 27-28, when the subjects for discussion will include: treatment of parents, juvenile delinquency, personality deviations and diagnosis of psychoses, the scope of the educational psychologist working in the schools and substitute homes. A session for administrative regulations will also be devoted to the consideration of the findings of the Feversham report on the voluntary mental health services as they affect the policy and administration of the child guidance movement. Further information can be obtained from the Secretary, Child Guidance Council, Woburn House, Upper Woburn Place, W.C.1.

ERRATUM.—In NATURE of December 3, 1938, p. 997, col. 2, letter by Prof. A. Schönberg, last reaction:



Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 122.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Human Cancer and the Theory of 'Cancer Phage'

To explain the observed fact that, in England and Wales for ages above fifteen years, the decrease in deaths from phthisis has been exactly compensated by the increase in deaths from cancer¹, I have postulated the existence of a *Bacillus tuberculosis* 'phage' which is carcinogenic². The idea has been followed up in more detail, and several additional relations of cancer and tuberculosis, all of which support the phage concept, have been disclosed.

If in any age group x persons die of cancer and y of tuberculosis, then the relative tendency of the hypothetical 'complex' of bacillus and phage to break down in the direction of cancer as opposed to tuberculosis is x/y . This 'virulence ratio', R , is a measure of the balance of the 'complex' and becomes the unit of measurement of the theory.

The values of R increase rapidly with age, and from twenty-five years onwards, to a close approximation $R_t = R_{poe} e^{kt}$, a law in harmony with the idea of the phage multiplying within the bacillus. (Fig. 1.)

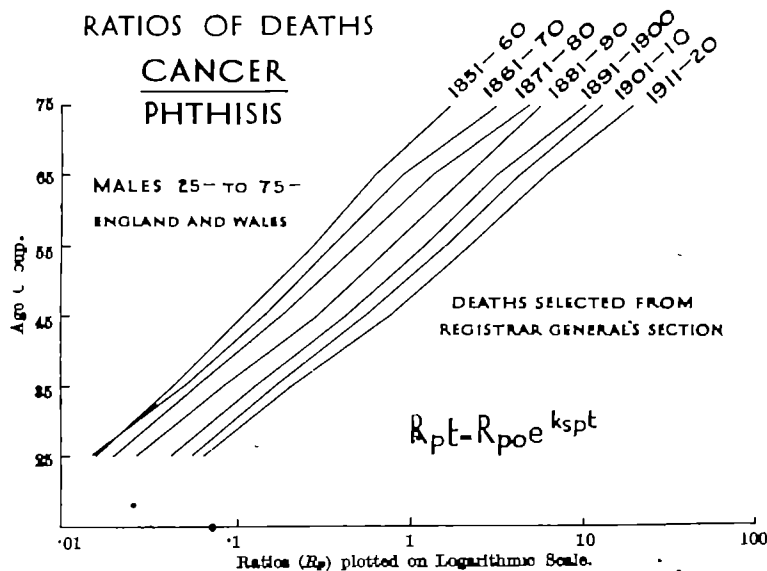


Fig. 1.

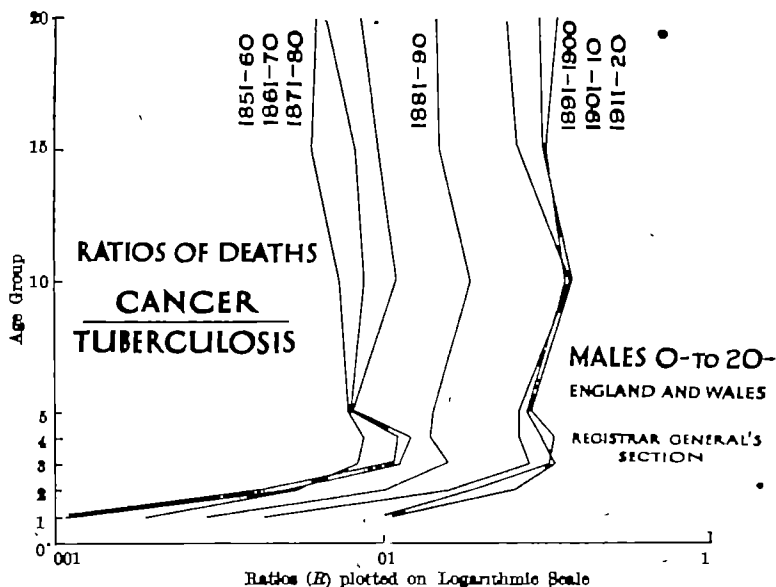


Fig. 2.

The log R law holds for every county of England and Wales and shows systematic variations for the different social classes and for rural, urban and county borough districts.

Two types of ratio may be used:

Cancer
Tuberculosis (R) and Cancer
Phthisis (R_p).

Similarly, two types of section may be chosen, the census unit and the Registrar-General's. For special reasons, the values of k must be calculated from the R values of a census unit section. From the value of K , thus obtained, the period of division of the phages (λ) twenty-five years to old age may be shown to be once in about every 4.5 years. The rate of division has slowly increased during the past century; this can be interpreted as a slowly increasing virulence of the 'cancer phage'.

A second constant of the curves is the 'equi-virulence group', that is, the age group at which $R = 1$. With advancing decennia, the age group at which R is equal to 1 becomes progressively lower. This is a more pronounced change than the alterations

in $\bar{K}_n$, and is interpreted in the theory as due to increased numbers of phages within the bacillus (see below).

The essence of particulate multiplication in geometrical progression must be a discontinuous increase in R . This shows in the values of R for lower age groups. From 0 to 3 years there is an approximate log R law ($\lambda = 6$ months), but from five to twenty years, where $\bar{R}$ remains fairly constant, the verticals do not move progressively to the right in successive decennia but are bunched together into two 'stationary periods' (1851-61-71- and 1891-1901-11-) which are separated from each other by a distinct interval. This is perhaps the most striking new relation in support of the 'cancer phage' theory. (Fig. 2.)

To account for the geometrical progression, values of R must be a direct function of the number of phages. Actually R_s/R_{min} is the number of phages at R_s , and two independent methods of calculating R_{min} give similar results. Using these, it appears that the number of phages present in the undissociated complexes by old age is tremendous.

If values of R represent certain whole numbers (of phages), then the ratios of small determinate values of R should be ratios of integers. These necessary conditions obtain at the stationary periods, where for males

$$\frac{\bar{R}_s (1891-1901-11-)}{\bar{R}_s (1851-61-71-)} = \frac{7}{2} \text{ (actually } 3.491)$$

and for females

$$\frac{\bar{R}_s (1891-1901-11-)}{\bar{R}_s (1851-61-71-)} = \frac{5}{2} \text{ (actually } 2.506).$$

The various regions of the composite curves are named as follows: 0 to 3 years, period of free division; 5 to 20 years, period of arrested division; 20 to old age, period of symbiosis. There is a close correlation between the life-cycle of the complex and the age distribution of pulmonary and non-pulmonary tuberculosis. It is to be noted, too, that early in life, when $\lambda = 6$ months, sarcoma is the chief type of malignancy, while later in life, when $\lambda = 4.5$ years, cancer largely replaces sarcoma.

It is hoped to publish full details of this work shortly.

D. BARRON CRUICKSHANK.

Simms Woodhead Memorial Laboratory,
Papworth, Cambridge.

¹ Cherry, T., *Med. J. Australia*, Oct. 11 (1924); June 6 (1925); Aug. 12 (1925).

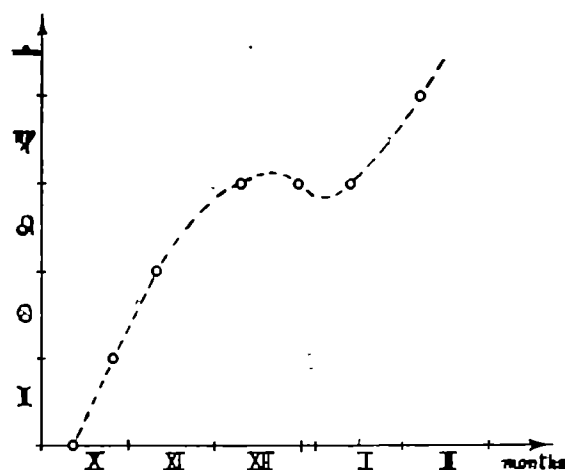
² Cruickshank, D. B., "Tuberculosis, Cancer and Zinc. An Hypothesis" (Medical Publications, London, 1936).

Egyptian Astronomy

WHILE we are very well informed about Greek and Babylonian astronomy, almost nothing was known of an Egyptian calculating astronomy until very recently. This situation, however, has been completely altered by the discovery and investigation of a number of Demotic texts. In the beautiful collection of Egyptian papyri belonging to the Carlsberg Foundation in Copenhagen, A. Volten found an astronomical text in the Demotic language which he and I have recently edited¹. We were able to show that the text deals with a simple scheme for calculating the beginnings of the months depending on a period of 25 Egyptian years (one Egyptian year being 365 days, this is almost exactly equal to 309

synodical months²). This text belongs to such a late period as Antoninus Pius (c. A.D. 150), it is true; but there are several good reasons for assuming that the same methods were already in use in the Twelfth Dynasty (c. 1800 B.C.³). Thus we know the method by which the Egyptians predicted the phenomena of the moon.

Since then, further essential progress has been made in the understanding of other parts of Egyptian astronomy. Mr. Volten directed my attention to an almost forgotten paper of H. Brugsch⁴, in which he investigated four wooden tablets acquired in 1853 in Egypt by the Rev. H. Stobart, correctly recognizing that these texts refer to the motion of the five planets. These tablets are now in Liverpool and, by the courtesy of the Director of the Museum there, I got excellent photographs of them, making a new investigation of all these texts possible. In this connexion, I would like to express my deep gratitude to the Museum authorities.



The principle of these planetary tablets is easy to explain by means of the following section⁵ belonging to the movement of Mercury:

year 8	10	11	II
		day 25	αβ
	11	10	δ
	12	9	ηξ
		day 29	δ
year 9	1	day 1	δ
		day 12	ηξ
	2	day 6	αβ

The meaning of these numbers is as follows: The years give the years of the reign of Vespasianus (year 9 is, thus, year A.D. 76), and the two following columns indicate the Egyptian months and days on which Mercury enters the different signs of the Zodiac. The only exception to this rule is the information given in the first line of every year. Here only the sign *inside* which the planet is standing on the new year's day is indicated.

To understand the text it is essential to recognize that the same tabulations contain also the *retrograde* entrances of the planet into a Zodiacal sign, a type of movement which manifests itself in the section above by the order δ ηξ δ ηξ. The investigation of these texts becomes as simple as possible if we use a graphical representation showing the velocity of

the planet. Such a graph, for the case in question, is reproduced herewith. For example, this diagram shows without any calculation that the positions of the planet were only calculated theoretically (at least in part), because the point in the middle of the retrograde motion must coincide almost exactly with the inferior conjunction, and in such a position in front of the sun it is impossible to observe a star.

It is easy to date these texts exactly by means of astronomical calculation; we find that they belong to the interval between Vespasianus 3 (= A.D. 70) and Hadrian 17 (= A.D. 132). In addition to the Stobart tablets there is a Berlin papyrus describing the movement of the planets by the same method for the years 14 to 41 of Augustus¹. I intend to publish elsewhere an extensive treatment of all these texts.

Finally, it may be remarked that Dr. H. O. Lange has deciphered an extremely interesting text, also belonging to the Carlsberg Collection, which treats the phenomena of the fixed stars (heliocentric risings and settings, etc.). Thus in an unexpectedly short time we have got a comparatively thorough knowledge of Egyptian astronomy, so that it is now possible to compare Egyptian, Babylonian and Greek astronomy as, for a somewhat longer time, we have been able to compare these respective mathematical systems.

O. NEUGEBAUER.

Institute of Mathematics
and Institute of Egyptology,
University, Copenhagen.

¹ Neugebauer, O. und Volten, A., "Untersuchungen zur antiken Astronomie IV. Ein demotischer astronomischer Papyrus" (*Pap. Carlsberg* 9). "Quellen u. Studien zur Geschichte d. Mathematik, Astronomie u. Physik", Abt. B, 4, 383-406 (1928).

² Cf. also "Almagest", 8, 2 (ed. Heiberg, 1, 464).

³ Cf., for example, the calendar of temple duty from Kahun, *S. Egypt. Sprache u. Altertumskunde*, 27, 92 ff. (1909).

⁴ Brugsch, H., "Nouvelles recherches sur la division de l'année des anciens Egyptiens, suivies d'un mémoire sur des observations planétaires consignées dans quatre tablettes égyptiennes en écriture démotique" (Berlin, 1869).

⁵ Tablet A (Tablet III of Brugsch), Rev. III, 29 to 33, and Rev. IV, 30 to Rev. V, 2. The order in which Brugsch arranged the tablets has proved to be incorrect.

⁶ Published (but only in part): "Demotische Papyrus aus dem Kgl. Museum zu Berlin" (ed. W. Spiegelberg, Leipzig u. Berlin, 1902).

The Expanding Universe and the Origin of the Great Nebulae

It is widely accepted that the system of great nebulae is at present in a state of uniform expansion, the relative velocity of recession between any two members of the system being proportional to their mutual distance. Thus we can write $v = \alpha r$, where the coefficient α has, according to Hubble¹, the value 3×10^{-17} sec.⁻¹. If we accept also the uniformity of expansion with time, that is, if we suppose that the relative velocity of any two nebulae is constant, we can easily calculate that about 10^9 years ago all nebulae were side by side, that is, space was uniformly filled up with the stars. This epoch should thus be considered as the epoch of the formation of stellar accumulations known at present as great nebulae.

Let us consider the necessary conditions for the formation of such condensations in an expanding, originally homogeneous, system of particles with the average mass m (atoms or stars) and average 'thermal' velocity v . Condensations of this kind might be originated by the occasional fluctuations of density, supplemented by the mutual gravitational attraction of slightly condensed particles². If R is the radius of the original condensation, the necessary condition for its formation through occasional distribution of

proper velocities of particles is evidently the requirement that the recession velocity on the surface should be smaller than the proper 'thermal' velocity of particles:

$$\alpha R < v, \quad \text{or} \quad R < v/\alpha \quad (1) \quad (1')$$

As soon as such a rudimentary condensation is formed, the condition for its increase and stability will be given by the requirement that the gravitational potential on the surface is larger than the proper kinetic energy of its particles:

$$\frac{GMm}{R} = \frac{4}{3}\pi R^3 Gm > \frac{1}{2}mv^2, \quad (2)$$

or

$$R > v\sqrt{3/8\pi G\rho} \quad (2')$$

Thus the radii of accumulations should be comprised between two limits. In order that the condensations may be possible at all, we evidently require that

$$\frac{1}{\alpha} > \sqrt{\frac{3}{8\pi G\rho}}, \quad \text{or} \quad \rho > \frac{3\alpha^2}{8\pi G} = 1.4 \times 10^{-17} \quad (3) \quad (3')$$

Since the present average density of matter in space is, according to Hubble¹, only of the order 10^{-28} , the condition for clustering is evidently not satisfied at the present time. However, looking into the past, we find it was satisfied once upon a time. In fact, when all distances were f times smaller, the average density was ρ^f and the value of α was f times larger (on our hypothesis of uniform expansion in time). We write thus:

$$f^2\rho = \frac{3\alpha^2 f^2}{8\pi G}, \quad (4)$$

from which $f \approx 1,000$. Since the present average distance between the nebulae is just about 1,000 times larger than their diameters, we conclude that the time of formation of nebulae coincides with the time after which the formation of condensations became impossible. Thus our picture is as follows: At the early condensed state of the universe, the formation of all different sizes of condensation was taking place. With the progressing expansion, the limits of possible radii were more and more narrowed, and at a certain stage (10^9 years ago) the existing condensation of almost the same radius was dragged apart by expansion. From the present size of nebulae (which we assume to be of the same order as their original size) we can now calculate the velocity v of the particles, and it comes out of the order of magnitude 100 km./sec., that is, of the general order of stellar velocities. Thus it is natural to suppose that the particles we have been considering above were the stars or, in other words, the formation of stars took place before the formation of the great nebulae. If, however, we suppose that the nebulae were originally formed from the gas, 100 km./sec. should be the velocity of gas molecules corresponding to temperatures of several million degrees, which seems to be very unlikely.

We must point out here that our assumption of uniformity of expansion in time can be correct only for the open cosmological models with negative curvature³. The investigations of Hubble¹ seem to indicate, however, that the observed density-distribution of nebulae in space shows thinning out at great distances, thus leading to positive curvature and a closed cosmological model. It should be mentioned, however, that the estimate of distances was made by Hubble on the hypothesis that the absolute luminosities of nebulae remain constant. So far as we

can see very distant nebulae in the earlier stages of their evolution, a slight decrease of total luminosity of a nebula with age will completely change the situation.

A more detailed account of this work will be given elsewhere.

G. GAMOW.

George Washington University.

E. TELLER.

Dec. 15.

¹ Hubble, E., "The Realm of Nebulae" (Yale Univ. Press, 1936).

² Jeans, J. H., "Astronomy and Cosmogony" (Cambridge Univ. Press, 1933).

³ Tolman, R. O., "Relativity, Thermodynamics and Cosmology" (Oxford University Press, 1938).

Red Auroral Lines on September 14-16

In a letter entitled "Very Small Intensity of the Red Or Triplet during the Auroral Displays of September 14-16", Vegard¹ has from his observations concluded that the intensities of the red auroral line 6300 Å. and of the red positive group of nitrogen were very weak at that occasion.

Our photographs on Agfa Isopan ISS plates of the auroral spectra on those nights give a quite different result.²

On September 14-15, spectrograms were taken in continuous succession with three different spectrographs from 20^h 45^m M.E.T. until 3^h 55^m simultaneously with photographic height measurements, from a series of stations. On each of the 17 spectra taken, the red auroral lines and bands are fairly strong, and on some of them, the line 6300 Å. is several times stronger than the green auroral line 5577 Å.

In the accompanying reproduction, *a* and *b* show the green and red parts of spectra taken simultaneously with the spectrum the photometer curves of which are given in Vegard's letter; *a* was exposed from 23^h 18^m until 23^h 35^m towards pulsating bands near Vega, *b* from 23^h 43^m until 24^h 00^m towards a red-green band in the north.

On September 15-16, nine spectra were taken, also simultaneously with height determinations. On each of them the red parts are very pronounced; *c* shows the red and green parts of a spectrum taken simultaneously with that taken by Vegard (see spectrum *b* in his letter) from 20^h 47^m until 21^h 52^m towards the summits of sunlit rays near the pole star.

CARL STÖRMER.

Institute of Theoretical Astrophysics,
Blindern, V. Aker.

Dec. 10.

¹ Vegard, NATURE, 142, 831 (1933).

² Störmer, NATURE, 142, 1034 (1938).

Further Remains of a Sterkfontein Ape

THE discovery at Sterkfontein by Dr. Robert Broom of new fossil anthropoid apes has created such widespread interest that it is desirable to report immediately on all new evidence that may come to hand.



MESIAL AND OCCLUSAL VIEWS OF THE NEW TOOTH
DISCOVERED AT STERKFONTHEIN.

Since March 1934 I have been working in the Sterkfontein district and have been fortunate enough to secure a number of new species of fossil mammals. Early in the present month (December) I discovered on the farm of Mr. Cooper, near the Sterkfontein Caves and about a quarter of a mile away from where Broom's first skull was discovered, a beautifully preserved tooth which differs in many respects from, but yet has certain characters of the same order as, those revealed by some of the upper molars of *Plesianthropus transvaalensis* and *Paranthropus robustus*.

The tooth is an upper left third molar. Its crown measures 13 mm. mesio-distally and 15 mm. buccolingually and its occlusal surface shows little indication of the wrinkling which is such a conspicuous feature of the corresponding molar in Broom's skulls. The crown is triangular in form with the base represented by the mesial side and the angles rounded off. This form is due primarily to marked reduction in the size of the metacone. Compared with the size of the crown, the masticating surface is small. Many of the detailed characters of the grooves and ridges bring to mind conditions shown in the upper molars of *Sinanthropus*. As yet the roots are not completely cleared from their matrix, but sufficient has been done to permit measurement of the height of the tooth from the summit of the paracone to the end of the mesio-buccal root. This measurement equals 21 mm.

It would be unwarranted at this stage to conclude that the tooth represents a different species from either *Plesianthropus transvaalensis* or *Paranthropus robustus*. If, however, it belongs to one of these apes, it is evident that there was very considerable variation in the form of the third molars. I consider the tooth now discovered to be more human-like than the corresponding teeth reported on by Broom, but feel that when assessing the significance of the characters presented both by this tooth and the anthropoid teeth previously discovered at Sterkfontein, it will be necessary to give very close attention to the subject of normal variation of teeth.

J. C. MIDDLETON SHAW.

University of the Witwatersrand,
Johannesburg.

Dec. 8.

Resonance in the External Auditory Meatus

In investigations on the extent to which objective tests can be used to obtain information on the magnitude of the effective amplification hearing aids give to a deaf user, a knowledge of the extent to which resonance occurs in the auditory meatus is of value. In normal human beings such a resonance occurs in the region of 2,000–3,000 cycles per second and to some extent accounts for the shape of the minimum threshold hearing curve as the frequency is varied. It is possible to calculate the magnitude of the resonance from results of mechanical impedance measurements at the opening of the meatus and to demonstrate its existence by means of a probing pressure microphone which indicates increase of pressure as the probe approaches the tympanic membrane. The method has limits, however, and in addition to being inconvenient can cause damage if extreme care is not taken.

Recently a method has been used which permits the measurement of the magnitude of resonance without the introduction of a measuring device into the meatus. It consists in replacing the air in the meatus by some other gas in which the velocity of sound V differs from that in air ($V = 332$ metres per second). The method uses a moving coil telephone receiver which has two tubes of narrow bore inserted through the periphery of the earcap. The receiver is held comfortably in position on the ear by means of a springy headband, the cap of the receiver being covered by rubber to reduce leakage to the external air. One of the tubes is connected to a cylinder of hydrogen ($V = 1,261$ metres per second) and the other tube left free to the external atmosphere. When hydrogen is allowed to pass at a slow rate, by means of a reducing valve, the air in the meatus can be displaced by hydrogen in quite a short time (a minute or so). If the receiver is connected to an attenuator operating on the output of an audio-frequency oscillator, hearing measurements can be made either at threshold or by aural balancing, and the effect of interchange of air and hydrogen quickly determined.

It is found that at frequencies below about 2,500 cycles per second the introduction of hydrogen reduces the intensity level of the sound, the reduction reaching a maximum of about 12 decibels at 2,500 cycles per second. As the frequency is raised further it is found the intensity level first increases as the hydrogen enters, reaches a maximum and then diminishes, while at a frequency in the region of 6,000 cycles the final level is equal to that with air in the meatus. At a frequency of about 9,000 cycles per second, the introduction of hydrogen raises the sound-level by about 9 decibels and at higher frequencies the effect diminishes rapidly to that of a reduction again. The resonant frequencies are not quite in the same ratio as that for the two velocities of sound ($3.8/1$) nor is the increase in level at 9,000 so high as the decrease in level at 2,500 cycles per second. This may indicate that the substitution of a lighter gas in the ear disturbs what might be an optimum reduction factor for the ossicular chain between the tympanic membrane and the oval window, so that there is an overall loss of efficiency due to the change. The initial increase and final decrease in the sound-levels shown in the region from 2,500 to 6,000 cycles indicate that resonance is occurring for air-hydrogen mixtures having values for the velocity of sound intermediate between those for air and hydrogen.

Similar results have been obtained with coal gas ($V = 500$ metres per second), where the two resonant frequencies are closer together, except that the reduction at the air resonant frequency is only about 10 decibels.

The experiments show that there is quite an appreciable pressure magnification (about three times) due to meatus resonance. The flatness of the resonance indicates that energy is absorbed by the material and mechanism of the ear. Undoubtedly some of this energy is consumed in overcoming viscous forces in the middle and inner ear and some of it may be transformed into electrical form in the inner ear.

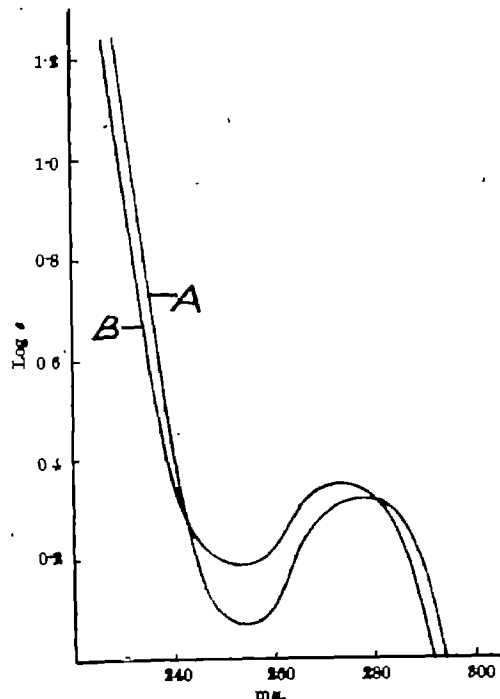
In addition to the above usage, filling the meatus with hydrogen suggests the possibility of reducing hearing by air conduction near the resonant frequency without corresponding reduction in bone conduction, so far as distant sounds are concerned.

T. S. LITTLEB.

Dept. of Education of the Deaf,
The University,
Manchester.
Dec. 14.

Ultra-violet Absorption of Genuine and Hydrolysed Protein

ACCORDING to the classical theory of protein structure, the carboxyl and amino groups found after hydrolytic splitting of a protein come from $-CO-NH-$ bonds. According to the cyclol hypothesis (Wrinch¹), however, the free carboxyl and amino groups must be formed, during the splitting, from bonds of the



structure $>O(OH)-N<$. The classical theory would predict on hydrolysis no great change in the absorption spectrum below 2400 Å. because the CO groups of the amino acids and of the peptide bonds both are strongly absorbing in this region². On the other hand, the cyclol hypothesis would predict a

greatly increased absorption because of the formation of new CO groups.

We have now compared the absorption spectrum of a genuine serum globulin (ox) with the same protein in the hydrolysed state. 15 c.c. of a salt-free dialysed 4.4 per cent suspension of globulin was dissolved in 180 c.c. $n/12$ $\text{NH}_4\text{OH}-\text{NH}_4\text{Cl}$ (pH 8.9) and sterilized by passing through a Berkefeld filter. To 65 c.c. were then added 45 c.c. of a sterilized 0.17 per cent trypsin solution (Merck) and the mixture (A) was left at 0° C. for 72 hours. Genuine serum-globulin is not digested by trypsin, and therefore another sample (65 c.c.) was denatured in a closed bottle 20 min. in a boiling water-bath. After cooling, pH was the same as before. 45 c.c. of the trypsin solution was added and the mixture (B) left at 39° C. for 72 hours. Sulphosalicylic acid gave then with A a large amount of precipitate, but with B only a faint opalescence. The ultra-violet absorption spectra of solutions A and B are shown in the accompanying figure.

The absorption for genuine (A) and for hydrolysed (B) protein is about equal. This seems to be in greater accordance with the classical theory on the structure of proteins than with the cyclol theory.

Some of the exposures were made at the Hygienic Institute of the University. For this favour we wish to thank Prof. Fridericia and Mr. Behre Jensen.

FELIX HAUBOWITZ.
TAGE ASTRUP.

Biological Institute,
Carlsberg Foundation,
Copenhagen.
Dec. 2.

¹ Wrinch, D. M., *NATURE*, 139, 796, 972 (1937).

² O. Magill, M. A., Steiger, R. H., and Allen, A. J., *Biochem. J.*, 31, 183 (1936).

Mechanism of the Oxidation of Reduced Coenzyme I

The oxidation in animal tissues of metabolites such as lactic, malic and triosephosphoric acids may be resolved into three component reactions:

- (1) Metabolite + coenzyme I $\rightarrow$ oxidized metabolite + reduced coenzyme I.
- (2) Reduced coenzyme I + carrier $\rightarrow$ coenzyme I + reduced carrier.
- (3) Reduced carrier + oxygen $\rightarrow$ carrier.

It was recently discovered^{1,2} that animal tissues contain coenzyme factor (diaphorase), an enzyme which specifically catalyses reaction (2). The chemical nature of the enzyme was not known. The flavo-protein isolated by Straub³ from heart muscle also catalyses reaction (2) and its properties have convinced us of its identity with the coenzyme factor. Under optimal conditions one molecule of flavo-protein catalyses the oxidation of 8,500 molecules of reduced coenzyme I per minute at 38° ($Q_{10} = 180,000$). The catalytic efficiency and the concentration in tissues of this new flavoprotein are sufficiently high to permit the conclusion that it takes a fundamental role in cellular respiration.

Muscle flavoprotein does not undergo a cycle of oxidation and reduction in the course of its catalysis and therefore cannot act as an intermediate between reduced coenzyme and molecular oxygen. There is evidence that under physiological conditions flavo-protein catalyses the reaction between reduced coenzyme and molecular oxygen via the cytochromes.

Coenzyme factor is present in almost every animal tissue and in several micro-organisms⁴. Correspondingly the amount of the flavin-adenine dinucleotide, that is, the prosthetic group of this flavoprotein, is found to be proportional to the amount of coenzyme factor present in the various sources.

F. B. STRAUB.
H. S. CORRAN.
D. E. GREEN.

Moltano and Biochemical Institutes,
Cambridge.
Dec. 17.

¹ Adler, Euler and Hellstrom, *Str. Vol. Abnd. Ark. Kemi*, 12, 1 (1937).

² Dewan and Green, *Biochem. J.*, 33, 628 (1938).

³ Straub, *NATURE*, [143, 76 (1939)].

⁴ Green and Dewan, *Biochem. J.*, 33, 1200 (1938).

A Roman Water Pipe

THE methods used by the Romans in making their lead water-pipes have been described in detail by Lanciani¹ and Gowland². Briefly, a cast sheet of suitable width is bent around a former, so that the edges come together; the inside is then filled with sand, or similar material, a temporary dam is built on either side of the seam and the welding is effected autogenously by means of molten lead or, occasionally, solder. Cross-sections of pipes, when etched in the ordinary way, betray their mode of fabrication, the coarse, crystalline structure of the weld-metal being particularly noteworthy.



ROMAN LEAD WATER PIPE. MICROGRAPH, NATURAL SIZE.

A pipe from the Roman baths at Augst, near Basel, recently examined by me, was exceptional, in that the weld-metal was extremely fine-grained (see accompanying photograph). Its position and the sharpness of the junction with the pipe-metal seemed to preclude the idea that the fineness of grain was due to deformation of the metal, and this was confirmed by the observation that the fine grain persisted after melting and re-casting. On analysis, the weld-metal was found to contain 0.08 per cent of copper (tin absent) and the sheet- or pipe-metal, 0.11 per cent of copper and 0.06 per cent of tin.

The explanation of the structure is now clear in the light of the experimental work, recently published, of Mr. Brinley Jones³, and of some additional information kindly supplied by him. It appears from this that castings of lead containing less than 0.08 per cent of copper (the eutectic proportion) are coarsely crystalline, whereas a higher percentage of copper produces a refined structure, owing presumably to the initial separation of a cloud of minute copper particles, which act as nuclei for the growth of lead crystals. It is essential that cooling should be fairly rapid, so that the copper particles are trapped in the alloy and do not float to the surface, and also that tin should be completely absent. The last condition explains satisfactorily why the pipe metal, though hyper-eutectic in composition, is of unrefined grain.

The useful properties of the metal are dependent, in no small measure, upon the fineness of grain, and I learn from Mr. Brinley Jones that practical use of these lead-copper alloys of fine grain is being made. It will undoubtedly be a source of satisfaction to those who seek application of these alloys to know that they can reckon on the persistence of the fine grain, at atmospheric temperatures, for at least eighteen centuries.

King's College,
Newcastle-on-Tyne.

J. A. SMYTHE.

Dec. 12.

¹ Lanciani, "Le Acque e gli Acquedotti", 194 (1880).

² Gowland, *Archæologia*, 414 (1891).

³ Brinley Jones, *J. Soc. Chem. Ind.*, 251 (Aug. 1938).

Fractures of Reversed Fault Type Produced in Concrete by Torsion

EXPERIMENTAL tests on concrete are frequently of interest to the geologist, since concrete is a brittle material and possesses physical characteristics similar

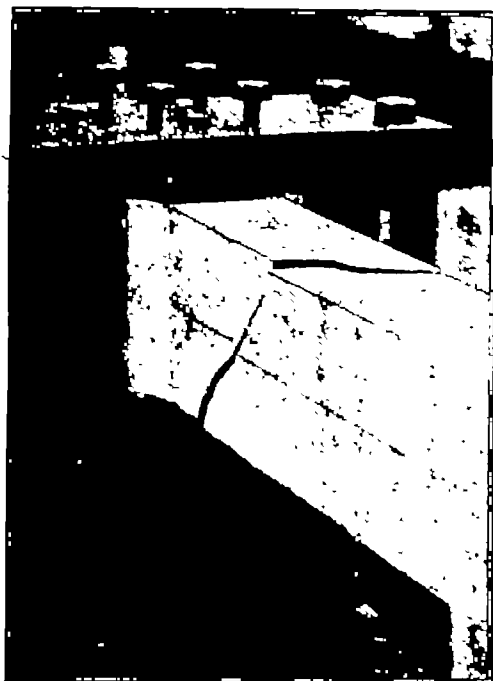


Fig. 1.

CONCRETE MEMBER AFTER TEST.

to those of certain rocks. Its behaviour under load, and in particular under breaking load, may therefore throw light on the interpretation of structural phenomena in geology.

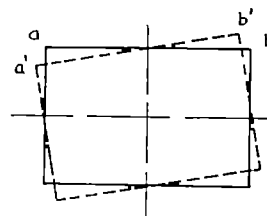


Fig. 2.

END ELEVATION OF MEMBER, SHOWING RELATIVE ROTATION OF FRACTURE-SURFACES.

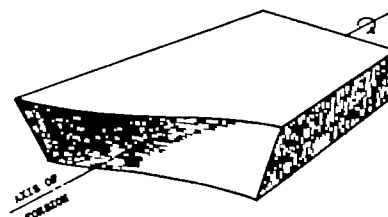


Fig. 3.

CURVED FRACTURE-SURFACE.

With the object of determining the torsional rigidity of plain concrete members, a number of experiments were recently carried out by a research student, Mr. N. Tembe, working with us in the Civil Engineering Laboratories of the City and Guilds College. The majority of the members were 4 ft. in length and 6 in. $\times$ 4 in. in cross-section, except for a distance of 6 in. at the ends, where the section was 6 in. $\times$ 6 in. In addition, some members of circular and of Tee-section were tested.

The concrete was composed of 1 part by weight of cement, 2 parts of fine aggregate (Stone Court sand) and 4 parts of coarse aggregate ($\frac{3}{4}$ in. Thames ballast), the water-cement ratio being 0.55. Two special members were made of mortar consisting of 1 part by weight of cement to 3 parts of Stone Court sand, thus producing a mortar approximating to a natural sandstone or grit in grade composition. Specimens were stored for seven days in moist air before they were tested.

One end of a member was gripped in the fixed 'chuck' of a specially designed testing machine, and the other in the rotating 'chuck' to which the torque was applied. The torque-strain curve for the members was linear, the modulus of rigidity determined from the tests being 2.25×10^6 lb./sq. in. Immediately before failure occurred the twist on a gauge length of 30 in. was approximately $1\frac{1}{2}^\circ$. Failure occurred suddenly by the formation of a tension crack of roughly spiral form, at 45° to the plane of twisting, and immediately after failure there was a relative angular movement of the separated sections of about $2\frac{1}{2}^\circ$ (Fig. 1).

The outstanding features of the failures, namely, the tension crack and the relative angular movement, were observed in every test. The members made of mortar, mentioned above, behaved in a similar manner; members of circular cross-section showed a more perfect spiral fracture. Fig. 2 shows in end view the type of displacement, the side ab being moved to $a'b'$, and Fig. 3 illustrates the curved fracture-surface.

The trace of the fracture-surface on each long face of a test member was inclined at an angle of about 45° to the length of the face. The surface of the fracture was not normal to the face, but had a varying inclination (Fig. 3) and sloped in opposite directions on either side of the centre line of the face. Thus in a broken member, each of the fracture-surfaces, on account of its curvature, consisted of a 'hanging wall' on one side of the axis of torsion, and a 'footwall' on the other side of the axis, to use the terminology applied to faults. When fracture took place, the 'hanging wall' was in each case raised with respect to the 'footwall'.

The concrete broke in tension, but owing to the fact that this was produced by torsional loading, the separation of the two parts involved the motion described above, which would correspond to that of a pivotal reversed fault if it occurred under geological conditions. In text-books of geology, reversed faulting has generally been attributed to compressional forces. A brittle stratum or series of strata in Nature, however, might be subjected to torsional loading, for example, through unequal settlement over an area; the torsional axis in this case would be horizontal (or nearly so). It is suggested that such a loaded stratum would then be likely to break in tension, in a similar way to that seen in the tests described.

F. G. H. BLYTH.

Geology Department,

W. T. MARSHALL.

Civil Engineering Department,
Imperial College of Science and
Technology,
London, S.W.7.
Nov. 20.

Jędrzej Śniadecki (1768-1838) on the Cure of Rickets

It is a view generally accepted that the English physician, Dr. T. A. Palm, first directed the attention of the scientific world to the curative effect of sunlight on rickets. L. J. Harris¹, when dealing with the frequency of the occurrence of rickets in relation to the climate, writes: "The explanation was given by an English medical man, Dr. T. A. Palm, in 1890. He it was who first pointed out that rickets is prevalent wherever there is little sunlight and unknown or comparatively rare wherever sunshine is abundant".

In connexion with the view expressed above, it seems of interest to quote an opinion of Jędrzej Śniadecki about the methods of curing rickets. Jędrzej Śniadecki was a Polish physician and physiologist and professor of chemistry at the University of Wilno. He was the first to introduce into Polish science Lavoisier's then new ideas. The hundredth anniversary of his death was celebrated this year by Polish men of science. In his book "On the Physical Education of Children", written in 1822, Śniadecki says in the chapter on "English Disease": "If the parents' financial status permits, it is best to take the children out into the country and keep them as much as possible in the dry, open and pure air. If not, at least they should be carried about in the open air especially in the sun, the direct action of which on our bodies must be regarded as one of the most efficient methods for the prevention and the cure of this disease. . . . Thus strong and obvious is the influence of the sun on the cure of the English disease, and the frequent occurrence of the disease in densely populated towns, where the streets are

narrow and the dwellings of the working-class people low and very poorly lit."

From the passages quoted above it is quite clear that J. Śniadecki fully realized the significance of the sun both in prevention and cure of rickets.

W. MOZOWSKI.

Institute of Physiological Chemistry,
Stefan Batory University,
Wilno.
Dec. 12.

¹ Harris, L. J., "Vitamins in Theory and Practice", 110 (Cambridge, 1935).

² Śniadecki, Jędrzej, "Dzieła", vol. 1, 273-274, Warszawa (1840).

Marine Turtles as Current Indicators

IN a letter recently published in NATURE¹, my friend Mr. Paul Deraniyagala directed attention to the fact that Kemp's loggerhead turtle, the normal range of which appears to be the Mexican Gulf neighbourhood, occasionally finds its way to the shores of the British Isles; he suggests that: "The possibilities of sea turtles as current indicators would thus appear to be considerable . . ."

A favourable opportunity to test this hypothesis has quickly presented itself, for there has been an unusual number of turtles stranded on the British coasts during the first eighteen days of December. Seven, in all, have been reported. Four of them (two at Bognor, one near Tenby and one on Selsey Bill) were common loggerheads, *Caretta caretta* (Linn.); the others (one at St. Ives, one near Charmouth and one at Bexhill) have not been identified.

Exactly whence they may have come is uncertain, since turtles occur in the tropical and sub-tropical waters on both sides of the Atlantic; but they must have come from that ocean, and it is difficult not to associate their coming with the remarkably warm weather and almost uninterrupted series of south-westerly gales which characterized late November and early December. It seems probable that there has been a strong in-drift of warm surface water into the English Channel from the south-west, but whether there has been that inflow of true Atlantic water which seems so essential for the rehabilitation of the West Country fisheries remains to be seen.

H. W. PARKER.

British Museum (Natural History),
London, S.W.7.

¹ NATURE, 148, 540 (Sept. 17, 1938).

Reproduction of the Dogfish

IN the course of a recent investigation, I have found that:

(1) Migration of ova from the ovary to the coelomic opening of the oviducts in *Scolecophagus ophiocoma* is entirely dependent upon ciliation, as it is in *Amphibia*¹.

The entire peritoneal wall and many abdominal viscera of an adult female are ciliated. The cilia, which are absent in the male and immature female, direct a current of coelomic fluid towards the ostium. An ovum excoiled from the ovary of one adult female and inserted through an abdominal incision into the peritoneal coelom of another will undergo migration towards the ostium. The speed of the migration depends upon the region into which the ovum is introduced. An ovum placed in the bridge joining

the two liver lobes will traverse the hepatic sinus, enter the ostium and descend an oviduct as far as the top of the oviducal gland, in three hours. There are no muscular movements of any of the organs concerned.

(2) In addition to its function of secreting albumen and the egg-case, the oviducal gland of the dogfish is a receptaculum seminis. By triturating a portion of the shell secreting zone of the gland in saline solution, active spermatozoa can be seen at all times of the year. There does not seem to be any sharply defined breeding season, but an increase in breeding activity is noticed in the spring. The oviducal glands of all adult females contain spermatozoa, but the sperm content is very variable. In preparations of resting glands, spermatozoa can be seen in the shell-secreting tubules, whilst in actively secreting glands, a proportion of these spermatozoa are emitted in the shell material. In this way fertilisation of an ovum is practically ensured.

A detailed account of this work will appear later.

H. MERTEN.

Biology Department,
Medical College,
St. Bartholomew's Hospital,
Charterhouse Square, E.C.1.
Dec. 18.

¹ *Bugh, R., J. Exp. Zool.*, 5, 71, No. 1 (July 5, 1935).

Kinetic Regions in Chromosomes

I HAVE previously disavowed any deeply founded conviction concerning the name applied to the kinetic region which, in one form or another, seems to be present in most chromosomes. The first thing needful is agreement on such a name, and then the abandonment of the ten or more other names now in use. I proposed the adoption of the word 'kinetochore', partly because it seems at least as good as any now in use and also because Sharp has employed it in a rather widely used book. But at about that time the term 'centromere' was used by Darlington, and British workers have accepted it quite generally. I should like to point out that not only is thereby added another to the long series of words that already have caused much confusion ('centrosphere', 'centrodesmus', 'centrosome', 'centriole', 'central body', etc.); but that the word 'centromere' was coined by Waldeyer in 1903 to designate the neck region of the spermatozoon. Since it seems certain that many future investigations will concern themselves with the chromosome region in question, I propose that an entirely new name be adopted if the word kinetochore be considered unacceptable.

FRANZ SCHRADER.

Department of Zoology,
Columbia University.

Points from Foregoing Letters

GRAPHS showing the relation between the incidence of cancer and of tuberculosis in different age groups are submitted by D. Barron Cruickshank. The author connects these with a theory which postulates the existence of a *Bacillus tuberculosis* 'phage' which causes cancer, the relative tendency of the hypothetical 'complex' of bacillus and 'phage' to break down determining how many persons die of cancer and how many of tuberculosis in any age group.

By deciphering an astronomical text in the Demotic language now at the Carlsberg Foundation in Copenhagen, and other texts in the Liverpool Museum, Prof. O. Neugebauer has elucidated some of the methods used by the Egyptians in their astronomical calculations. The texts refer to the dates in which the planet Mercury entered the different signs of the Zodiac and astronomical calculations show that they belong to the period A.D. 70-132; the same methods were probably in use at much earlier periods.

Assuming that the Universe has been uniformly expanding with time, Dr. G. Gamow and Dr. E. Teller calculate that the existing nebulae were dragged apart about one thousand million years ago. Up to that time the nebulae had been together as part of a non-expanded Universe, consisting of particles having a velocity of about 100 km./sec. (of the same order of magnitude as the velocity of the stars, with which the 'particles' may be identical).

Prof. O. Störmer submits photographs of auroral lines taken on September 14-16. Unlike those reported by Prof. Vegard the red auroral lines are

fairly strong and in one instance stronger than the green line.

The discovery of a well-preserved upper left third molar at Sterkfontein, South Africa, more human like than the corresponding teeth described by Broom, is reported by Prof. J. C. Middleton Shaw.

A method of determining the magnitude of the resonance occurring in the external auditory meatus is described by Dr. T. S. Littler. A gas (hydrogen or coal gas) in which the velocity of sound is different from that in the air, is introduced in the meatus, and the change in the intensity level of the sound at different frequencies is observed. An appreciable pressure magnification (about three times) due to meatus resonance was found.

According to F. Haurowitz and T. Astrup, the ultra-violet absorption of genuine and hydrolysed protein seems to be in greater accordance with the classical theory than with the cyclol hypothesis.

Dr. F. B. Straub, H. S. Corran and Dr. D. E. Green have shown the identity of coenzyme factor and the flavoprotein isolated from heart muscle by Straub. This flavoprotein appears to be the normal physiological agent for catalysing the oxidation of reduced coenzyme I.

A photograph of a cross section of a Roman lead water pipe welded by means of lead containing 0.08 per cent copper is submitted by Dr. J. A. Smythe. Owing to the copper percentage being higher than the eutectic proportion, the weld shows a fine grained structure, which has persisted for 18 centuries.

Research Items

East Greenlanders in Olden Times

THE late Knud Rasmussen for many years had contemplated writing an account of the inhabitants of East Greenland before their mode of life had been modified by contacts with civilization, and for this purpose had collected much information, both by personal observation on his expeditions to Greenland, and by conference and correspondence with Christianized Eskimo. His notes and draft for such a work have been edited and published posthumously by H. Ostermann (*Medd. om Grønland*, København, 109, 1; 1938). A topographical record of Eskimo settlements in East Greenland, taking Angmagssalik as its centre, is followed by studies of Eskimo philosophy, religious and magical beliefs, and of East Greenland words, names and expressions. The trading station known as Angmagssalik was called by the Eskimo Tasiussaq, the former name being applied to the whole of the great ford, which extends far into the country, on account of the small fish *angmagssaq*, caught there and there only, to serve as part of the provision for the winter. The inhabitants of this dangerous and inhospitable part of Greenland lived by hunting, the staple of their subsistence being the seal; but they also hunted the bear and, in a lesser degree, other game. If the seal failed them, they ran the risk of starvation; and on occasion so many as fifty per cent of a settlement have perished from this cause, while others have saved themselves by cannibalism, the bodies of those who died being eaten, or, as in certain instances is orally recorded, murder being committed for the sake of the flesh of the victims. While the weather was sufficiently warm to dry the pelts, seals were flensed so as to preserve the skin whole; when dry it was used for the storage of blubber, in which fragments of the meat were preserved—a great dainty. As the weather grew colder, the carcasses were stored whole in the open, the extremities being covered with stones to keep the dogs away. Carcasses preserved in this way might not be eaten for six months, the higher the degree of putridity, the greater the appreciation of those who partook. When the carcass of a seal was brought in to be eaten, all the members of the community shared, the hunter's wife dividing it up, and he and his family usually securing the least share.

Archæology of Eastern Tennessee

IN view of the forthcoming inundation of an area of 56 square miles to the height of the 1,020-foot contour by the building of dams by the Tennessee Valley Authority, it was decided in 1934 to make an archæological survey of the Norris Basin in eastern Tennessee—an area of especial importance for the prehistory of American culture, as the river valley and fertile bottomlands had furnished ideal sites for the rudimentary agriculture of aboriginal man. A report on the results of the survey has been made by Mr. William Webb, who acted as supervising archæologist for the Tennessee Valley Authority (Smithsonian Institution, Washington, *Bull.* 118; 1938). The survey revealed 23 sites showing definite evidence of prehistoric occupation. On these sites there were 20 earth mounds, 9 stone mounds, 4 village sites and

7 caves. Of the 29 mounds, 12 were burial mounds and 17 were associated with prehistoric structures. The sites investigated fall into four or five major divisions, of which the stone mounds had been previously excavated and being largely destroyed, furnished little in the way of archæological data. The cave sites afforded evidence of occupation by a rather primitive people, who buried their dead in or under midden debris on the cave floor. Bodies were usually fully flexed, without artefacts. Bone and shell were used extensively to make simple artefacts. A few burials were after partial cremation elsewhere. These sites seem similar to sites in eastern Kentucky, and with them present similarities to the later components of the Stallings Island complex. The burial mounds in earth have fully flexed skeletons without artefacts. Two are characterized by bundle burial of bones. Of the earth mound and village sites, all with one exception show evidence of rectangular post-mold patterns of dwellings and 'town-houses'. The culture traits here fall definitely into two groups, one showing 'small-log' construction and the other 'large-log' construction. It is suggested, speculatively, that these two cultures are those of people precedent to the Cherokee, by whom elements of the culture were adopted. The early 'large-log' people may be Creeks, while the 'small-log' people were connected with the Creeks by association rather than affinity, and may have been the problematical Yuchi.

Storage of Oranges

PAMPHLET No. 80 of the Australian Council for Scientific and Industrial Research, which has just been issued, contains the results of co-operative work carried out by the Council, the Victorian Department of Agriculture, and the Biochemistry School of the University of Melbourne, and discusses the storage of oranges with special reference to locality, maturity, respiration and chemical composition. High-temperature treatments are not effective in controlling mould development in Washington Navel oranges, but there are indications that such treatments render the fruit less susceptible to mechanical injury and to subsequent low-temperature disorders. Mould development in unjured oranges is a normal disorder of senescence, and any method which aims at its control should be directed towards delaying the senescence of the fruit. Washington Navels picked in early June in the early districts remained palatable for twelve weeks at 40–42° F., and for a further week at atmospheric temperatures. If the fruit was left on the tree longer, the life in cool storage was reduced by an equivalent period. The length of storage life and the rate of progress towards senescence was similar in fruit picked on the same date from both early and late maturing districts, but the oranges took longer to become palatable in the latter case. The development of colour and flavour and loss of acidity were retarded by removal from the tree, whereas progress towards senescence was the same whether the fruit was gathered or not. Palatability was found to depend on the composition of the juice, but respiration and storage life were more closely related to the constituents of the rind. Respiratory activity varied

considerably with the type of orange, that for Washington Navels increasing four times for a rise in temperature of 10°C ., whereas in the case of the Valencia late-orange the increase was only 2.4 times.

Outer Regions of the Earth's Core

In a preliminary attempt to investigate this region of the earth, B. Gutenberg has considered (*Bull. Seis. Soc. Amer.*, 28, No. 3, July 1938, p. 197) the wave *SKS*, also known as *S₀P₀S* or [*S*]. This is a wave which starts at an earthquake epicentre as a transverse pulse, *S*, is transformed as it reaches the earth's core to a longitudinal pulse, *P*, proceeds through the core as a *P* wave, is transformed again at the boundary of the core to an *S* wave and proceeds thus to the station where it is received. The travel time of an *SKS* wave thus depends much on the velocity in the outer part of the core. It is found that the graph obtained by plotting distance, measured in degrees, between the station and the epicentre, against the time of travel of this pulse, begins somewhere between 65° and 90° on the travel time graph of the *S₀P₀S* wave, that is, an *S* wave reflected once at the outer core of the earth, and that the first segment of *SKS* is below *S₀P₀S*. It is thought that *SKS* has a focal point at some distance between 70° and 80° . The extreme values of the velocities of the longitudinal wave in the outer core of the earth appear to be 8.0 and 7.4 km./sec. respectively, though more detailed investigations are proceeding.

Rate of Faulting near an Earthquake Epicentre

An earthquake which has a surface focus might conceivably have a point focus causing subsequent faulting, or might have a line focus, simple or complicated by having the faulting take place synchronously with the initial time of the shock. The former appears, *a priori*, to be the most probable, since the faulting, due to resistance, takes an appreciable time to complete. Taking the former as a hypothesis, Hugo Benioff initiates (*Bull. Seis. Soc. Amer.*, 28, No. 2, April 1938) an instrumental method of determining the rate of faulting and applies it to determine the extent of faulting in the Long Beach earthquake of March 10, 1933, this faulting being invisible at the surface. In a simple vertical fault in which the displacement is perpendicular to the direction of extension, the faulting impulse is considered to be propagated by shear waves. Thus the shear waves from the end-point can never arrive earlier than the wave from the focus. This does not apply where the displacement is parallel to the direction of extension. On these considerations an observed early arrival of *S* indicates that the source is a fault movement in which the displacement is parallel to the direction of extension. This conception can be applied variously, but in the Long Beach earthquake the available evidence indicates that the faulting extended from the focus $\lambda = 117^{\circ} 58' \text{ W.}$, $\phi = 33^{\circ} 36' \text{ N.}$, approximately to Signal Hill, a distance of 27 km. with a faulting speed in the neighbourhood of 4.2 km./sec.

Infra-Red Absorption of Carboxylic Acids in Solution

M. M. Davies and G. B. B. M. Sutherland (*J. Chem. Phys.*, 6, 755; 1938) have investigated at 18° and 75° solutions of acetic, benzoic and trichloroacetic acids in carbon tetrachloride at the three regions of the spectrum where absorption arises from

the O—H, C—O and C=O bonds of the carboxyl group. In each region, double bands appear, one due to the monomeric and the other to the dimeric form of the molecule, and the separation is so small that it suggests that very little change is brought about in the molecule by association. The intensities of the O—H bands of acetic and benzoic acids increase with rise in temperature, indicating a preponderance of monomeric molecules at the higher temperature, thus corresponding with the behaviour of the O—H band of alcohols on rise of temperature. Trichloroacetic acid gives a shift to longer wave-lengths on increasing temperature, suggesting that the O—H bond in this molecule is weaker, in agreement with its behaviour as a stronger acid than acetic. Essentially similar results have been obtained for the other bonds. Different concentrations of acid have been examined, and bond distances for each of the three bonds have been estimated. The same authors (*ibid.*, p. 767) have shown that the integrated intensity of the monomeric O—H and C=O bands give heats of association less than the accepted values, and this is attributed to variation in the absorption coefficient with temperature. In a third paper (*ibid.*, p. 770), Davies has found that α -hydroxyundecanoic acid in carbon tetrachloride at 74° gives two sharp bands at 2.755μ and 2.835μ , corresponding respectively with the alcoholic and carboxylic O—H absorption. From the integrated absorption, estimates of the molar concentration of free O—H groups of each type have been made, and the proportion of free carboxylic O—H is less than that of free alcoholic O—H. The various possible dimeric associations are discussed, and it is shown that, in addition, intramolecular interaction must occur with formation of a cyclic monomer which exists in equilibrium with the open chain monomer.

Nuclear Spin of ^{14}N

ACCORDING to Fermi-Dirac statistics, ^{14}N — ^{14}N should have even-numbered rotational lines strong, whereas in ^{15}N — ^{15}N they should be weak. Two attempts to determine the spin of ^{14}N have just been reported. R. W. Wood and G. H. Dieke (*J. Chem. Phys.*, 6, 908; 1938) found a spin of $\frac{1}{2}$ and that ^{15}N nuclei obey Fermi-Dirac statistics by examining the bands of ^{14}N — ^{14}N produced from ammonia containing approximately 36 per cent ^{15}N . Generally the bands are confused with those of ^{14}N — ^{14}N and ^{14}N — ^{15}N , but the $1 \rightarrow 0$ band of the negative band (N^+) is an exception having its head at 3582.3 A. for ^{14}N — ^{14}N , 3587.4 A. for ^{14}N — ^{15}N , and 3592.5 A. for ^{15}N — ^{15}N . In this last band the *P* branch is free from overlapping by other bands and, on resolution with a 21-foot grating with 30,000 lines per inch and a dispersion of 0.6 A. per mm. , exhibits alternating intensities of successive lines, the odd-numbered lines being strong. C. E. Miller (*ibid.*, 6, 902; 1938) found that it was impossible to obtain a value for the spin of ^{14}N from the rotational Raman spectrum of N_2 , although he obtained good spectrograms from it at four atmospheres with a 20-hour exposure. The difficulty arose from the fact the spectrum contained a very large number of lines due to the three isotopic analogues, ^{14}N — ^{14}N , ^{14}N — ^{15}N , and ^{15}N — ^{15}N . He was, however, able to obtain all the rotational lines from $J = 2$ to 18, and his values are in good agreement with those calculated from theory. The $0 \rightarrow 1$ vibration frequency of nitrogen is 2328.3 cm.^{-1} .

Science Masters' Association

Annual Meeting

THE thirty-ninth annual meeting of the Science Masters' Association was held in Cambridge on January 3-6, under the presidency of Prof. James Gray.

The presidential address—"The Role of Science in Education"—was delivered to about five hundred members. Prof. Gray recalled that at the last meeting Sir Richard Gregory gave a challenge to all those engaged in the teaching of science. In his address Sir Richard said, "Undergraduates are led to believe that their studies in any particular branch of science unfit them for any occupation other than those of teacher, research worker, or technologist in that branch." Prof. Gray maintained this was a challenge which neither the schools nor the universities could ignore. Early in life a boy had to choose the course of his future studies, whether he would follow a literary, a linguistic or a scientific road. Sir Richard Gregory had pointed out that a very small proportion of our administrators are recruited from those travelling along the scientific road because it is alleged that such a path provides an unsatisfactory medium of general education, while administrative ability and an aptitude for science are mutually exclusive. Prof. Gray said that many claims have been made for a scientific education, but they fail to stand up to critical examination. Although the door of the Civil Service is open equally to those trained in any subject, men with a scientific training rarely enter because they are found inadequate as men of the world.

Men of science have long claimed that a scientific education is necessary for life in the modern world, but further investigation has shown that this cold detached attitude is not that required by those having intercourse with the ordinary man. Further, when we claim excellence in observational faculties, investigations suggested that our observation is too limited and specialized, whereas our literary, legal and classical colleagues are better able to detect the solution of human problems: the main difference between the two types of education lies in the attitude towards moral values. The scientist bases his training on a moral code far simpler than that which is deemed adequate for other walks of life. As Sir Richard Gregory said, "Science as such is not concerned with moral values which in the long run determine the policy of the statesman; science is concerned with truth." Men of science may feel glad that this is so, but it may tend to widen rather than bridge the gap between us and our literary friends.

The amazing growth of the Association indicates that, could it but speak with one voice, it could achieve much. If science teachers are to give the best preparation for life to their students, they must give them width of vision and depth of insight, which link together into a natural unity the fields at present separated by unscalable walls. Is it not therefore desirable to bring about a much closer correlation between our scientific training and the matter dealt with on the literary, linguistic and historical sides of school and university? Could not science be less specialized and held together with other studies by

an intellectual cement? One of the greatest barriers to the widened curriculum is the present examination system. But surely, if the Science Masters' Association would state unequivocally what it considers should be the content of examination and other syllabuses faithfully reflecting the teaching which in its opinion is most appropriate, the labour would be well spent.

An interesting lecture, "Terrestrial Magnetism and the Sunspot Cycle" was delivered by Prof. E. V. Appleton. He dealt with the results of observations on the variations of the magnetic elements and their relation to the sunspot cycle. He showed how the explanation of this interrelation, first suggested by Dr. Balfour Stewart, is supported by recent observation.

In a talk on "Arctic and Antarctic Seals and Sealing", Mr. G. O. L. Bertram explained the different species of seals and how the exploitation of two species is scientifically controlled. Other species are virtually extinct due to irrational exploitation and are woeful examples of man's lack of foresight.

Prof. R. G. W. Norrish, lecturing on "Experiments in Photo-Chemistry", delighted a very large audience by the display of a number of spectacular and convincing experiments.

In his lecture, "X-Ray Optics", Prof. W. L. Bragg explained some recent advances in the technique of determining crystal structures. He dealt with the modern method of synthesizing an image, from the experimental measurements of scattering, of the atoms in a crystal, the final pattern having a magnification of 10^5 .

A lecture, "Some Aspects of Geology", by Prof. O. T. Jones aroused interest in a subject which is being more generally recognized to-day in the schools than it has been hitherto. The importance of the subject, particularly on the applied side, was stressed.

Many delightful slides in a lecture of general interest delivered by Dr. H. B. Cott interested a mixed group. This dealt with "Camouflage in Nature and in War". Dr. Cott explained various methods of camouflage adopted by animals for concealment and showed how every scheme of applied camouflage must be based upon the effects employed by animals.

At an open meeting, Mr. N. E. Odell, who has just returned from the 1938 Everest Expedition, gave a graphic description of the events of this last attempt on Everest. He showed how the exceptionally bad weather conditions, in spite of all efforts, prevented the summit being reached.

Mr. H. E. Dance and Mr. J. W. Cottingham opened a film discussion on "Films in the Science Classroom". The opening talks were followed by lively discussion.

The headquarters of the meeting were in the new building of the Department of Zoology. Here were housed exhibitions of books by various publishers and of scientific apparatus by instrument makers. The programme included visits to laboratories and works in the district. Demonstrations were arranged by the science departments of the University.

Lord Horder was elected president for 1939.

Scientific and Industrial Research in New Zealand

THE twelfth annual report of the Department of Scientific and Industrial Research, New Zealand, includes the Minister's statement, together with the Secretary's report, and the reports of the various research committees, institutes or bureaux under the Council. Some account of research work at Canterbury Agricultural College is included, and also of the work of the Geological Survey Branch, the Meteorological Branch, the Dominion Observatory and the Apia and Magnetic Observatories. Referring to the work of the Meteorological Branch, the Minister emphasizes its growing importance as a result of the rapid expansion of commercial aviation within New Zealand and the development of trans-oceanic aircraft. The Geological Survey Branch has gained importance through the Government's proposals in regard to the establishment of an iron and steel industry, and also through the recent activity of oil prospecting, with its emphasis on the importance of accurate data on geological structure and mineral resources of the Dominion. During the year, the Soils Survey Division of the Department has carried out an extensive programme of work in Hawke's Bay, North Auckland, Blenheim, West Coast and Bank's Peninsula, the results of which are being published. The Soils Survey Division has also contributed important data collected in the course of soil surveys which bear on the problem of soil erosion and land deterioration in New Zealand.

These activities fall under the broad section of the activities of the Department which is concerned with provision of essential scientific services to the Government. In this section is also included the work of the Dominion Laboratory, which has recently carried out much work for the Housing Department in connexion with the examination of a wide range of building materials, and has given valuable advice as to the durability and general standard of the materials used. The laboratory is also carrying out important industrial research work, particularly in relation to the phormium, kauri gum and fruit industries, and has almost completed an investigation of the curing of lemons, which has given results of real value to the industry. The work of the Plant Research

Bureau has been further consolidated and is now a major branch of the Department's activity. The Botany Section (now established in Wellington) has been engaged in two major investigations which have a bearing on economic problems—ragwort and South Island tussock grasslands. These studies have revealed the remarkable capacity of the ragwort to regenerate from root fragments, and have indicated that toxic sprays seldom injure the plant to such an extent that regeneration of roots will not occur. The Entomological Division has largely centred on measures designed to control the two principal insect pests of rape and turnip crops and has undertaken a study of insect pests of wheat. Work has also been completed on the effect of Agrosan and Ceresan dusts on the seed of wheat, oats, barley and peas, and has shown that little or no adverse effects can be detected on the treated seeds when stored for periods less than five months, either in subsequent germination or in the control of disease. The Plant Diseases Division has made good progress with spray testing technique, and with the growing of pyrethrum. Attention has also been devoted to problems of industrial mycology.

The Dairy Research Institute has been responsible for important advances in the study of the technique for the maintenance of single strain starters, and in this connexion the experience of the Institute has emphasized the importance of the technical education of managing foremen in industrial efficiency. New research associations have been established to provide a co-ordinated scientific and technical service for the woollen manufacturing, boot and shoe manufacturing and tobacco industries. The newly-formed Social Science Research Bureau has directed its activities to a study of the standard of living of dairy farmers. The study of dietary requirements has been handed over to the Medical Research Council, at a stage where family diets have been formulated giving sufficient energy and protective food values. The report also includes accounts of the work of the Wheat Research Institute, of the Fruit Research and Radio Research, as well as of the work of the Standards Institute.

Protection of the Natives of Dutch New Guinea

MEN of science in Holland have been by no means blind to the havoc which is being caused, especially among fauna and flora, by Western exploitation of natural resources in the remoter parts of the world. They also appreciate to the full the deleterious effects of the impact of Western civilization on primitive peoples. This latter problem is one which has been brought home to them with peculiar force and urgency, not only on behalf of the native populations under Dutch administration in Indonesia, but also owing to the prospective rapid

development of the natural resources of Dutch New Guinea in the near future, where the use of aeroplanes by the great oil interests and also prospecting for minerals are bringing about the speedy opening up of the hitherto inaccessible interior.

On April 28, 1937, the Netherlands Committee for International Nature Protection, an influential body which came into being, as its name implies, for promoting international co-operation in devising measures for preventing or alleviating the grosser and more harmful results in Nature of the spread of civilization

appointed a sub-committee to consider measures for the protection of the natives of Dutch New Guinea. This sub-committee was composed of members eminent in science, or with experience of primitive peoples and of industrial organization in the tropics. Among them were Prof. O. de Vries, of the Government Agricultural Experimental Station at Groningen, Dr. A. J. M. van W. van der Graacht, of the Government Service for the Supervision of Mines, and Dr. H. J. T. Bijlmer, whose expedition to the mountain region of Dutch New Guinea in 1936 effected contacts with native peoples who had never previously seen a white man. The sub-committee has prepared a report, which has been adopted by the main committee and has recently been submitted for consideration to the Governor-General of the Dutch Indies and the Minister for the Colonies*.

The native problem, it is pointed out by the Committee in its report, is twofold. The population of the coastal lands, which on broad lines is already known geographically, consists of tribes of Papuan stock, which already have been in contact with Europeans, official, mission and other, for some decades. These tribes are fierce and warlike, cannibals and head-hunters, among whom murder and manslaughter are rife. Some of them are still uninfluenced by civilization. In the mountain region, until recently almost entirely unexplored, on the other hand, the inhabitants are Papuans of a specialized type, some indeed of so low a stature as almost to warrant the designation of pygmies. Of these a few only had been reached in recent years by scientific expeditions, and that with extreme difficulty, before the aeroplane made the country more readily accessible. The culture of these mountain peoples is of a different order from that of the peoples of the coastal lands. They cultivate gardens and keep pigs, are industrious, and have settled habitations, while their warfare is of a mild type. In disposition they are friendly, and greet European contacts in an amicable spirit.

Two alternative methods of dealing with the native problem presented themselves to the Committee for consideration. Of these the first was the complete segregation of the native population from all contacts with civilization in a native reserve, in which they might be preserved with their culture as museum specimens. The second alternative was the protection of the native population from the effects of a full and sudden impact of white civilization—the abruptness of the impact constituting, it was felt, the essential danger—by a process of gradual preparation and education, in which contact with European influence would be subject to stringent and careful regulation.

The Committee elected in favour of the latter course as the more practical, and at the same time the more fair to the native, as it would leave open to him the possibility of cultural development, from which, it was felt, he should not be debarred, as he would be under the first alternative.

It is, therefore, suggested that provision should be made for three stages of development and contact: (1) a period of gradual reconnoitring and penetration, research and study, with a minimum of native control by Government agencies; (2) a period of gradual building up of a new culture, the introduction of

missions and mission schools, the intensification of Government functions, with a recognition of native authorities, and the extension of communications, and other forms of economic development; and (3) the normal colonial condition of Dutch administration, with co-operation with, and recognition of, local native autonomy.

In order to bring about the smooth development of these three stages of progress, certain regulations are suggested, which include the declaration of population reserves, in which in addition to the existing regulations as to permits for entrance, no Eastern immigrants should be admitted, and no corporate or individual enterprise should be allowed except under special conditions framed to protect the interests of the natives. As a condition of admission to New Guinea, medical examination and precaution against infectious or other diseases should be added to the requirement of a permit; the importation of all alcohol and drugs should be prohibited; and the importation and sale of drapery goods should also be prohibited in order to enforce the wearing of the native type of clothing. Further, the establishment of estates should be subject to regulation, ensuring the preservation of sufficient agricultural land for the needs of the native population, while the importation of labour and recruiting of indigenous labour should be regulated. A large area of the mountain region should be declared a reserve, though not debarred to prospecting, which being for the most part of a transient character should not, under permit, affect the interests of the native population. This large reserve, when known ethnologically, and technically explored, might be broken up into smaller units.

It will be seen that the Committee, in framing its recommendations, has wisely aimed at reconciling the efficient protection of the interests of the indigenous population with the opening up and commercial development of this valuable territory. In framing its policy it has been, as is duly acknowledged, much indebted to the measures taken by the Australian Government for the administration of the Mandated Territory of New Guinea, and above all to the conceptions in native administration of Governor General Sir Hubert Murray.

University Events

BELFAST.—The title of professor emeritus has been conferred on Prof. F. Hummel, who retired recently from the chair of civil engineering.

EDINBURGH.—On January 11, Sir William Bragg formally opened the new common room of the University, situated at King's Buildings, West Mains Road. It is designed to meet the physical and social needs of the students of science, most of whose work is done at King's Buildings. During the ceremony, it was announced that Dr. J. A. Thomson had given £5,000 and promised up to £10,000 towards the maintenance of the building.

Sir William Bragg also took the chair at the inaugural lecture of the newly instituted lectureship of crystallography. The lectureship was founded by a fund left by Lady Dewar, widow of Sir James Dewar, in 1936, and the lecture was delivered by Dr. C. A. Beevers, Dewar research fellow.

* Netherlands Committee for International Nature Protection: Report concerning the Possibility of Protecting the Primitive Natives, especially the Mountain-Papuan-Tribes in Dutch New Guinea. Pp. 32. (Amsterdam, Nederlandse Commissie voor Internationale Natuurbescherming.)

Science News a Century Ago

Schools of Engineering, Mining and Surveying

"As very great ignorance seems to exist among the would-be political economists as to the state and progress of the schools for engineering, mining and surveying, we are induced to publish the following remarks:—The Government have the departments at Sandhurst, Woolwich and Chatham; the East India Company have also a college; the Royal Dublin Society have long given regular courses of lectures and instruction, under the superintendence of Mr. Griffiths; and surveying has been so effectively taught at the Agricultural School of Templemoyle, that the Ordnance Survey Department there has received considerable assistance from it. Surveying is one of the regular branches of instruction at Elizabeth College, Guernsey, and we believe also at King William College in the Isle of Man.

"But if any deficiency of these institutions exists it will be fully supplied by the facilities established at Durham and in University and King's College, London. . . ." (*Civil Engineer and Architects' Journal*, Jan. 1839).

Statistics Applied to Medicine

BEFORE the Statistical Society on January 23, 1839, a paper was read by Dr. Guy, professor in forensic medicine, King's College, London, entitled *On the Value of the Numerical Method as applied to Science, but especially to Physiology and Medicine*.

"The success," said the author, "with which calculation has been applied to unorganized matter, and the confidence with which the natural philosopher resorts to it on all occasions, have not failed to exert a powerful influence on those who pursue the study of organized beings, and a growing disposition to apply calculation to the phenomena of life is one of the characteristics of the age in which we live." Having referred to the application of statistics to insurance, crime, bills of mortality, etc., he went on to say that "it often happens that an event is attributed to a cause which varies in intensity under different circumstances or in different localities, and we have no other means of testing the accuracy of our opinion than by comparing the frequency of the event in question, with the varying influence of the assumed cause; and should the same numbers be obtained in every case we are justified in rejecting that cause. If this rule be applied to the received opinions on the subject of phthisis pulmonalis, we should soon see how void they are".

Dr. William Augustus Guy (1810–1885), the author of this paper, edited the *Journal of the Statistical Society* from 1852 until 1856 and served as president of the Society during 1873–75. He was a vice-president of the Royal Society and a founder of the Health of Towns Association.

Geology of Portugal

ON January 23, 1839, Daniel Sharpe (1806–56), a business man who had resided in Portugal, read a paper to the Geological Society "On the Neighbourhood of Lisbon". "In few countries," he said, "can the separation between the tertiary and secondary formations be more strongly marked than in the neighbourhood of Lisbon. The rocks of the latter class were distributed and denuded before the commencement of the tertiary epoch, and a vast mass of

basalt, covering an extensive district to the west and north of Lisbon, is interposed between the youngest of the secondary and the oldest of the tertiary strata". "The 'Hippurite' limestone," he said, "consists in the upper and middle parts of marls and argillaceous limestones, containing layers of flint, and in the lowest of a beautiful hard marble. It occurs only on the Lisbon side of the Tagus." The 'Espichel' limestone is composed of shale and grey limestone. It constitutes the Cape after which it is named."

Sharpe at the time of his death was president of the Geological Society.

Societies and Academies

Edinburgh

Royal Society of Edinburgh, January 9.

F. L. G. RAWLINS: Physical methods in the investigation of paintings (address). A painting, considered scientifically, is an essentially stratified structure, consisting of the support (stone, wood or canvas), the ground (gesso or priming), the paint-film, and the varnish film. These layers may themselves be complex, and they are rarely independent as regards forces of binding, expansion and contraction. Methods of investigation, therefore, have been developed akin to those which have proved valuable in petrology, surface-chemistry and crystal structure. The chief aims of a picture laboratory are (a) the study of condition, (b) study of technique of pure examples of the chief schools. X-rays, ultra-violet and infra-red rays are all of use. Also microscopy, with polarized light, is employed.

K. FUCHS: Invariance of quantized field equations. It is proved that the theory of quantum dynamics as developed by Heisenberg and Pauli is invariant not only against Lorentz transformations but also against all transformations allowed by the general theory of relativity. Although it is impracticable to write the quantized Hamiltonian equations and the quantum conditions in tensor form (the canonically conjugate variables do not form a tensor), it can be shown that the complete system of field equations plus commutation relations does not depend on the co-ordinate system.

Paris

Academy of Sciences (C.R., 207, 1341–1456, Dec. 27, 1938).

H. DESLANDRES: Application to some interesting molecules of the new analysis of molecular spectra.

H. COLIN and M. SIMON: Nitrogen, organates and saccharin richness of the sugar-beet.

F. GRANDJEAN: Neoteny (presence of immature characters in the adult) in the Acarids.

G. GIRAUD: A new extension of the theory of elliptic equations.

J. HAAG: A biharmonic problem.

D. RIABOUCHINSKY: Interpretation of theoretical movements of fluids by 'animated' diagrams.

G. DENIGES: Very sensitive micro-crystalline reactions of bismuth and antimony metalloids.

L. DANIEL: Two new cases of xania in the apple-tree.

H. DAVENPORT: Sums of integral powers.

P. LÉVY: Properties of some indefinitely divisible laws.

P. HEBBONI: Continued two-term matrices and their application to linear integro-differential equations.

J. DELSARTE: Continuous hypercomplex systems and the theory of multi-groups.

L. KANTOROVITCH and A. PINSKER: Partially additive functions in semi-ordered spaces.

L. HIBBERT: The system (R.V.) of integral functions about the essential singular point.

P. DIVE: Barotropic [surfaces of equal pressure and equal density coincident] rotations in the second approximation in a fluid star stratified in ellipsoidal layers.

D. BELORIZKY: Singular points in the limited problem of three bodies.

L. NÉEL: Application to nickel of a new method of measuring the true specific heat.

W. UYTERHOEVEN and C. VERBURG: Temperature of electrons T_e in a positive column discharge with alternating current (50 ~); experimental method.

Mlle. S. VAIL: Silver-platinum comparisons in aqueous solutions of iodides, and electrostatics of the contact Ag-I.

R. FORRER: Decomposition of the elementary moment of ferromagnetics, and the gyromagnetic phenomena.

A. DAUVILLIER: Identification of Hoffmann collisions with electron bundles produced by cosmic rays.

T. KIRI: Remarks on the curves of blackening on [photographic] plates in the region of under-exposure.

G. LILANDAT: Two different examples of the non-additivity of the photo-electric effects of simultaneous luminous fluxes.

C. BENEDICKS: Diagram permitting the graphical representation of the composition of multiple systems, such as those of the light alloys.

A. MAMAN: Contribution to the study of the octanes.

E. LUCATU: Relation between vapour pressure, viscosity and molecular association.

R. VAILLARD: Inflammation of gaseous mixtures by the electric spark: air-diethylether mixtures.

R. LUCAS: Mechanism of fusion.

J. BÉNARD and G. CHAUDRON: Solid solutions of the cubic sesqui-oxide of iron obtained by oxidation of substituted magnetites.

A. PORTEVIN and H. JOLIVET: A mode of decomposition of austenite.

Mlle. D. BIQUARD: Raman spectra of *cis* and *trans* α and β decalones.

Mlle. P. RAMART-LUCAS: Structure of rhodamines from their absorption spectra.

P. CHOVIN: Researches on the Pechmann colouring matters: osimion reactions in the symmetric dinaphthylated series.

R. PAJEAU: Influence of bromides of beryllium, magnesium, zinc and cadmium on the bromination of benzene. They show catalytic activity increasing with atomic weight of the metal, excepting beryllium.

L. DUBREUIL: The Oligocene and the Burdigalian in Syria.

R. FUBON and P. LEMOINE: Presence of the nummulitic at Pondicherry (French India).

L. BÉTRAND: Triassic terrains of the middle part of the Département du Var.

F. BLANCHET: Tectonics of the left bank of the River Durance in the neighbourhood of La-Roche-de-Rame (Hautes-Alpes) and its relations with the Guil nappes.

B. RAJÓSVIÓ: The regime of the sands of the estuary of the Seine.

C. DAUZÈRE: Lightning strokes in the Département de la Haute-Garonne. Frequency of lightning strokes is related to the nature of the soil.

R. GRANDMONTAGNE: Decrease of blue and red light at the end of twilight. Photo-electric measurements show that the red radiation decreases to constant intensity earlier than the blue radiation.

J. MAGROU and J. BOUGET: Presence of mycorrhiza in potatoes reverted to the wild state.

M. BREISTROFFER: An umbellifer hitherto not known in the French flora, *Scandicium stellatum* Thell. of the Baronnies (Hautes-Alpes).

R. FRANQUET: Inulin in grafts of annual sun-flowers and of perennial Composites.

P. CHOUARD and P. VAILLON: Distinct action of photoperiodism on the formation of buds and the development of flowers in the chrysanthemum.

Mlle. S. LALLEMAND: Experimental production, with the aid of colchicine, of strophosomous chicks [with exposed thoracic and abdominal organs, tail applied at the head, etc.].

J. ESCHER-DREHVIKENS, E. LUDMERER and Mlle. M.-L. VERRIER: Researches on the retinal pigments of Cephalopods.

Mlle. V. DANTCHAKOFF: Folliculin in the sexual histogenesis of the embryo of mammals.

J.-H. VIVIEN: Effects of hypophysectomy in a marine teleostean, *Gobius paganelus* L.

Tokyo

Imperial Academy (Proc., 14, No. 8, October 1938).

TSURUBABURO TAKASU: A conformal geometric generalization of geodesic lines.

TATSUO KAWATA: Remarks on the representation of entire functions of exponential type.

TAKESHI IWAGAKI: Remark concerning a problem of M. N. Lusin.

MASAO INOUE: The stability of Dirichlet's problem.

KENJIRO SHODA: (1) Equivalence of representation of finite groups through semi-linear transformations. (2) Invariants of finite groups of half-linear transformations.

KÔSAKU YOSIDA: (1) Abstract integral equations and the homogeneous stochastic process. (2) Mean ergodic theorem in Banach spaces.

SHIZUO KAKUTANI: Iteration of linear operations in complex Banach spaces.

RYOJI SAKATA: Representation of compactness of a sphere.

SABURO NAKANO: Harmonic analysis of nineteen years material of latitude variations observed at some international latitude stations.

KEN SUGAWARA: Dichotomous microstratification of pH. A new type of dichotomous stratification of pH developed in the epilimnion of Takasuka-Numa.

YOSHIKAZU TOYOHARA: Inclination of the strand along a sandy seashore (1).

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Monday, January 23

UNIVERSITY OF LONDON, at 5.15.—Prof. R. A. Peters, F.R.S.: "Some Aspects of Vitamin B₁ and Brain Biochemistry".*

UNIVERSITY COLLEGE, LONDON, at 5.30.—Dr. H. S. W. Massey: "The Quantum Theory and Modern Physical Science".*

Wednesday, January 25

COURTAULD INSTITUTE OF ART, at 5.30.—Prof. W. Percival Yette: "Astronomy in Chinese Art".*

Thursday, January 26

ROYAL SOCIETY, at 4.30.—W. J. C. Lawrence, J. R. Price, Sir Robert Robinson, F.R.S. and Lady Robinson: "The Distribution of Anthocyanins in Flowers, Fruits and Leaves".

Friday, January 27

PHYSICAL SOCIETY AND ASTRONOMICAL SOCIETY (Joint Meeting), at 5.15.—Discussion on "The Expanding Universe", to be opened by Prof. G. F. J. Temple and Dr. G. C. McVittie.

ROYAL INSTITUTION, at 9.—Prof. J. D. Bernal, F.R.S.: "Structure of Proteins".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

LECTURER IN HISTORICAL AND MECHANICAL ENGINEERING in Shrewsbury Technical College—The Clerk to the Committee of Management, County Buildings, Shrewsbury (January 23).

ASSISTANT LECTURER IN BACTERIOLOGY in the West of Scotland Agricultural College, Glasgow—The Secretary (February 1).

TEACHER OF MIXING in Doncaster Technical College—The Secretary, Education Office, Doncaster (February 8).

ASSISTANT LECTURER IN MECHANICAL ENGINEERING in the Manchester Municipal College of Technology—The Principal (February 6).

GUIDE-LECTURER (woman) in Leicester Museum—The Director (February 14).

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Nutrition and Local Government—What your Local Authority can Do. By Marjorie H. Green. Pp. 20. (London: Children's Minimum Council.) 3d. [1912]

The Air Almanac, 1939, January-March. Prepared by H. M. Nautical Almanac Office on behalf of the Air Ministry. (Air Publication 1602) Pp. 188+xii. (London: H.M. Stationery Office.) 5s. net. [1912]

Imperial Forestry Institute: University of Oxford. Fourteenth Annual Report, 1937-38. Pp. 36. (Oxford: Imperial Forestry Institute.) [1912]

Amgueddfa Genedlaethol Cymru National Museum of Wales. Thirty-first Annual Report, 1937-38. Pp. 52. (Cardiff: National Museum of Wales.) [1912]

Department of Scientific and Industrial Research. Report of the Fuel Research Board for the Year ended 31st March 1938, with Report of the Director of Fuel Research. Pp. x+225. (London: H.M. Stationery Office.) 4s. net. [1912]

Manchester Museum: University of Manchester. Museum Publication No. 115: Report of the Museum Committee for the Year 1937-38. Pp. 31. (Manchester: Manchester Museum.) 6d. net. [1912]

Leeds University. Report to the Worshipful Company of Clothworkers of the City of London of the Advisory Committee on the Departments of Textile Industries and Colour Chemistry and Dyeing, during the Session 1937-38. Pp. 24. (Leeds: Leeds University.) [1912]

John Innes Horticultural Institution. Twenty-eighth Annual Report for the Year 1937. Pp. 28. (London: John Innes Horticultural Institution.) [1912]

National Physical Laboratory. Tests and Measurements undertaken by the Physics Department, Acoustics Division. Pp. ii+28. Tests and Measurements undertaken by the Physics Department, Heat Division. Pp. iii+56. Tests and Measurements undertaken by the Physics Department, Radiology Division. Pp. ii+23. (Teddington: National Physical Laboratory.) [1912]

Hull Museum. Publication No. 87: Illustrated Catalogue of the Museum of Fisheries and Shipping. By Thomas Sheppard. Eighth edition. Pp. 88. 6d. Publication No. 186: Willerforse House, Hull. By T. Sheppard. Second edition. Pp. 24. 2d. Publication No. 197: Excavations at Eastburn, East Yorkshire. By Thomas Sheppard. Pp. 15+6 plates. Publication No. 198: A Roman and Saxon Site at Hunsall, East Yorks, 1937. By Anthony L. Congreve. Pp. 42+2 plates. (Hull: Hull Museum.) [1912]

Twenty-ninth Report of the Commissioners of His Majesty's Customs and Excise for the Year ended 31st March 1938: Being the 82nd Report relating to the Customs and the 81st Report relating to the Excise. (Cmd. 5876) Pp. 215. (London: H.M. Stationery Office.) 3s. 6d. net. [1912]

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 10, No. 2, September 1938. Compiled by Agnes Elizabeth Glennie, assisted by Gwen Davies and Catherine Robson. Pp. vi+95-187. (London: H.M. Stationery Office.) 4s. 6d. net. [1912]

Other Countries

Cours. Vol. 4 Part 2: Science, Technology and Society in Seventeenth Century England. By Robert K. Merton. Pp. 360-632. (Bruges: St. Catherine Press, Ltd.) [1912]

Crohamhurst Observatory. Observatory Paper 9: The Climate of Australia during the Hypothetical Jovian Sunspot Cycle 1913-1924 together with the Monthly and Annual Rainfall Observations at Selected Stations during that Period, and some Comments on the Evidence of Cyclical Reproduction of the Weather. By Inigo Jones. Pp. 111. (Crohamhurst: Crohamhurst Observatory.) [1912]

Commonwealth of Australia. Council for Scientific and Industrial Research. Bulletin No. 121: Observations on the Toxicity of Fluorine for Sheep. By A. W. Pearce. Pp. 35+6 plates. (Melbourne: Government Printer.) [1912]

Geological Survey of British Guiana. Bulletin No. 11: Report on the Geology of the Superficial and Coastal Deposits of British Guiana. By Dr. D. B. Grantham and B. F. Noel-Paton. Pp. 122. (Georgetown: Geological Survey of British Guiana.) 1 dollar. [1912]

Carnegie Institution of Washington. Annual Report of the Director of the Department of Terrestrial Magnetism. Pp. lii+62. (Washington, D.C.: Carnegie Institution.) [1912]

An Introduction to the Study of Air Mass Analysis, by Jerome Namias; and Characteristic Properties of North American Air Masses, by Prof. Hurd O. Willett; also The Norwegian Wave-Theory of Cyclones, by B. Haugen; and Notes, Bibliography and Illustrations. Fourth edition, enlarged and revised. Pp. iv+122. (Allston, Mass.: American Meteorological Society.) 75 cents. [1912]

Journal of the Indian Institute of Science. Vol. 21A, Part 32: Dissociation Constants of Oils and Traces Caronic and Norpinic Acids. By O. T. Abichandani and S. K. K. Jaitkar. Pp. 373-384. 1 rupee. Vol. 21A, Part 33: Studies in Binary Systems. Part 2. Heats of Adsorption from Binary Mixtures of Toluene and Acetic Acid by Charcoal and Silica Gel. By J. G. Kane and S. K. K. Jaitkar. Pp. 385-394. 14 annas. Vol. 21A, Part 34: Detergent Action of Soaps. Part 1: Interfacial Tensions of Pure Soap Solutions. By B. S. Kulkarni and S. K. K. Jaitkar. Pp. 395-406. 14 annas. Vol. 21A, Part 35: Studies in Binary Systems. Part 3: Adsorption and Heats of Adsorption from Binary Mixtures of Methyl Alcohol-Water by Activated Charcoal and Silica Gel. By J. G. Kane and S. K. K. Jaitkar. Pp. 407-412. 10 annas. Vol. 21A, Part 36: Studies in Binary Systems. Part 4: Adsorption from Mixtures of Toluene and Acetic Acid by Deashed Animal Charcoal. By J. G. Kane and S. K. K. Jaitkar. Pp. 413-416. 8 annas (Bangalore: Indian Institute of Science.) [1912]

Advisory Committee on Education. Staff Study No. 7: Selected Legal Problems in providing Federal Aid for Education. By Robert B. Hamilton. Pp. ix+71. (Washington, D.C.: Carnegie Institution.) 15 cents. [1912]

Carnegie Corporation of New York. Report of the President and of the Treasurer for the Year ended September 30, 1938. Pp. 158. (New York: Carnegie Corporation of New York.) [1912]

Seventy-five Years: a History of the Buffalo Society of Natural Sciences, 1861-1936 (Vol. 18 of the Bulletin.) Pp. 204+53 plates. (Buffalo, N.Y.: Buffalo Society of Natural Sciences.) [1912]

Meddelelser om Grønland udgivne af Kommissionen for Videnskabelige Undersøgelser i Grønland. Bind 82, Nr. 5: The Godthaab Expedition 1928—The Phytoplankton of the Waters West of Greenland. By Jul. Grøntved and Gunnar Seidenfaden. Pp. 380+2 plates. 18.00 kr. Bind 96, Nr. 6: Geologisk Ekspedition til Østgrønland 1936-38—Middle Devonian Vertebrates from Osmung Land and Wogener Peninsula (East Greenland). Part 1: Placodermal Ichthyodontoformes. By E. A. von Steenrood and G. Sævi-Söderbergh. Pp. 38+14 plates. 3.50 kr. Bind 100, Nr. 7: Trears ekspeditionen til Christian den X's Land 1931-34—The Biology of some Important Plankton Animals in the Fjords of East Greenland. By Hans H. Usung. Pp. 108. 5.00 kr. Bind 103, Nr. 4: Trears ekspeditionen til Christian den X's Land 1931-34—Sedimentpetrographische Untersuchungen in Ost-Grønland: Petrographie, Granulometrie und Abbröcklung rezenter Sande aus Christian X's Land. Von Armin von Moos. Pp. 76. 3.25 kr. Bind 103, Nr. 5: Trears ekspeditionen til Christian den X's Land 1931-34—Die tektonischen Strukturelemente des ostheuen Mooshooftefjordes. Von H. Butler. Pp. 8. 0.25 kr. Bind 100, Nr. 1. 6 og 7 Thule-Expedition til Sydøstgrønland, 1931-33—Knud Rasmussen's Posthumous Notes on the Life and Doms of the East Greenlanders in Olden Times. Edited by H. Ostermann. Pp. 215. 10.00 kr. Bind 112, Nr. 4: Trears ekspeditionen til Christian den X's Land 1931-34—Skeletreste von *Dicrostonyx groenlandicus* Trull als Inhalt von Raubvogelgewölle. Von H. v. Mandach. Pp. 54+23 plates. 5.00 kr. Bind 119, Nr. 7: Weberite, a New Mineral from Ivigtut. By Richard Bagdadi. Pp. 12+1 plate. 0.54 kr. Bind 119, Nr. 8: Archeological Investigations in Knud Rasmussen's Land. By Holge Larsen. Pp. 78+3 plates. 4.00 kr. Bind 121, Nr. 2: The Zoology of East Greenland—Colembola. By Marie Hammer. Pp. 42. 2.00 kr. (København: O. A. Reitzels Forlag.) [1912]

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Finance for Scientific Research

THE publication by the Association of Scientific Workers in the *Scientific Worker* of the final draft of a memorandum on the financing of research, a preliminary draft of which has already been discussed in a leading article in *NATURE* (138, 51; 1938) focuses attention once more upon the provision of finance for, and organization of, research, and the arguments of the memorandum itself and the observations of the Advisory Council upon them deserve close study by scientific workers. A brief survey of the way in which the present position has developed appears elsewhere in this issue (p. 146). The comments of the Advisory Council on the scheme put forward by the Association indicate, indeed, complete agreement with the general thesis that there is need—and urgent need—for much greater application of science by industry. Disagreement with much in the memorandum is based on special knowledge of the difficulties to be overcome, for it is stated that some of the premises upon which the conclusions of the memorandum are based are incomplete and inaccurate.

In the first place, an explanation is given of the way in which Government expenditure on research is limited by the degree to which industry generally is prepared and able to apply scientific method and advance in scientific knowledge. Over a very wide field, though perhaps not necessarily the whole field of science, Government expenditure on scientific research will be largely abortive unless its results are ultimately used in industry, at least in its broadest sense. There are of course branches of research which the State cannot leave to the initiative of industry, such, for example, as work on the preservation and transport of food or the economical use of fuel and the work of the National Physical Laboratory on the application of exact measurement.

It is perhaps pertinent to refer here to one special field which has hitherto largely been left to individual initiative or voluntary support, namely, that of industrial psychology. The success which has already attended the work of the National Institute of Industrial Psychology, demonstrates the valuable service which research in this field can render not simply to industrial efficiency but also to health and safety in industry and in society generally. Work in these latter fields is of course also carried out by the Medical Research Council through the Industrial Health Research Board, with which the Institute has sometimes been associated. In spite of this, the position of the Institute is far from satisfactory. Lack of resources prevents it from pursuing promising lines of work, and the response to its recent appeal has been quite inadequate. Under such conditions the national importance of its work may fairly raise the question of State assistance or development on a much larger scale.

Allowing, however, for such exceptions, though even here the co-operation of industry is often invited and forthcoming, the Advisory Council holds that the worst way of attempting to secure increased expenditure by industry is to spend large sums of public money for its direct benefit in advance. If the importance of securing contributions from industry itself be conceded, the soundness of this view can scarcely be challenged. Indeed certain sections of industry might be in a healthier position had regard been had to this principle before according them the protection of tariffs.

The Advisory Council then proceeds to refute the assertion that fluctuating finance has been a main difficulty. While the Parliamentary Science Committee has probably overstressed the

importance of fluctuations in income—the real trouble is that the general average level of contributions is much too low—the Advisory Council appears to go too far in the other direction. Figures are quoted to show that the net estimates of the Department of Scientific and Industrial Research as laid before Parliament increased continuously from 1929 to 1937, apart from a slight decrease in 1931. The actual expenditure of the Department as given in its annual reports decreased continuously from £740,520 gross or £555,691 net in 1930–31 to £654,736 gross or £451,987 net in 1932–33, increasing again in 1933–34 to £664,482 gross or £476,877 net and thereafter continuously to its present level. These fluctuations cannot be described as violent, nor can they be dismissed entirely as negligible.

On this point, therefore, the difference in the views of the Advisory Council and of the Parliamentary Science Committee appears to be rather in degree than in kind.

As regards the substitution of a fund for a Parliamentary vote, the Advisory Council directs attention to the fluctuations which occurred before the exhaustion of the Million Pound Fund, and deprecates the validity of this argument for replacing a vote by a fund. There is much better ground, however, for criticizing the proposal that the control of the funds for research to be provided by the Exchequer should no longer rest in the hands of the Lord President as minister responsible to Parliament, but in an autonomous body with the Development Commissioners as its nucleus and containing representatives of the learned societies, the universities, medical and agricultural associations, etc. The main reason for employing a minister responsible to Parliament and advised by Government research councils, the members of which are selected on the basis of knowledge and experience as distinct from interests, is the necessity of obtaining a proper balance of research expenditure as between industrial, agricultural and medical research. It is the minister's responsibility to satisfy himself that such a balance is maintained and to that end to submit proposals to Parliament.

The Committee is undoubtedly right in pointing out that Great Britain has lagged far behind Germany, the United States and the U.S.S.R. in providing institutions of this type. The Committee suggests, in particular, institutions for research in optics, silicates and fibres, while chemical engineering, particularly in problems of materials

and unit operations, is a yet further field where a call is for. Institutions of this type would largely be concerned with the long-range or fundamental type of research, and there is no reason to assert, as the Advisory Council does, that, if a vigorous industrial policy in industry is provided, coupled with steady pressure from the Government, they will yield results greatly in advance of the capacity of industry to utilize them.

The Committee then returns to its former contention regarding the fluctuating income for research. It is of course desirable that research should be free to develop without violent fluctuations, and particularly that it should be pursued vigorously in time of depression, when in the past it has been liable to be curtailed. The point is, however, in our opinion insignificant compared with the raising of research contributions from all sources to a really adequate level. Moreover, one of the most important needs of to-day is the consideration of the utilization of research resources from the widest possible point of view. This will almost certainly involve the re-distribution or re-orientation of research effort.

It appears to us, therefore, that the Committee's strongest comments on the Advisory Council's report are its silence on this question of the need for greater co-ordination and on the extension of scientific research into fields which at present make little or no use of it. It is not really possible to separate the two aspects of the problem—the planning or co-ordination and the financing of research. More adequate provision for the finance of research is not more needed to-day than better provision for a really wide view of the national efforts and resources for research with a view to their better distribution, particularly between the physical and the social sciences.

It is probable indeed that this question will be an early consideration of the new Division of the British Association. What will then remain is the question of the authority which can give effect to any recommendations coming from such an influential and representative source. We find no evidence in the present report that the machinery now in existence is incapable of being developed or modified to meet this need without essentially changing its structure. It will be recalled that Sir Daniel Hall's proposal for a Planning Council, intended to pass a technical opinion on proposals submitted to the Cabinet or to Parliament, comparable with the Treasury review which is already provided, contemplates representation in the

Cabinet by the Lord President of the Council, and the ultimate enhancement of his status in the Cabinet.

This appears to us to be far more promising a line of development than that of the autonomous board proposed by the Parliamentary Science Committee. We regard it as essential that any great development on these lines in the expansion of scientific and industrial research should provide, not merely for adequate scrutiny in Parliament, but also for adequate discussion of the financial and technical details in the general sense by technical and professional bodies in general. Despite the excellence of the work of certain public utility corporations such as the British Broadcasting Corporation, the Electricity Commissioners or the Port of London Authority, it cannot be contended that this system provides adequate opportunity for discussion or debate in Parliament, or the information which renders possible informed discussion in the scientific and technical press or elsewhere.

It is no condemnation of the present system that in practice the vote of the Department of Scientific and Industrial Research is normally passed without criticism or debate. That may be merely an indication of the lack of interest which it should be the task of scientific workers to dispel. All the evidence in fact goes to show that the Department is increasingly desirous of co-ordinating its work with that of the Medical Research Council and the Agricultural Research Council, and that the existing machinery should be reasonably adequate if used. Moreover, the Department has already proved its capacity to establish *ad hoc* institutions for special purposes where required as, for example, the Bridge Structures Research Committee, the Steel Structures Research Committee, and the Locomotive Experimental Station Enquiry Committee.

If, therefore, it is conceded that the Parliamentary Science Committee has not made out an entirely convincing case for the establishment of an endowment fund for scientific and industrial research, particularly for the institution of an autonomous authority, neither has the Advisory Council advanced convincing reasons why it should not stimulate research on a somewhat larger scale, and particularly by increased Government grants. It should be remembered that, as the report states, the total expenditure on all kinds of scientific research in Great Britain amounts to only about £4,000,000 a year, or much less than

one tenth per cent of the national income, as compared with one half per cent in the United States and possibly one per cent in Soviet Russia. As has been pointed out from time to time, ultimately Government grants are provided by industry, and if industry is unable or unwilling to provide the required funds directly, increased Government support is merely an indirect means of achieving that end.

It is of course recognized that there are limits to Government effort in this direction, imposed no less by practice than by the educational position of industry as affecting its ability to utilize the results obtained. The field of work of a research association is by no means co-terminous with that of the research department of even the largest industrial firm. In the nature of things its work must be more generalized and less specific than that of an individual research department. On the other hand, a research association is well qualified to undertake the fundamental and long-range investigations which lie outside the scope or resources of even the largest individual research department, and it is precisely in this field that Government help is most desirable.

We do not suggest, of course, that fundamental or long-range research alone should be undertaken by the research associations, or that it is or should be exclusively their task. Much important work of this type is already undertaken by other Government research institutions, such as the National Physical Laboratory, and a strong case could probably be made out for a few more *ad hoc* research institutions. Moreover, such work belongs inherently to the universities also, and in this respect it is highly important that due regard should be had to all existing resources, particularly where, for example, as in chemical engineering, duplication involves the duplication of expensive equipment which may only be imperfectly utilized in any one centre.

Here is a particular case where co-ordination and planning appear to be called for and where some central authority might well on review find the increase in specific grants a sound policy. Never was it more essential to guard against sectionalism and to secure full flexibility if re-orientation and re-distribution are to be possible where required. It may well be hoped that the discussion of the report by influential associations as well as by individual scientific workers, may stimulate further attention to the national financing of research.

Science and its Applications in the Eighteenth Century

A History of Science, Technology and Philosophy in the Eighteenth Century

By Prof. A. Wolf. (History of Science Library.) Pp. 814 + 128 plates. (London: George Allen and Unwin, Ltd., 1938.) 25s. net.

THIS book is the successor of Prof. Wolf's history of science, technology and philosophy in the sixteenth and seventeenth centuries published in 1935, and is planned to form part of a complete history, to be extended in the future both backwards and forwards. The present instalment well bears out the favourable impression created by the earlier volume.

The arrangement of the work may be judged by a list of subjects with the number of pages given to each. Mathematics and physics occupy 297 pages; chemistry, geology and geography, 84; botany, zoology and medicine, 72; technology, 170; psychology, social sciences with economics, 78; and philosophy, 53. Thus it will be seen that most attention is given to the physical sciences and technology. This apportionment is perhaps justified by the relative advances made in the different subjects, and by the author's deliberate restriction of his account of philosophy to the supply of a philosophic background for eighteenth century science.

The book begins with an account of what the eighteenth century inherited from the sixteenth and seventeenth, and then gives a preliminary summary of what was accomplished in the eighteenth. "Enlightenment", born in England in the seventeenth century, spread to France and then to other countries. It involved the new idea of tolerance—freedom for every man to think what he wished and say it. It was believed that Voltaire and the Encyclopædists had established tolerance once for all in the world, to be developed more fully in the nineteenth century. If it were not true, it would be incredible that in the twentieth century half Europe has turned its back on tolerance and freedom, or allowed them to be suppressed by dictators.

The chief work of the eighteenth century in pure science was the acceptance and development of Newton's discoveries. They were spread in France at first largely by Voltaire; they underlay the most important articles in the French encyclopædia, and were carried many stages further towards the end of the century by Lagrange and Laplace. Mechanics and astronomy more and more confirmed Newtonian principles.

After a description of this work, Prof. Wolf

passes to an account of observational astronomy, beginning with Bradley's unsuccessful search for annual parallax in the stars, which led as a by-product to the detection of aberration, and an estimate of the velocity of light. He then deals with other observations, the most important perhaps being the determination of the density of the earth by Maskelyne and Cavendish, and the very prolonged and extensive studies of stars, double-stars and nebulae by William Herschel. From astronomical observation, it is natural to proceed to astronomical instruments, and here Prof. Wolf opens a subject often ignored in histories of science. Scientific instruments not only need great skill in their planning and manufacture, but also enable men to make discoveries and measurements which without them would be impossible. It needs but one example—the determination of longitude at sea by the invention of an accurate marine chronometer by John Harrison.

Next come chapters on the development of light, sound, heat and electricity and magnetism, in which perhaps the most interesting sections deal with Black's work on latent heat and the foreshadowing of the mechanical theory by the measurement of the heat developed in the boring of cannon by Benjamin Thompson, Count Rumford. In electricity, Coulomb established the law of attraction and, towards the end of the century, Galvani started the study of current electricity by observing the movement of frogs' legs when touched with two metals in contact.

In the early years of the century, chemistry was dominated by the phlogiston theory of combustion, chiefly formulated by Stahl. Here Prof. Wolf might have made the essence of the subject clearer. Phlogiston escapes when bodies burn, and, since there is an increase in weight, phlogiston must have a negative weight, a return to Aristotle's ideas. It was the work of Priestley, Cavendish and finally Lavoisier, that explained combustion in terms of ordinary bodies with positive mass and weight, and thus carried the fundamental principles established by Galileo and Newton in mechanics over into chemistry.

The work of Linnæus on systematic botany was followed by that of Wolff and Stephen Hales in plant and animal physiology, the latter subject being greatly influenced by Haller, whose eight-volumed book marked a new epoch. Medicine was developed by a line of medical men ranging from Boerhaave of Leyden to John Hunter of London.

Turning to technology, Prof. Wolf deals successively with agriculture, textiles, building, transport, power and machinery, the steam engine, mining and metallurgy, industrial chemistry, lenses, mechanical calculators and telegraphy. The list shows how wide is the scope of the book. Doubt-

less the description of these "practical applications" will appeal strongly to some readers.

The volume closes with chapters on psychology, the social sciences and philosophy, bringing an able and interesting work to a successful conclusion.

W. C. D. DAMPIER.

Stellar Dynamics

Stellar Dynamics

By Dr. W. M. Smart. Pp. viii+434. (Cambridge: At the University Press, 1938.) 30s. net.

IN the year 1914, when the study of the movements of the stars was in its infancy, a monograph was published by Prof. (now Sir Arthur) Eddington in which was given an account and a discussion of what was known at that time of stellar movements and the structure of the universe. This survey, with its co-ordination of different lines of investigation, undoubtedly stimulated interest in the subject. In the intervening quarter of a century, investigations dealing with the many important problems connected with the movements and distribution have followed at a rapidly increasing rate. But until the publication of Prof. Smart's book, there has been no book in English to take stock of the position and to summarize what has been done.

The volume under review does not cover the whole field. It is concerned almost entirely with the movements of the stars, as may be inferred from the concise title. The related subject of the distribution of the stars receives scant attention. This is to be regretted, because the movements and distribution of the stars are so closely related.

The treatment in this book of the subject of the movements of the stars is mainly mathematical. The observational bases of many of the assumptions that are necessarily involved in a mathematical formulation are not discussed, and the results that follow from the mathematical analysis are not sufficiently compared with the data provided by observation. The Gaussian form of the general luminosity function, for example, is assumed, though it is well known that the observed luminosities show systematic deviations from the Gaussian law, and that the form of the luminosity function changes with galactic latitude. Again, the density distribution in the galactic system is represented by a formula of an analytical character, in which the density is determined by a single variable—the distance from the sun. Such representations of the density distribution were derived by disregarding or smoothing out real irregularities and are approximately valid only within a

relatively small distance from the sun. It is now recognized that there are considerable fluctuations in the density distribution.

The statistical mathematical discussions are not without value and have played their part in the development of the subject. But their limitations are now clearly recognized. Analytical functions do not possess the degree of flexibility that is needed in dealing with the stellar universe, and consequently the analytical methods of the earlier investigations, elegant though many of them were, have largely been displaced by numerical methods. For these reasons, it seems to the present reviewer that many portions of Prof. Smart's book would have been of greater value if the treatment had been less mathematical and more closely related to observational data. In some respects, the book has appeared too late for the method of treatment that has been followed. Ten years ago, the objections to a purely mathematical treatment would not have been so strong.

After an introductory chapter, mainly concerned with an account of the data of observation, four chapters are devoted to the solar motion and the phenomena of star-streaming, the two alternative points of view—that of Kapteyn, of two intermingling streams of stars, and that of Schwarzschild, of a preferential direction of motion—being fully discussed. These chapters contain a good deal of rather heavy, but straightforward, mathematics, and might with advantage have been considerably compressed. The sixth chapter is devoted to the discussion of methods for deriving statistical parallaxes of the stars from their proper motions. This is an important matter, because the zero point for the period-luminosity relationship for the Cepheid variables must be derived from the application of the statistical method to the nearer Cepheids, and the whole scale of the dimensions of the galactic system and of the distances of the external galaxies depends upon the correct fixing of the zero point. There are many traps for the unwary in these statistical discussions, but Prof. Smart is a safe guide.

The space distribution of the stars is discussed in the next chapter, on the basis of one particular

hypothetical law for the density distribution. The mathematical superstructure is too top-heavy for the slender foundations and the results are not of great practical significance. No reference is made to star counts, which provide important information about the space distribution. It may be said that star counts are no concern of stellar dynamics, but neither, in the narrow sense, is the luminosity function, which is much used in this chapter. Star counts are intimately related both to the density distribution and to the luminosity function. In Chapter viii, general statistical methods of deducing certain frequency functions associated with various characteristics of the stars from other assumed frequency functions is discussed; the treatment in the main follows along the lines of the pioneer investigations of Schwarzschild.

A short chapter on moving and globular clusters is followed by three chapters dealing with the dynamics of stellar systems in general, galactic rotation and the dynamics of the galaxy. These chapters are the most interesting in the book, and contain a good account of the recent work of Oort, Lindblad and Plaskett on the rotation of the galaxy, as well as of the explanation of the preferential motion of the stars and the asymmetrical motions of the stars of high velocity. It may be mentioned that the approximate equipartition of energy among the stars is not referred to under the dynamics of stellar systems, and that there is no discussion of the information as to the time-scale of stellar evolution that can be derived from various dynamical considerations.

H. S. J.

Silva and Sentiment

Trees and Men

By Eleanor Hughes-Gibb. Pp. viii+171+11 plates. (London: Alexander Moring, Ltd., 1938.) 8s. 6d. net.

THE sentimental approach to a technical subject is unusual in modern times though common enough in books intended for the juveniles of Victorian days. In a work intended not for the expert, but rather to awaken the public conscience to the desirability of, and in some cases the necessity for, protection of our trees and forests, both at home and throughout the world, sentiment may play a useful part. In skilled hands it can be an effective instrument in a useful form of propaganda, providing it is supported by incontrovertible facts. Much of the information given in the book under review is taken from reliable sources and is pieced together with some skill, but it is unfortunate that many inaccurate or dubious statements have been allowed to stand. Thus, on p. 94, in reference to the cajuput forests of Cochin China, the following appears: "But more important is their invaluable property of absorbing the harmful germs of swamp fever in the soil in which they grow."

The book is divided into three parts, the first of which includes a justification of sentimentality, and such themes as trees of the Bible, tree worship and the economic value of trees. Economic products become "The Gifts of the Tree to Man" and the uncomfortable conditions of a treeless world are conjured up in a fantastic sketch. The second part deals with the manner in which mankind has used and abused these "gifts". Paper-making is given a chapter, which includes an

account of the manufacture of pulp and paper and emphasizes the wastage that occurs in the non-utilization of damaged trees and the lop and top in the forest. Other products discussed include turpentine, rubber and maple sugar.

Several chapters are given up to afforestation in various parts of the world, emphasis being placed on the importance of forests in the conservation of water supplies and prevention of erosion as well as for the maintenance of timber supplies. Some striking examples are given of the devastation caused by forest fires, many of which could be prevented if the public were fully aware of the dangers. The third part, which is given a separate title, "The Life of the Tree", includes a description of the life processes of a tree that is misleading on account of numerous inaccuracies. For example, on p. 145, we are told that sugars are derived from "the carbon dioxide and the moisture of the atmosphere", and on p. 149 we learn that "The green chloroplasts take in the carbon dioxide through the 'stomata'". If the manuscript had been submitted to a competent botanist, such elementary mistakes could have been avoided and the numerous invalid and mis-spelt botanical names corrected.

The book is illustrated by photographs and by a number of drawings by Archdeacon Lonsdale Ragg, who with characteristic touch has caught the beauty and personality of his subjects. The fine avenue of beeches at Tarrant Gunville Manor, which provides the frontispiece, was drawn specially for the book, while the fine old Cedar of Lebanon at the Rookery, Streatham, will be recognized by many Londoners.

R. M.

Racial Fallacies

Lehrbuch der organischen Geographie:
Vorschule und Einführung in das Studium. Von
Prof. Ewald Banse. Pp. ix + 628 + 5 plates.
(Berlin und Leipzig: Walter de Gruyter und Co.,
1937.) 18 gold marks.

THE author claims that his book marks an epoch in the supersession of mechanical by organic thought about the world. It would almost appear that the discovery that "Landschaft und Volkheit" should be treated together is claimed by him as his contribution to knowledge. Surely, not to go farther back, we all acknowledge our debt to Ferdinand von Richthofen and Paul Vidal de la Blache in this matter, the more so as we do not feel that Banse gets as far in that direction as they and others have done. Banse claims that he does not follow out details in the way that 'liberals' would, but makes the presentation of *Ganzheit* (wholeness) his aim. One could wish that he did this more carefully, but for that purpose some insight is needed that he clearly lacks. Looked at as a product of a mechanistic mind, the book has its value as a work of reference for its immense series of definitions. It is regrettable that the author should find it necessary to overstate his own claims, for example, to be the chief author of a system of major regions (1912), dismissing the Herbertson scheme (1905), as a timid effort.

The book begins with physical geography of the still or non-moving *Landschaft* and its evolution under the influence of endogenous and atmospheric influences, and the chief forms it demonstrates to us. One notes that the author includes in this section a review of the facts concerning rivers, lakes and seas, as well as a study of the earth's vegetation. He then proceeds to the moving *Landschaft* which, for him, includes the atmosphere and animal life. Already, in each of these sections, he includes some paragraphs about the relations of man and the various natural phenomena with which he deals. This element in his work would be more valuable were it not for a continual reiteration of the view that war is, apparently, the chief end of life. But that is in keeping with the fashion that the author seems to be so anxious to follow.

Much of the third chief section of the book is devoted to generalizations concerning *Rasse und Volk* as seen in the totalitarian State. A race is defined as a group within mankind which is distinguished from all others by its inalienable heritage of spiritual and corporeal qualities, and

it is stated that it is to be distinguished from a 'folk', within which one finds examples of several races side by side or mixed. It is well to say that the earth's peoples practically all show diverse biological types living side by side. To assert that a supposed spiritual (or mental) heritage is inalienably attached to each corporeal type is pure speculation. This hypothesis is followed by the claim that the language and the energy of will of the Germans are derived from the Fälsch-Nordisch Oberrasse, which has thus given the spiritual, linguistic, cultural and national heritage to the people, but is unfortunately bound to live side by side with other 'races' in Germany. The author makes a special point of 1933 as the beginning of a great advance in the spiritual influence of this Fälsch-Nordisch Oberrasse. One would regret to ascribe to it the cruelties and oppression which have marked recent developments in Germany. Would it not be better to think of the liberalism and toleration so characteristic of the peoples of Sweden, Norway and Denmark as a Nordic feature?

To a Germanophile, these unfortunate characteristics seem rather an example of the mutability of psychological traits under social and political influences. As to the Fälsch-Nordisch idea, it is probably of little use to reiterate that the immense majority of the German people are broad-headed, and that most of the great figures of German life in the past are far from the Nordic type, even if we twist the facts of observation to suit a prejudiced outlook, and call Nordic anyone whose colouring is light. No mention is made of the services of German Jews to German culture.

In the matter of origins of man we find a restatement of the ideas of Klaatsch, which, it has long been understood, he abandoned before his death. The notions of a separate descent of man from perhaps even Palaeozoic ancestors, of an infinite gulf in descent separating white men from Africans and so on, are all expounded in a not very skilled fashion, and unfounded claims about Fälsch-Nordisch origins of cultural features are implicit as well as explicit in many paragraphs.

The German people have a great tradition; their contributions to civilization have been outstanding in almost every field. It is to be hoped that German thought may yet recover from the petty vanities and prejudice that have affected so much of it in recent years.

H. J. F.

Enzyme Chemistry

Kurzes Lehrbuch der Enzymologie
Von Theodor Bersin. Pp. viii + 170. (Leipzig :
Akademische Verlagsgesellschaft m.b.H., 1938.)
12.80 gold marks.

DR. BERSIN'S interesting book covers a very large field in a very small space and he is to be congratulated on the brevity, clarity and, on the whole, the accuracy of his exposition. The book is highly condensed, probably too much so for those with little acquaintance with the subject, and whilst general analytical or mathematical treatment is restricted to the barest outline, prominence is given to some of the remarkable advances which have been made in the field of enzyme chemistry during the last few years.

The subject-matter is divided into three sections. The first is concerned with the general properties of enzymes, the second (taking up about half the book) is concerned with the properties of individual enzymes, and the third has to do with a much too brief treatment of the parts played by enzymes in respiration, nutrition and metabolism.

Dr. Bersin's conception of an enzyme is a generous one. He includes in his classification such substances as cytochrome and flavoprotein. It is not clear what is his justification for this procedure, especially as he states that the activation of a substrate by an enzyme takes place only at certain suitable areas (*aktive Gruppen*) of the enzyme surface. One would like to know what substrate molecules are specifically activated by cytochrome or flavoprotein; there is no indication of their nature in Dr. Bersin's book. It is characteristic, however, of the state through which a certain section of enzyme chemistry is now progressing that prominence is given to the nature and functions of prosthetic groups (coenzymes) rather than to the specific proteins which are the actual activating agencies of the substrates that undergo change. This is entirely to be expected, for it is only recently that the chemical nature of these prosthetic groups has been elucidated. Yet there seems to be a definite danger that the significance of the special protein to which the substrate molecule is specifically attached is being overlooked; certain it is that the importance of the specific protein is at present overshadowed by that of the 'prosthetic group'.

Dr. Bersin deals shortly in the first section of the book with such topics as the protein nature of enzymes, enzyme reactions in heavy water, enzyme kinetics, optical specificity, temperature effects,

enzyme formation in the cell and with some other topics relevant to a chapter on the general chemistry of enzymes. He has but little to say, however, on the recent work on adaptive enzymes, on the reversible inhibitors of enzymes, on the protective influence of substrates on their enzymes, and it is surprising that, in a text-book of this nature, details concerning enzyme equilibria (for example, with the dehydrogenases, fumarase, aspartase, etc.) are absent.

Dr. Bersin proceeds to deal at greater length with esterases (considered, however, very scantily), carbohydrases, amidases and proteases. Due prominence is given to the recent work on the crystallization of proteolytic enzymes, useful descriptive procedures are noted and care is taken to impress the reader with the importance of the thiol groups in the activity of papain. It should, however, be pointed out that Bergmann and Ross have shown that the activity of papain cannot be interpreted solely on a $-SH$, $-SS-$, basis. The section is terminated by chapters on carbonic anhydrase, carboxylase and the reduction-oxidation catalysts. These are fairly adequately treated considering the space at Dr. Bersin's disposal, but there are many omissions (for example, carrier linked reactions, amino acid oxidases) and there are several points where criticism may be directed.

Dr. Bersin states, for example (p. 124), that disulphide-thiol systems (for example, glutathione, cystine) act as hydrogen acceptors to the succinic acid dehydrogenase system. There is no evidence for the truth of this statement. Moreover, he states that succinic acid enters into an equilibrium with its dehydrogenase giving rise to fumaric acid and a reduced form of the enzyme. The latter is held to be not autoxidizable but to reduce cytochrome. Such a statement is at present without direct experimental support, and the text-book under review seems scarcely the place to make such a statement without some sound evidence to support it. A similar criticism may be directed against the inclusion (p. 119) of glyoxalase as a system consisting of two dehydrogenases, flavoprotein and another, unknown, factor.

Dr. Bersin's book would have been improved, especially for those for whom it claims to be a guide, by the inclusion of more references to original articles. The total number of references cited is just over a hundred, of which one third are references to review articles in the *Ergeb. d. Biochemforschung*. The book is well printed and free from typographical errors. J. H. Q.

Die Binnengewässer

Einzeldarstellungen aus der Limnologie und ihren Nachbargebieten. Herausgegeben von Prof. Dr. August Thienemann. Band 16: Das Phytoplankton des Süßwassers, Systematik und Biologie. Von Dr. G. Huber-Pestalozzi. Teil 1: Allgemeiner Teil, Blaualgen, Bakterien, Pilze. Pp. v+342. (Stuttgart: E. Schweizerbart'sche Verlagsbuchhandlung. (Erwin Nägele, 1938.) 42 gold marks.

BRITAIN took the lead at one time in the making of big books of reference in botany and natural history; this was in the days, for example, of Bentham and of Hooker, of the *Challenger* Reports and of the British Museum Catalogues of Birds and of Fishes. But nowadays the Germans seem to have it all their own way, and here, drawing at last to a close, we have the sixteenth volume, or part of it, of the great work on "Die Binnengewässer", or what we have learned to call limnology, which the late Einar Neumann of Lund and Prof. Thienemann of Kiel began to publish a dozen years or so ago.

This last part, by Dr. G. Huber-Pestalozzi, deals with the phytoplankton, or so much of the fresh-water flora as floats or swims; and as the present volume includes neither the diatoms, nor the desmids, nor the Volvocineae nor many more, there is still a deal to come. In fact we have here only the free-living bacteria and a few fungi and the blue-green algae or Cyanophyceae, with a hundred pages of introductory matter thrown in. The account of the Cyanophyceae covers 150 pages and is very fully illustrated; as a compendium of many important genera, *Nostoc*, *Oscillatoria*, *Anabaena*, *Lyngbya* and the rest, it is all that could be reasonably desired. The introduction deals with many points of general interest. It divides the plankton into plankton proper and the so-called 'neuston'—a term new to us—which means the organisms the peculiar province of which is the surface-film; here various minute plants accumulate, here *Gyrodinium* and *Ranatra* skate on top, and here *Scapholeberis* clings on below. A long chapter deals with *Schwebestheorie*, that is to say the conditions of magnitude, form and density which fit the organism for a floating life, and cause or help it to shift its place and depth according to time and season. Here Dr. W. Ostwald's well-known work, and that of other writers on the physical side, is duly dealt with; but this side of the case is by no means easy, and the author is more at home on the other.

Our Wandering Continents:

an Hypothesis of Continental Drifting. By Dr. Alex. L. du Toit. Pp. xiii+366. (Edinburgh and London: Messrs. Oliver and Boyd, 1937.) 18s. net.

THE author is to be congratulated upon a brave project, the writing of a geological history of the earth in terms of continental drift. He has unrivalled credentials, based upon a special knowledge of South Africa, combined with comparative study of that sub-continent and South America, and with extensive travel in many other lands. His introductory chapters include useful summaries of the writings of Taylor, Baker and Wegener, to

mention but a few. Then follows the Palaeozoic and Mesozoic story of Gondwana and Laurasia, considered separately. The Carboniferous glaciations and *Glossopteris* flora of the former receive due consideration. More novel is a synthesis of the Samfrau geosyncline, named after South America, South Africa and Australia.

The subsequent history of the lands of the world as a whole is grouped geographically about the great double fold-girdle of Tertiary mountains, which in its southern loop embraces the scattered segments of Gondwana, and in its northern loop, those of Laurasia. Later chapters deal with such topics as oceans, the significance of chemical changes leading to condensation in depth, climatic changes, distribution of plants and animals, geodetic evidence, and, of course, possible causes of continental drift.

Readers should be warned in advance that they will find du Toit's book difficult to digest, and that they may feel affronted by uses that have been made of fragmentary evidence. On the other hand, it is to be hoped that they will have sufficient vision to be grateful to a courageous pioneer. E. B. BAILEY.

Botany for Fun

By Gareth H. Browning. Pp. xii+176. (London: Lindsay Drummond, Ltd., 1938.) 5s. net.

THIS delightful book is not intended as a text-book, but is designed to engage the interest of young readers in the study of plant life. With this aim in view, the author has adopted a unique style of writing which forces itself upon the reader so that he almost learns without thinking. Technical terms, though not altogether excluded, are relegated to the background, and though the style of writing is attractively conversational and non-scientific in the technical sense, no one would condemn the author for that. The teaching botanist would agree that such chapter headings as "Magic in the Factory", "Flower-Parents and their Children", "Adventuring into the Outer World" and "Family Gatherings" convey just the right shade of meaning to the child-mind.

It is very difficult to write in this style yet not stray from the path of scientific accuracy; but careful scrutiny shows that the author has succeeded in surmounting this difficulty. We are glad to see, for example, that the author writes of "food materials passing up from the roots to the leaves" and of the "stream of *manufactured* food" travelling from the leaves. He even goes so far as to emphasize the important words by using italics. Many botanical texts are guilty of erroneously referring to mineral salts, carbon dioxide, etc., as plant *foods* so that it is very difficult to teach children the essential similarity between plant and animal foods.

The illustrations are good and the interpolation of interesting historic episodes adds much of value to the whole.

Though the author emphasizes that this is not a text-book, we venture to suggest that it might with distinct advantage be adopted in classes of children of about eleven years of age.

(1) *Unit Processes in Organic Synthesis*
By P. H. Groggins (Editor-in-Chief). (Chemical Engineering Series.) Second edition. Pp. xiii+769. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 36s.

(2) *Industrial Chemistry*
By William Thornton Read. Second Edition. Pp. ix+605. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 25s. net.

THE very rapid development of the chemical industry in the United States, which country probably leads the world to-day in this respect, has brought about a demand for trained chemists both on the research and on the factory side. The magnitude of the profession is witnessed by the fact that the American Chemical Society has a membership of more than 21,000 and has enlisted more than 2,000 new members per annum for the last three years. It is becoming customary for students entering on the factory side to take a course in chemical engineering. It was stated last summer that rather more than half the chemical graduates do this. In consequence there is a demand for chemical engineering literature both of a general and a specific character, and to-day America is well served in this respect. The demand for such books enables them to be kept up to date, an important factor in a rapidly developing science.

Both these books are second editions, that of Groggins after four years. It deals with unit processes in the organic industries, many of the individual chapters being contributed by experts, as is now the custom. The new enlarged edition is likely to enhance the reputation of the work.

Read's book has likewise received expert criticism, the individual chapters having been sent to more than a hundred authorities in the particular fields. The sections relate to individual branches of the industry, a wide range being included. With these two books on his shelves the trained chemist is well equipped to tackle problems in any branch of the chemical industry.

Summable Series and Convergence-Factors

By Prof. Charles N. Moore. (American Mathematical Society, Colloquium Publications, Vol. 22.) Pp. vi+105. (New York City: American Mathematical Society, 1938.) 2 dollars.

THIS work is designed to give a systematic treatment of convergence-factor theorems, where these consist of results concerning the relationship between a definition based on mean-values and a formally distinct definition in terms of convergence-factors. For all the methods of summing divergent series in general use may be classified as either mean-value or convergence-factor methods, and to any method of either type, a formally equivalent method of the other type can be constructed. The range of validity of these methods is approximately the same in most cases; and where there is a difference, it will usually be in favour of the convergence-factor form.

Here, two types of convergence-factors are considered. Those of Type I have, as sole object, the maintenance and production of convergence; while those of Type II may be used to obtain the sum of

a series. In this most instructive work, both types of convergence-factors are examined; and the theory is developed for multiple series of any order, as well as for simply-infinite series. By means of the use of the Norlund, instead of the Cesàro means, the theory developed here is more general than that found in most of the available literature on the subject. Thus, many previous results appear here as special cases of the theorems proved—particularly in the third, fourth and fifth chapters.

A. V. Z.

Rezeptbuch des Alltags

Von Dr. Hermann Rompp. Auflage 3. -Pp. 349. (Stuttgart: Franckh'sche Verlagshandlung, 1937). 8.50 gold marks.

THE word *rezept* is liberally interpreted, and this book includes prescriptions for dealing with all the problems that are likely to arise in an ordinary household. It gives directions for making emetics, hair dyes, shampoos, face creams, eau de Cologne, mouth washes, shaving soap, alcoholic drinks, boot polish and about ten kinds of ink, and for treating colds, warts, nose-bleeding, sea-sickness, heat-spots, sunburn and indigestion. Sections are devoted to the keeping of horses, cows, dogs and cats, and to getting rid of mice, rats, earwigs, ants, snakes and a host of other pests that afflict houses and gardens. There are sections on gardening, photography, food and clothes. The information appears to be accurate and up to date.

A Course of Physics

By Prof. Henry A. Perkins. Pp. ix+820. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1938.) 15s. net.

PROF. PERKINS, of Trinity College, Hartford, has written a text-book of elementary physics covering more ground than is usual. His aim has been to give the student a substantial grasp of physical principles rather than to describe phenomena. Simple algebra and trigonometry have been freely used because most students find a concise symbolic statement easier to grasp than a verbal one. Modern physical ideas have been treated as fully as is feasible in a course of this kind, and nearly eighty pages have been devoted to 'corpuscular physics'. The book should prove suitable for an intermediate science examination in Great Britain.

The Cradle of the North Wind

By A. S. T. Godfrey. Pp. xi+234. (London: Methuen and Co., Ltd., 1938.) 8s. 6d. net.

THIS charmingly naive book gives a glimpse of the fun which, according to the author, may be derived from roughing it in the Arctic and from killing its animals, always with the proviso that there is not too much "scientific nonsense" about. It must, however, be remembered that the penalty for a frivolous attitude of mind towards the polar regions is very likely to be death, and not for one's self alone: the ice is not suitable for a kindergarten. It is a little surprising that such a book should presumably have been sanctioned by the Oxford University Exploring Club.

J. E. HAMILTON.

The Sea-Bird as an Individual: Results of Ringing Experiments*

By R. M. Lockley, Skokholm Bird Observatory

SKOKHOLM ISLAND lies a few miles off the coast of Pembrokeshire. It is about 240 acres in extent, is entirely rock-bound, and has only two houses on it, a lighthouse at the most westerly point, and this is a mile from my own house on the east side of the island. The cliffs are of Old Red Sandstone, and there is a good thick soil on the greater part of the island.

I was attracted to the island in the first place by its great wealth of sea-bird life. Later, as opportunity afforded, I commenced to look into the individual lives of these birds. The first essential in such a study, since individual sea-birds of one species are more exactly alike than peas in a pod, was some method of marking. I adopted Mr. Witherby's scheme for marking birds with numbered leg-rings. This scheme has now been taken over by the British Trust for Ornithology and is housed in the British Museum (Natural History).

There are seven sizes of rings to suit all species of British birds from a wren to an eagle. Each ring has a serial number and the inscription "Inform British Museum (Natural History), London"; so that those who capture alive or find dead a bird with such a ring will know what to do in the interests of scientific bird-study.

I started my study of the individual sea-bird with the Manx shearwater (*Puffinus puffinus* (Brünn.)), the habits of which were at that time very little known. There are probably ten thousand pairs breeding on Skokholm. The shearwater nests in a hole in the ground, sometimes deep in a rabbit-hole, but it will also excavate a hole for itself in soft ground. A small colony nested in shallow burrows within a few yards of my back door. So it was not difficult for me to trace with a stick the winding of the burrow to the nesting recess at the end, and to cut out a turf immediately above the nest, and then to use that turf as a convenient inspection lid.

By degrees my wife and I were able to work out something of the Manx shearwater's life-history. The burrow would be inhabited so early in the year as February, the paired birds meeting each dark night as if they were determined to make sure of their nesting territory for another season, although the egg would not be laid until late April or May. Ringing has since shown us that the old breeders always arrive first.

Sexes are indistinguishable in the field, but in some cases we knew the female by finding her on a new-laid egg. In any event both birds were ringed. Only one egg is laid, and incubation is equally shared. Thus the male, for example, would spend two, three or four days on the egg without quitting the burrow. Then the female would take over. On dark nights, the bird at sea would return and converse with the sitting bird for an hour or two, but would not necessarily relieve it. Nor could we get any evidence that it fed its sitting mate. We came to the conclusion that the sitting bird stuck to the egg as long as hunger permitted, or as long as it could retain possession of the egg against its mate's determination to brood it. This at least appears to be the explanation of the irregular shifts or watches by one or other of the pair on the egg on dark nights.

On moonlit nights, however, this ardour to incubate was cooled by what we presume must be the bird's fear of being seen and killed by the many predatory gulls and hawks which frequent the island. So when a period of moonlit nights intervened, the bird at sea never visited the bird on the nest. Thus for five, six, seven, and more rarely up to ten, and once twelve, nights and days when the moon happened to be near or at the full, and the skies cloudfree, the sitting bird remained brooding but starving at the nest. We even weighed some of these starving birds and proved an average loss of a very small fraction of an ounce every twenty-four hours. Starving is really the wrong word, though at the time it seemed appropriate enough. Now we have found that a sea bird can easily endure long fasts, and no doubt this fact will help us to understand how the sea-bird rides out long storms at sea, when the weather conditions are such that feeding may be impossible and the bird's energies may have to be directed entirely to fighting the storm.

The incubation period of the shearwater we found to be a record for a British breeding bird—fifty to fifty-four days. One parent remained in the burrow by day to brood the downy chick for the first week of its existence; but afterwards the chick was only visited by night. When the moon was bright at night, the same thing happened as during incubation—the burrow was not visited at all. The young chick thus early had its first lesson in fasting. However, it was fat from the day of its birth, and showed no perceptible sign of going back during the occasional enforced fasts; in fact

* From a Friday evening discourse delivered at the Royal Institution on November 18.

it seemed simply to sleep and, so to speak, consolidate the position already gained. At any rate, this programme of cramming interspersed with an occasional fast results in the chick becoming enormously fat by the time it is sixty days old. To our surprise, we now found that the parents deserted the chick. They had spent sixty days gathering fish for it and many nights of feeding it with the result of that gathering, from a supply of semi-digested food stored in the parental crop. Now suddenly and completely they gave all this up. They went off to sea and certainly would not appear on the Island again until the following spring. We can surmise, if we like, that the physiological state immediately preceding the autumn moult has something to do with this, to us, rather unnatural desertion of the tender nestling. Yet if it seems unnatural, it is at least not improvident. At this age the chick was so fat that it could scarcely waddle to the sea. If it did so and plunged over the cliffs it would drop and go to pieces on the rocks below.

But after nearly a fortnight of fasting, the fledgling is fully feathered and has very little down visible. It takes off for the sea at night, blundering along on all fours, using wings and legs and beak to scramble over rough ground, for it cannot fly yet. When it reaches the cliffs, it is now light enough to flap down on a long plane and so avoid the rocks below.

Once in the sea the young bird is safe. We have taken shearwaters at this stage and put them in the sea by day. How thirsty they were—I wonder if thirst may not be for them an important factor in drawing them to the sea, the sound of which they must hear before they leave the nest. At any rate, their first action is to drink, then to wash; then suddenly they discover that they can dive. They half-open their wings so that the quills remain partly spread, like a half-opened fan, and with these strong paddles they swim under water with the agility of penguins. They come up for air, and dive again, and so gradually work off to sea, apparently making haste to leave behind the land, of which they have perhaps unpleasant memories of hunger and thirst.

Although we have ringed these young birds, for the time being we have lost them as individuals. But not for long. Recoveries at sea of some of these ringed birds prove that the shearwater has a winter haunt as far south as the Bay of Biscay.

We find that the old breeding birds return faithfully to their nesting burrows early in the spring, and ringing proves that the same individuals pair for another season, probably for life. The breeding bird has built up an association of memories—I scarcely like to call them visual

memories in view of the fact that some of the most important events take place in the pitch blackness of the burrow—which lead it back to the same burrow. It must lose contact with its mate at times at sea in winter, possibly altogether. I do not know. But at least the nest is the focal point, the well-remembered place of meeting, and, allowing for frequent gaps caused by death, we have proved by means of ringing that the shearwater pairs for life.

You may ask, what about the young bird? Does it, too, in succeeding years return to the nesting burrows in one of which it ~~was~~ reared? So far we have not recovered a young bird in the immediate neighbourhood of its birthplace. But it is obvious that in order to keep up the numerical strength of the species a great many young birds must return to breed on the island. It is interesting to speculate as to whether they are guided to the island in the spring by the movements of the adults or by memories of fledging days. Possibly both these factors operate, and the young bird gradually builds a fresh association of memories during preliminary visits to the island. It discovers an empty crevice or hole one night and finds a mate, or more properly I should say a sweetheart, and plays at housekeeping. Next year it will return to this spot, search for or dig a more suitable hole, and start a home in earnest.

To return to more definite information. At present we have adult shearwaters under observation which bred with us for three and four and five years running, and there are two individuals which have bred seven years running. Allowing that the shearwater does not breed until nearly two years old, we thus have individuals five, six, seven and nine years old. So that in time we may well be able to work out the average duration of life of this species.

We have conducted some experiments with ringed sea-birds in an attempt to learn something more of their reputed homing power. An adult shearwater was taken from its egg on Skokholm and released at Start Point in Devon, which is about 200 miles from the island by the sea-route around Cornwall, or 125 miles overland as the crow flies. When released it flew low over the waves, making for sea. It did not attempt to rise up and strike overland in a bee-line for the island. Yet that bird was back on its egg at Skokholm within ten hours. So that if it continued by the sea-route it must have flown steadily at twenty-two miles per hour. Of course its speed by this sea-route must have been much greater, since a shearwater normally does not travel in a straight line, but has a curving, deviating flight, and probably it paused to drink if not to feed.

Two birds released at Fransham Ponds, Surrey,

performed a similar feat and were back at their nests the following night; but in this case before reaching the sea after release these birds had to cross forty miles of land. But land masses interposed between shearwaters and the sea do not seem to disturb the homing faculty. Shearwaters released inland at Birmingham, Evesham and Manchester, as well as at Limerick in Ireland, have safely homed to Skokholm, though not with the rapidity of the Start Point and Frensham releases. Other birds released in the Firth of Forth and as far north as the Faeroe Islands, and as far south as France and north Spain have also got back to their nests on Skokholm in varying times.

All these homing experiments were within, or (in the case of the inland releases) bounded by, the known sea-range of the species. We needed to go farther afield and see what would happen to birds released outside that range. The farthest distance by sea which we could easily arrange for without transport hardships for the birds (for we wished to be sure they were in good condition for a long flight), was Venice, approximately 3,700 miles from Skokholm via the Adriatic and the Straits of Messina and Gibraltar. Two shearwaters from separate nests were sent, by courtesy of Imperial Airways, to Venice, the distance by air being a little less than one thousand miles. So far as I know the Manx shearwater does not enter the Mediterranean, and therefore is not found in the Adriatic. Certainly ringing has so far proved that our Skokholm birds in their winter wanderings do not go beyond the Bay of Biscay. One of these two shearwaters is an individual of some interest to us, for it has returned to its burrow on Skokholm for five consecutive summers. It had already returned safely from Frensham. Now it returned from Venice in fourteen days. It is impossible to say whether it found its way out through the Straits of Gibraltar, or whether it made a bee-line straight over the Alps, or whether it crossed the backbone of Italy and then over the Pyrenees to the Bay of Biscay. The other shearwater may have returned from Venice in that summer; but we did not catch it until the next spring, when it was back at its usual nest.

These experiments have proved a remarkable homing ability, but we have still nothing but theories to explain it, and the physiological mechanism remains obscure.

We have made similar studies of individuals of other species of sea-birds; the storm-petrel, *Hydrobates pelagicus* (L.), for example, which breeds in numbers in the rock crevices and old farm-walls of Skokholm. In a similar study of individuals it has shown a life-history not unlike that of its cousin, the shearwater: nocturnal on land—a long incubation period of 38–40 days—

and an average fledging period of 61 days. The chick is deserted in the end, and flies off to the sea on its own when sufficiently thinned down from its over-fat nestling stage. The storm-petrel is more nervous and difficult to observe than many sea-birds; but we have individuals on our books that have been breeding four years with us in the same crevice.

Our ringing study of the puffin, *Fratercula arctica grabe* (Brehm), enabled us to discover several new facts: an incubation period of 40 days and a fledging period of 49 days. Also the surprising truth that this bird too is deserted by its parents, although other members of the auk family to which it belongs, the razorbill and the guillemot, feed and accompany their chicks at sea when these leave the rocks where they were hatched. The puffin follows the petrel family in deserting its single chick; but this desertion, as with the petrel family, is a wise provision. The young puffin is often reared in burrows some distance from the edge of the cliffs, and so has a long walk to get to that edge, and during that walk it would be exposed to the attacks of predatory gulls and hawks. The puffin chick is full-grown and very fat when it is deserted by its parents. It certainly needs a fast of a week or so to make it light enough to take off without fear of crashing on the rocks below the cliffs. So the young puffin solves two problems, the problem of its excessive weight, and the problem of the predatory gull, by starving for some days before selecting a dark night for its lonely and unseen but momentous stroll to the cliff edge, where it takes the plunge to that friendly element, the sea.

I have spoken of ringing large numbers, even thousands, of sea-birds, and it may be wondered how it is possible for one person to do this and keep account of so many individual birds from year to year. When I began this study of the individual sea-bird I had only my wife's help, and very valuable this was. But we should scarcely have been able to carry on this work as well as our normal duties had we not received encouragement from outside, an encouragement which we were most grateful to have. In the last few years other students have come along, until a voluntary organization has grown under the name of Skokholm Bird Observatory. It is now so organized as to permit us to endeavour to ring every breeding bird on Skokholm, from a rock-pipit to a gull, and to the gannets of Grassholm. We also catch many migratory birds which use the island as a temporary resting place. For example, we ringed in 1938 more than six thousand birds of sixty-one species. This is a figure comparable with figures achieved by subsidized observatories in foreign countries. In Germany and Italy and the United

States, ornithological work of this nature is recognized officially as having an educational and scientific value, and it is blessed with the practical support of the Government concerned. Here in Britain ornithology outside museums depends entirely on voluntary support. So that the running of an observatory on a remote island is not without its anxieties in more than one direction. Rings at three-farthings each add up to a considerable figure in one year, and there is a very large amount of clerical work in the recording and card-indexing of thousands of individual ringed birds. Nevertheless, this voluntary organization is being carried on for the present, and is about to issue its third modest annual report.

Finally, it may be suggested that catching and handling birds must disturb them unduly. On the contrary, by gentle handling many birds have become so used to us that they are almost tame, as tame, in fact, as wild animals are in nature reserves where they have learned that no harm will come to them from human beings. Indeed if the birds were not reasonably tame, it would be impossible to study them individually. This way of studying birds by ringing them is a good deal better than the old way of studying them by means of the gun and the collecting box. Ringing establishes a new kind of contact, a sort of friendly conspiracy with the living bird.

British Empire Cancer Campaign

THE fifteenth annual report of the British Empire Cancer Campaign was presented at a meeting held at the House of Lords at the end of November. The Duke of Gloucester, as president, announced at the meeting that a new cancer research centre of the Campaign was to be established at the University of Oxford and a grant was voted for the work to be carried on at this new centre. During the last year, £50,000 was expended by the British Empire Cancer Campaign on research mainly in Great Britain. Ten years ago the corresponding annual expenditure was only £20,000.

During the past year a considerable amount of work has been carried out on the biological effects of radiations. Mr. H. Burrows, Dr. W. V. Mayneord and Dr. J. E. Roberts have found that the exposure of inflamed tissue in the groins of rabbits to X-rays (600 r.) produced malignant tumours in eight out of nine rabbits. Dr. J. C. Mottram has examined the effect of combined treatment with the carcinogenic hydrocarbon, 3:4-benzpyrene, and gamma radiation. Doses of 160-1440 r. increase the carcinogenic action of the benzpyrene, while higher doses of radiation inhibit this action. It would therefore appear that for tumour production by radiation there is an optimum dosage. Dr. L. D. Parsons has shown that treatment of mice with X-rays or with a carcinogenic agent both result in the deposition of some iron compound giving a Prussian Blue reaction, in the lymphoid tissue. It seems possible that carcinogenic action may be associated with hæmolysis. Lymph glands of mice bearing sarcomas produced by a carcinogenic compound have grown like sarcomas when transplanted into

other mice. These changes occur in glands quite irrespective of their proximity to the graft, and the microscopic appearances suggest that they are not metastatic.

Research carried out at the Middlesex Hospital has shown that if rats bearing the Jensen rat sarcoma are cured by treatment with X-rays, they are afterwards immune to that tumour. Partially successful attempts to transfer this immunity have been made by injecting the fluid from irradiated tumours. Injection of the fluid from tumours which have received a dose of X-rays which would eventually cause their disappearance gives some resistance to this tumour in other rats. Work from the J. H. Burn Laboratories at Newcastle-on-Tyne on two rat tumours has shown that the Jensen rat sarcoma is much more radio sensitive than the Walker carcinoma. The Walker carcinoma also is more resistant to heat treatment *in vivo*, although the two tumours show little difference when heated *in vitro*. Both types of tumour are killed *in vitro* by heating for one hour at 45° or 3 hours at 43.5°.

Experiment has frequently shown that radiation with split doses is more effective than a single exposure. Fresh experiments on mice with epitheliomata at the Mount Vernon Hospital have again confirmed this. Patients at that hospital are treated by the so-called 'stop and go' method in which the tumours are frequently examined and irradiated only when they are considered to be radio sensitive. The intervals between treatments are often as much as three or five weeks.

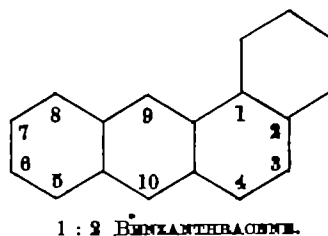
Investigations on the cancer viruses have not yet led to the isolation of these as chemical entities, but considerable progress has been made in the purification of the Rous chicken sarcoma virus.

It has been found that incubation with purified trypsin for short periods leads to increased activity of Rous tumour extracts, possibly owing to enzymic destruction of inhibiting substances present in the extracts. One of the difficulties in the problem of purification of this tumour-producing agent is the small amount present in tumours. The particles of the Rous virus are about 90 m μ in diameter, and recent experiments carried out by Prof. J. McIntosh show that the particles of the Shope rabbit papilloma virus are of a similar size.

Interesting results have been obtained by Sir Edward and Lady Mellanby on the dissemination of the Rous sarcoma virus in normal and malignant tissues. They have never been able to propagate a chemically induced tumour by cell-free filtrates. If, however, a fowl with a chemically induced tumour is injected with Rous virus, then cell-free filtrates of the chemically induced tumour may produce Rous sarcomata in other fowls. If cell inocula of this same tumour are grafted into other fowls, tumours resembling the original induced tumour are produced. These experiments show that chemically induced tumours cannot contain a virus with similar properties to the Rous virus. The Rous virus will pass not only to other tumours but also to normal organs, so that the blood and the organs such as liver, spleen, muscle and brain of fowls injected with the Rous sarcoma may all contain large amounts of the cancer-producing agent. The amount of virus in the organs is maximal between the seventh and twentieth days after inoculation with the tumour. If intravenous injections of Rous virus are given to fowls, the virus disappears from the blood and is taken up by the organs of the body, but generally no tumours are produced. The organs contain the virus, but do not develop tumours. If, however, a muscle is injured immediately after intravenous injection of the virus, tumours develop at the site of injury, but if the injury is made before injection, then no tumours are developed.

Research into the chemistry of carcinogenic compounds is a branch of cancer research in which the British contribution is pre-eminent. A large number of carcinogenic hydrocarbons have been discovered, some of which are much more active than coal tar and many of which are derivatives of 1:2-benzanthracene. All the theoretically possible monomethyl derivatives of 1:2-benzanthracene have now been synthesized, and of these compounds the 5-, 9- and 10-substituted compounds have definite carcinogenic action; 3-, 4- and 6-mono-methyl-1:2-benzanthracenes have slight activity. The carcinogenic agent of coal tar, 3:4-benzpyrene, can be considered as a derivative of 1:2-benzanthracene with an additional group

in the 9 position; while methylcholanthrene is another derivative with substituents in the 10-, 5- and 6-positions. A new derivative, 9:10-dimethyl-1:2-benzanthracene, has been found to be the most active cancer-producing compound known, producing tumours in about one half the time required by methylcholanthrene.



Some relationship between chemical structure and carcinogenic action of 1:2-benzanthracene derivatives can therefore be shown. If two groups are present in positions in the benzanthracene nucleus (that is, particularly the 5-, 9- and 10-positions) which favour the development of carcinogenic action, then these groups reinforce each other in increasing cancer-producing activity. This summation of the effect of groups in producing cancer activity is analogous to the summation of different cancer-producing factors. One example of this is the combined action of a carcinogenic compound and X-radiation mentioned above. Treatment with carcinogenic agents often increases the incidence of cancer at some particular site to which the animal is normally susceptible. Thus mice have a natural tendency to cancer of the lung which is increased by treatment with carcinogenic substances. In an experiment reported from St. Bartholomew's Hospital, 1:2:5:6-dibenzanthracene was introduced into the stomachs of mice in an attempt to produce cancer of the alimentary tract. All these mice, which survived six months, developed lung cancer. Old rabbits are liable to uterine cancer, and in an experiment in which 1:2:5:6-dibenzanthracene was administered to rabbits by various routes, no tumours were produced at the site of application. A large number of uterine tumours, however, were found, which suggests that the carcinogenic compound possibly increased the incidence of this form of cancer. The tissues of the rabbits to which the substance was applied appeared to be resistant to tumour formation, for the same treatment in mice, rats or fowls would certainly have produced cancer in a certain proportion of animals. Invertebrate animals are not known to suffer from cancer; in the Leeds laboratory earthworms have been kept in earth containing 3:4-benzpyrene for twenty months without showing any histological changes.

Dr. A. Haddow has continued his investigations on the growth-inhibiting action of carcinogenic and related compounds. When animals with tumours are treated with such substances together with X-rays, a summation of effects is obtained. In many cases, animals treated with a carcinogenic

agent alone showed active regression. There are many references in the report to experiments on the possible treatment of cancer by chemotherapy, and the fact that an effect is sometimes obtained by such treatment suggests that development of this method may occur in the future. E. B

State Aid for Scientific Research in Great Britain

SINCE the Committee on New Industrial Development, appointed by the Economic Advisory Council, issued its report in September 1932, the structure and financing of scientific and industrial research has attracted the continuous attention of scientific workers. Many of those interested in the research association movement were concerned as to the future of those associations when the Million Pound Fund was exhausted, and an article from Mr. H. W. J. Stone, secretary of the Parliamentary Science Committee, which appeared in the *Nineteenth Century* in November 1933, urged the importance of more adequate endowment of research and suggested the allocation of revenue for this purpose from the new tariff revenue. Less specific proposals that the granting of tariffs to an industry should be made conditional upon adequate support of research have from time to time been advanced (cf. *NATURE*, 131, 67; 1933), while the national organization of research was discussed much more recently by Sir Daniel Hall in an article in the *Nineteenth Century* in which he proposed the formation of a Planning Council in place of the Economic Advisory Council, to co-ordinate the planning of research and the work of the Medical Research Council, the Department of Scientific and Industrial Research and the Agricultural Research Council.

Other considerations besides finance have focused attention upon the organization of research, particularly the growing importance of social research, the recognition of the disparity between research effort in the physical sciences and in the social and biological sciences, and the need for some re-orientation of effort. Still more recently, national defence considerations have reinforced the cause for further co-ordination of effort. Prior to its merging in the British Association, the British Science Guild gave some attention to the financing and organization of research, and it may be expected that this same question will receive early attention at meetings of the newly formed Division of the Social and International Relations of Science. Closely associated with the British Science Guild in its consideration of this matter until 1936

was the Association of Scientific Workers. Since then, in collaboration with the Parliamentary Science Committee, the Association of Scientific Workers has continued its interest in the question, and a preliminary draft memorandum on the financing of research was prepared (see *NATURE*, 138, 51; 1936). The final draft of this memorandum was transmitted to the Lord President of the Council in April 1937 and has now been published in the *Scientific Worker*, the November-December number of which is devoted entirely to the finance of research, including with the memorandum, the report to the Lord President of Council of the Advisory Council, together with the reply of the Parliamentary Science Committee and the final report of the Advisory Council giving its reasons for not endorsing the proposals. A memorandum on private enterprise as a factor in industrial research is also included.

The main thesis of the argument is that scientific research should be provided with a regular and increasing income. The present system is criticized chiefly because of the rapidly fluctuating amount of money available for research and the lack of provision for the steady development of scientific research in industry. Stress is also laid upon the adverse effect of the present position upon the personnel and conditions of employment of the scientific staff. Accordingly, it is urged that in financing scientific research the first requirement is that it should provide security for completing work undertaken, and the second that it should make provision for steady and maintained expansion of research.

Pointing out that the ultimate sources of money needed for research are the Government and industry, the Parliamentary Science Committee discusses in its memorandum ways in which both might contribute. The idea that scientific research should be financed from Government sources alone is rejected, and also the method of raising funds by a statutory levy from the several industries concerned. Equally the alternative method of a voluntary levy is regarded as unsatisfactory, because it has "the double disadvantage of

penalizing those firms who contribute as against those who do not and affording an extremely irregular income for scientific research".

The memorandum argues, therefore, that if the principle be accepted that industry should contribute directly to scientific research, a way must be found of converting variable contributions into a fixed income; and the proposals outlined are intended to achieve this by the endowment of research. They are summarized in eleven recommendations, four of which are concerned with the needs, maintenance and development of the existing research associations, particularly with regard to continuity, and are strictly independent of the means taken to raise the funds for necessary research. The remaining seven recommendations outline the scheme for endowment of science.

The first four recommendations propose that the Government contribution to the research institutions and to research associations should take the form of block grants for a period of five to ten years in advance, and that the Department of Scientific and Industrial Research, with the Medical and Agricultural Research Councils, should endeavour to obtain a corresponding guarantee of industrial contributions for a corresponding period. It is also recommended that negotiations should be undertaken by the Department with industries for which research facilities are at present inadequate, with the view of providing a comprehensive system of Government-aided industrial research.

The second group of proposals recommends the establishment of a National Scientific Research Endowment Fund, to which the Exchequer would contribute an annual sum of £3,000,000 (or

£2,000,000-£4,000,000) or 10 per cent of the value of Customs receipts. Part of this sum should be used to defray the Government contribution to scientific research, the accumulated reserve of the Fund being invested and the income used to defray part and ultimately all of the expenditure on scientific research. It is also recommended that the Department of Scientific and Industrial Research should endeavour to secure, from industry and agriculture, contributions to the Fund which, over a number of years, would provide an aggregate equivalent to that provided from Government funds. Control of the Fund and of the payments from it to scientific research would be vested in a Scientific Research Endowment Board, an autonomous authority including representatives of Government departments, industry, agriculture and scientific and medical associations, the universities and the public.

In observations on the scheme, the Committee stresses the need for a rationalization of the present organization and for an attempt to bring all scientific research—State, university and, so far as possible, industrial—into one comprehensive ordered and yet flexible scheme. It is pointed out that the scheme is intended to direct attention to four primary needs which must be met before science in Great Britain can be regarded as making its full contribution to the national welfare: a large income for science; a steady income, not dependent on general economic fluctuations; a greater degree of co-ordination of activities; and the completion and development of its connexion not only with part but also with the whole of industry, agriculture and health.

Obituary Notices

Prof. A. W. Porter, F.R.S.

THE death of Prof. A. W. Porter, which occurred at West Kirby, Cheshire, on January 11, has deprived physical science of the services of one who has played a notable part in the development of physics in Great Britain. His death was not wholly unexpected, for, as the result of a fall experienced during the bitter weather of the winter of 1937-38, a fall in which he suffered serious injuries, his health had declined.

Alfred William Porter was born on November 12, 1868. He took up the study of physics at a later age than is usual and, after a course of study at University College, Liverpool, he migrated to University College, London, whence he graduated in the University of London in 1890. He was a fellow of University College, London, and for many years assistant professor of physics in the College, finally

being appointed to a University chair of physics in 1923, from which chair he retired in 1928, with the title of emeritus professor.

Porter's contributions to physical science were the products of an erudite and highly critical mind. It has been said of Maxwell that he had a vast knowledge of the history of his subject, and could always relate some incident about the most familiar fact which would give to it an added interest. Much the same may be said of Porter, who, moreover, had an innate capacity for the critical discussion and elucidation of delicate points dealing with the fundamentals of the different branches of physical science. He was specially happy in such subjects as osmotic pressure, capillarity, colloidal science, and heat, and many generations of students will look back with gratitude to the help they have obtained from verbal discussion with Porter.

His literary activity was great and varied. The treatise on magnetism and electricity known as Carey Foster and Porter's edition of Joubert-Atkinson was far more than a mere translation of Joubert's work, and reflects, in considerable measure, Porter's skill as a teacher. His articles on surface tension in the fourteenth edition of the "Encyclopædia Britannica" and on thermal expansion in the "Dictionary of Applied Physics", are excellent examples of Porter's massive learning and powers of clear exposition, and his capacity for throwing new light on an old problem is admirably shown in his presidential address to Section A (Mathematical and Physical Sciences) of the British Association at Glasgow in 1928, an address which dealt with the Volta effect and some problems in thermo-electricity.

One of Porter's earlier books, a treatise on elementary mechanics, is less widely known than its merits deserve. It was one of the first elementary books to inculcate sound teaching concerning the nature of mass, and the whole subject is developed by easy stages and by the use of the simplest mathematics to a point at which the reader is introduced to the solution of problems concerning the two-dimensional motion of a rigid body. Porter was also the author of two monographs on thermodynamics and on the method of dimensions, and completed, with a considerable measure of success, the difficult task of bringing out a new and revised edition of Preston's "Theory of Light".

Porter was always at his happiest when handling problems dealing with the manifestations of surface energy, and of late years had occupied himself with the calculation of the form of the capillary surface of revolution, giving special attention to the region in which the ordinary methods of approximation are of little use. In these calculations, he never lost sight of the needs of the experimenter, and his results are of great assistance to those concerned with the determination of capillary constants.

Porter's services to physics on the administrative side were most valuable. For many years he acted as secretary to the University of London Board of Studies in physics; he was one of the founder fellows, and the first honorary secretary, of the Institute of Physics. In this last-named capacity he played no small part in forming and in guiding the policy of the newly formed institution. He was president (1913-14) of the Röntgen Society, and president (1920-22) of the Faraday Society. At the time of his death, he was one of the editors of the *Philosophical Magazine*.

Porter was temperamental, and, like most temperamental men, was apt, on occasion, to take up hurriedly a completely indefensible position—and thoroughly to enjoy defending it. He was all the more lovable on that account, for his mind and outlook were always generous, and it is with real and deep sorrow that his many friends of all ages realize that they have looked their last upon the eyes kindly twinkling behind their gold-rimmed spectacles, and that they can no longer call upon that great store of ordered knowledge that was always so readily placed at their disposal.

A. F.

Prof. T. W. Todd

THE death was announced from Cleveland, Ohio, on December 28, 1938, of Prof. Thomas Wingate Todd, anatomist and anthropologist, at the age of fifty-three years. He was born at Sheffield, England, in 1885, and entered the University of Manchester as a student of medicine, graduating in 1907. His attention was originally devoted to surgery; he became a fellow of the Royal College of Surgeons of England in 1911. His early love for anatomy reasserted itself, and he entered the anatomical department of his university as demonstrator and then as lecturer under Prof. Young and later under Sir Grafton Elliot Smith. His first research was on the relationship of cartilage and bone cells to bone formation. Incidental observations led him to infer that certain changes in the coats of arteries were due to pressure on sympathetic nerves.

In 1912, Todd was invited to the chair of anatomy in the Western Reserve University, Cleveland, Ohio. His colleague in physiology was another British subject, the late Prof. J. J. R. Macleod. He had occupied his chair for twenty-six years at the time of death, and had extended his department to many times its original dimensions. The researches carried out by him were of a threefold nature. When he wished to settle such simple matters as the order in which epiphyses unite with their shafts, the times at which the sutures of the skull close, the changes which the human face undergoes from childhood to adolescence, the changes undergone by the bones of the skeleton from maturity to old age, the manner and extent to which male bones differ from those of women, he discovered that such questions could not be answered because there was nowhere in the world a collection of human skeletons of which the age and sex were known. He set to work and slowly accumulated within his department skeletons of white Americans and of American Negroes, of known age and sex. At the time of his death this standard collection contained more than three thousand skeletons, besides skeletons of mature and immature animals—especially of those which most nearly approach man in structure. Fellow researchers joined him from many parts of the world; paper after paper dealing with age and sex changes as manifested in his collections of human skeleton appeared in the *American Journal of Physical Anthropology*, the *American Journal of Anatomy*, the *Journal of Anatomy* and the *Anatomical Record* during the past twenty years.

During the last twelve years of his life, Todd organized a survey of the growth changes in childhood. With the aid of the Brush Foundation, he obtained opportunities and means of keeping eight hundred children, born in Cleveland to well-off parents, under observation from infancy to full maturity. Four times yearly each child was examined medically and physically and records made—especially X-ray records—of the growth changes in their bones. His aim was to obtain a series of stages which would serve as a standard of the normal for medical men and especially for school medical officers. In

1937, appeared the first volume of his results, under the title of an "Atlas of Skeletal Maturation" (St. Louis, 1937). This first volume contains 75 plates giving X-ray photographs of the human hand, each plate representing a certain stage of normal growth. Subsequent volumes were to deal with the growth of other parts and regions of the human body.

Todd made the alimentary tracts of his students the subject of a systematic X-ray survey, his object being to determine what might be the normal dispatch of a bismuth meal in healthy young men, and the extent to which the normal may be departed from within the range of health. His observations were summed up in his Beaumont Lectures of 1930 and published in book form under the title "Behaviour Pattern of the Alimentary Tract".

Todd's object was to lay sure and wide foundations on which other workers might build. He lived and worked to the utmost limit of his bodily and mental strength. He sowed on an immense—an almost unprecedented—scale; it was when he harvested and especially when he came to thresh out and market his grain that his life's endeavour fell short of greatness.

ARTHUR KNECHT.

Mr. S. H. Ray

MR. SIDNEY HERBERT RAY, whose death was recently announced, was born in London on May 28, 1858. In January 1882 he was appointed by the London School Board as assistant master in the Olga Street School, Bethnal Green, a position which he held until his retirement in May 1923. He was twice married, but had no children. He died on January 1, 1939. By unremitting labour, combined with a peculiar gift for languages, he raised himself to an honoured position in linguistic science. A noticeable characteristic of Ray was the absence of self-seeking; he worked under conditions which a less devoted man might well have found impossible. Nothing daunted his enthusiasm, and he became a recognized expert in a neglected field of linguistics.

This is not the place to detail his numerous papers on Papuan, Melanesian and Polynesian languages. On suitable occasions he exposed those who juggled with words in order to support vain theories of origins, for the construction of a language and its phonology were to him of prime importance. His studies of particular languages, however, afforded a basis for those wider surveys in which he gave to students the benefit of his erudition.

In 1892, Ray read a paper on the languages of British New Guinea at the Ninth International Congress of Orientalists, in which he showed definitely that there are languages in New Guinea that differ in vocabulary and grammar from the Melanesian and Polynesian spoken in western Oceania and also from the undoubtedly Melanesian of south-east New Guinea. These non-Melanesian languages he named Papuan as a convenient term for numerous distinct languages with archaic features; about the same time, W. Schmidt made the same deduction for German New Guinea. In 1894, Ray recorded traces of

Papuan languages in various islands of Melanesia. In the same year he demonstrated that the Motu and allied languages of south-east New Guinea were not eastern Polynesian, as had been believed, but were Melanesian. He regarded the languages of the Massim area as originally Papuan upon which have been grafted words and idioms from Melanesian tongues. Their Papuan origin accounts for their diversity, and the Melanesian element, which is common throughout the area, accounts for their partial agreements.

When Ray visited Torres Straits and British New Guinea (Papua) as a member of the Cambridge Anthropological Expedition to Torres Straits in 1898, he for the first time was able to study various languages from the mouths of the natives, and he was untiring in his endeavour to make the most of his opportunities. His assiduity was such that he continually reduced his informants to exhaustion, while he himself remained quite fresh. In 1907 he published, as volume 3 of the Reports, a monumental work on the languages of New Guinea, which extended and confirmed his previous deductions. He proved that the western language of Torres Straits belonged to the same group as those of northern Australia, and that the eastern language was Papuan and allied to certain languages of the extreme west of Papua.

In 1926, Ray published a comparative study of the Melanesian languages, a further proof of his industry and erudition. In Melanesia there is a linguistic sub-stratum which differs from island to island. Upon this was grafted an immigrant Melanesian language which had spread at an early date from Indonesia and through its simpler grammar and facility of expression obscured the radical differences of the older languages. Later there were colonists from Indonesia who settled mainly on some of the smaller islands and introduced a pidgin-tongue. The words can only rarely be referred to any one original Indonesian language and they form only a small proportion of the vocabulary of any single language. The linguistic diversity in parts of Melanesia suggests that the Melanesian languages were originally variant stocks and that their apparent uniformity has been brought about by the influx of Indonesian words and idioms. This was the first of a projected series of studies, but the expense of their publication prevented the appearance of further volumes. In more favourable circumstances, Ray could have enriched linguistic science to a much greater extent; we can only marvel that, handicapped as he was, he accomplished so much work that will have a lasting value.

A. C. HADDON.

Prof. E. H. Hall

PROF. EDWIN HERBERT HALL, emeritus professor of physics in Harvard University, whose death occurred on November 20, devoted most of his life to the study and investigation of electric conduction. He will doubtless be most remembered by the Hall effect which he discovered in 1878. This effect is the production of an electromotive force when an electric

current flows across the lines of force of a magnetic field. This electromotive force is perpendicular both to the magnetic field and to the electric current or, speaking more generally, it is proportional to the vector product of the last two quantities. Other aspects of electrical conduction to which Hall made contributions include the Thomson effect in soft iron, thermo-electric heterogeneity in different metals, the theory of thermo-electric action and of thermal conduction in metals and the relations of the four transverse effects of the magnetic field (the Hall effect was the first of these to be discovered). His keen interest in this field was maintained to the end of his life. In fact, a book entitled "A Dual Theory of Conduction in Metals", in which he summarises his considered views on the subject, has recently appeared.

Hall was born at Gorham, Maine, on November 7, 1855, and educated at Bowdoin College and Johns Hopkins University. Practically the whole of his working life was spent in the service of Harvard University, in which he joined the Physics Department as an instructor in 1881, became professor in 1895 and emeritus professor in 1921. He attended the Solvay Conference at Brussels on the Conductivity of Metals and Related Problems in 1924 and the Volta Memorial Congress at Como in 1927. He was a member of the National Academy of Sciences, American Association (vice-president in 1904),

American Physical Society (member of Council 1908-9), American Academy of Sciences, and corresponding member of the British Association.

Hall's contributions to physics were not confined to the various aspects of electrical conduction. Among the other subjects he wrote of we find the changes in temperature of the walls of steam engine cylinders, the thermal conductivity of nickel and iron, the deflection of falling bodies and the air resistance to falling inch-spheres. Some of this suggests an interest in engineering as well as in pure physics. He was also the author of several text-books of physics of varying scope.

Hall was a kindly man and a pleasant companion. He was interested in a great variety of matters about which he could speak in an attractive and sometimes humorous way. He kept his interests alive until the end, and his loss will be felt by a wide circle.

O. W. R.

We regret to announce the following deaths:

Dr. Calvin B. Bridges, known for his work on genetics at Columbia University and the California Institute of Technology, on December 27, aged forty-nine years.

Prof. H. H. Woollard, F.R.S., professor of anatomy in University College, London, on January 18, aged forty-nine years.

News and Views

Scientific and Other Services in War Time

FROM time to time in the columns of NATURE, reference has been made to the need for full consideration of the part that men of science can take should Great Britain be unhappily involved in a major war. The Association of Scientific Workers has recently had the subject under consideration (see NATURE, Jan. 21, p. 110) and has put forward proposals the fundamental principles of which will, we believe, meet with general approval. A sign that the Government was giving attention to this aspect of national defence was anxiously awaited. The appointment of an advisory council by the Minister of Labour to advise him on the utilization in war time in Government departments or elsewhere of persons with scientific, technical, professional and higher administrative qualifications would appear to be the answer. The representation accorded on the council to scientific interests will not satisfy everyone, but it must be admitted that it is substantial. Sir Walter Moberly has been appointed chairman of the council, and the following have accepted appointment as members: Sir Charles Bressley, Dr. E. J. Butler, Sir Eustace H. Tennyson d'Eyncourt, Mr. S. B. Donkin, Dr. H. L. Eason, Mr. A. H. R. Fedden, Dr. A. P. M. Fleming, Dr. G. S. Gordon, Dr. H. J. Gough, Sir Hector Hetherington, Prof. A. V. Hill, Viscount

Leverhulme, Miss Hilda Martindale, Sir Edward Mellanby, Mr. J. S. Nicholson, Mr. Charles J. G. Palmour, Mr. H. Parker, Sir Robert Pickard, Dr. D. R. Pye, Mr. David E. Roberts, Mr. Basil Sanderson, Mr. T. E. Scott, Sir Frank Smith, Rear-Admiral H. G. Thursfield, Mr. R. S. Wood. The secretary to the Council is Miss B. M. Power, of the National Service Department of the Ministry of Labour, Montagu House, Whitehall, S.W.1.

Dr. Lev T. Berg

ICHTHYOLOGISTS throughout the world will be interested to learn that Dr. Lev Semenovitch Berg, of Leningrad, has recently completed forty years work upon the fishes of his native country. One of his earliest papers, entitled "Ueber Theilung und Bildung des Parablastes bei *Rosa lucius*", was published early in 1899, and from that time onwards a veritable stream of valuable contributions, mainly of a taxonomic nature, has flowed from his pen, and more than one hundred papers bearing his name have appeared in scientific journals throughout the world. Always a patient and careful worker, Dr. Berg has come to be regarded as the foremost authority upon the freshwater fishes of the U.S.S.R., and is a recognized authority upon problems concerning the geographical distribution of fishes. His imposing

work on the freshwater fishes of the U.S.S.R. and neighbouring countries; a third edition of which appeared in 1932-33, will long remain a standard work, invaluable to all students of Palaeolithic fishes. Dr. Berg, who was born in 1876, is still actively engaged in his work, and his many friends and co-workers will wish him many more years of fruitful labour in ichthyology.

Mr. S. Hazzledine Warren

There is a special propriety in the award by the Geological Society of the Prestwich Medal to Mr. S. Hazzledine Warren. The ground of the award, as officially stated, is "in recognition of his researches on the geology and archaeology of East Anglia, particularly in the Lea Valley"; but without detracting in any degree from the value and importance of his original researches and discoveries in this area, it is placed to his credit by archaeologists that his severely critical attitude of mind on every point of evidence bearing on the antiquity, character, and condition of flint implements, and the natural or artificial origin of their fractures, has conduced to sanity in that study of the earliest evidence of man's handiwork, with which the name of Sir Joseph Prestwich has been associated from the earliest days when the discovery of 'eoliths' was first proclaimed. Throughout the whole of his long and distinguished career as a prehistoric archaeologist, Mr. Warren has devoted himself indefatigably to the close scientific examination of such questions as patination, modes of fracture under varying conditions, and other matters depending upon the physical properties of flint, with the view of determining their evidential value as clues in the technology of antiquity; and if he has not always been able to go all the way with his fellow workers, it has been recognized that his conservatism has always advanced knowledge in a real sense and not retarded it. Of Mr. Warren's investigations in the field, posterity will perhaps be most indebted to him for his discovery of the Graig Lwyd factory site, significant for the light it throws on prehistoric economics, and his exploration of the Clactonian industry, which has had so profound an effect on all subsequent study of palaeolithic cultures.

Pre-Crag Implements

A COMMUNICATION has been issued by Mr. J. Reid Moir recapitulating his arguments rebutting the criticisms of his claim for the human origin of the pre-Crag 'implements' discovered in, or derivative from, Pliocene deposits in East Anglia. It has been argued from their physical condition and the high angle of flaking that not only were these flaked flints produced by natural forces, but also that in actual fact they are such as could not have been produced, or if produced, used for their supposed purpose, by man. This, it is claimed, has been shown by experiment. To this Mr. Reid Moir replies, pointing out that the flaking of certain, and especially the older classes of pre-Crag implement could not have been produced by the forces responsible for the striations they exhibit, as these score a post-flaking patination;

while the argument from the steepness of the angle of flaking—apparent in some instances only—and the inability of the modern critic to reproduce typical specimens applies equally to certain types of palaeolithic implement, of which the authenticity is unquestionable. It has, however, been found possible to imitate high angle flaking experimentally, and the product is also a practicable tool for working wood and bone. Mr. Reid Moir classifies pre-Crag implements into five groups, which differ in age and in character of flaking. "Is it to be supposed," he pertinently asks, "that nature varied her methods of flaking flints five times in the Pliocene epoch?" Finally, as the result of many years' study devoted to the examination of later deposits, he asserts that never has he discovered a flint fashioned *in situ* which bears any resemblance to a pre-Crag implement, as might be expected were such flaking attributable to natural forces. At the same time it is to be remembered, he points out, that rostro-carinates have now been found in many parts of the world from Palestine to Java, where glacial conditions and solifluxion could not have operated to produce them.

Social Relations of Science

CORRESPONDENCE has passed between the British Association and the Parliamentary Science Committee concerning the possibility of a working liaison between the Association's new division for the Social and International Relations of Science and the Parliamentary Science Committee. At a recent meeting of the latter body it was decided to invite Sir Richard Gregory, in his capacity as chairman of committee of the new division, to accept co-option to the Executive Committee of the Parliamentary Science Committee, and this invitation has now been accepted by Sir Richard. Normally the Parliamentary Science Committee confines co-option to its executive to members of one of the Houses of Parliament. It was felt, however, that in this instance it was particularly desirable to make an exception in favour of the chairman of this newly formed division of the British Association. It was a fitting compliment on another ground, for, as the erstwhile chairman of the British Science Guild (now merged in the British Association), Sir Richard was intimately associated with the formation of the Parliamentary Science Committee. Indeed, had it not been for other preoccupations at the time, he would have been a member of the Committee from its inception.

Survey of Nyasaland Food Resources

A COMPREHENSIVE nutritional survey, under the leadership of Dr. B. S. Platt, the first of its kind to be undertaken in the British Colonial Empire, is now being carried out in Nyasaland with the object of studying the actual and potential food resources of three contrasting areas. This survey is the outcome of a recommendation made by the Committee of the Economic Advisory Council on Nutrition in the Colonial Empire. Dr. B. S. Platt has been appointed to the staff of the Medical Research Council for five years to organize and co-ordinate, with the assistance

of a small central staff, nutritional surveys throughout the Colonial Empire. The Nyasaland party, which is being financed jointly by the Medical Research Council and the Colonial Development Fund, actually arrived in Nyasaland some months ago. An anthropologist under the auspices of the International Institute of African Languages and Cultures is working with the party. The party is now being joined by Dr. O. K. Ricardo and by Dr. E. Trewavas of the British Museum (Natural History), who will undertake a survey of the fishery resources of Lake Nyasa; and also by Dr. G. A. C. Herklots, reader in biology to the University of Hong-Kong, who has been seconded for eight months to assist with the economic work. It is hoped that the surveys will produce valuable results, on one hand by increasing existing knowledge of the relation between nutrition and ill-health, and on the other hand by suggesting means whereby improvements in nutrition may be effected. It is also interesting to note that the present investigation in Nyasaland is the sort of scheme which Lord Hailey had in mind when advocating, in his recently published *African Survey*, that scientific research should form an essential basis of policy in Africa.

New Broadcasting System

According to a recent report by the New York Correspondent of *The Times*, a new type of wireless transmission and reception will be used in an experimental station now being erected at Columbia University by Major E. H. Armstrong, professor of electrical engineering in the University, and inventor of the now well-known supersonic-heterodyne receiver. The station will use the frequency-modulation system of transmission, as distinct from the amplitude-modulation system at present used by all broadcasting stations. In the former method, the frequency of the emitted carrier wave is varied by the speech and music modulation; whereas in the methods so far employed, the frequency of the carrier wave remains constant and its amplitude is varied by the applied audio-frequencies. The principles of frequency-modulation have been known since the earliest days of radio-telephony, but it has remained for Prof. Armstrong to demonstrate how these may be brought into practical use with modern valves and circuit arrangements. Among the advantages claimed for the new system are that it effects a considerable reduction of interference in radio reception, and that a much larger number of broadcasting channels will become available in any given wave-length band. Against these, however, is the serious disadvantage that special receivers are necessary for frequency-modulated transmissions, and this factor is likely to involve serious delay in the introduction of the new system into modern broadcasting technique. The first transmitting station on the new system will be at Alpine, New Jersey, opposite New York City, and it has a licence to broadcast on a frequency of 40 megacycles per second (wave-length 7.5 metres). It is also understood that suitable receivers are already being manufactured, so that the result of this practical experiment will be awaited with interest.

North Rona: A North Atlantic Island

At the Friday evening discourse at the Royal Institution on January 20, Dr. F. Fraser Darling described the island of North Rona. It is Britain's loneliest island; it lies forty-five miles north-west of Cape Wrath and north-east of the Butt of Lewis and is less than half a square mile in area. The island consists of Hebridean gneiss, but being free of peat and covered with a thin layer of soil, it differs radically from Lewis in its vegetative covering, which is of grass, quite free from heather. St. Ronan is reputed to be the first human inhabitant of Rona in the eighth century A.D. He built a cell almost underground, and much of the original building is still present. A chapel was built somewhat later contiguous with the cell and at its western end. Dr. and Mrs. Fraser Darling have excavated the accumulated stone and earth from the chapel and cell, disclosing the altar supports of masonry in the chapel, the rammed clay floor, the doorway into the cell, the original stone paving of the earlier building and the altar of masonry in the cell. Many quern stones and two fragments of stone vessels have been found. The wild life of Rona is of exceptional interest. There is an immense summer population of guillemots, razorbills, puffins, fulmar petrels, kittiwakes and great black-backed gulls. The storm petrel is also numerous, and Rona is one of the three British stations where Leach's fork-tailed petrel breeds. Rona is the headquarters of the Atlantic grey seal in Scottish waters, and a study of the social behaviour of this animal in the months it is ashore for breeding was the main purpose of Dr. Fraser Darling's expedition. Although this seal cannot dispense with the land for reproduction, this annual association with the land is a time of great danger. The social system is finely adapted to reducing the danger, and so are the animal's metabolic processes. The maiden cows and immature stock, for example, do not come ashore on the main mass of the island at the breeding season, but remain on skerries constantly ringed with surf. The calves feed from their mothers intensively for three weeks and are then weaned and left to find the sea for themselves. As the gestation period is 11½ months, mating takes place while the mothers are ashore with their calves.

Royal Meteorological Society

At the annual general meeting of the Royal Meteorological Society held on January 18, Dr. B. A. Keen, the president, referred to the Council's activities in pressing for the installation of meteorological institutes in Great Britain, in order that urgently needed facilities, such as were available in many other countries, might be provided for research in meteorology in this country. The matter was also raised later in the evening, on the occasion of the award of the Buchan Prize to Dr. E. W. Hewson. Dr. Hewson, who is a Canadian and has recently been appointed to the Canadian Meteorological Service, was not able to be present to receive the prize, but in a letter which was read to the meeting he expressed his sense of indebtedness to the Beit Trustees and to the Royal Society of Canada for

the grants which had enabled him to carry out research in meteorology at the Imperial College of Science and Technology in London for three years; and he stressed the great benefit which could be conferred on science by the endowment of scholarships in meteorology which would permit post-graduate students to study meteorology in Great Britain. Dr. Keen's presidential address dealt with the subject of "What happens to the Rain?" An annual rainfall of 30 in. means that 3,000 tons of water fall on an acre of land. In the course of the year this all disappears, by run-off, evaporation, transpiration through vegetation, and by downward percolation. The relative importance of these factors in British and overseas conditions was discussed. It is only in recent years that the true picture of the movement of water in the soil has been built up. In consequence, some of the traditional practices need revision, while others now have a different explanation. The new work has also clarified some of the concepts used in hydrology.

Opening of Griffith Institute of Archaeology, Oxford

THE Griffith Institute of Archaeology, an extension of the Ashmolean Museum of the University of Oxford made possible by the generous benefaction of the late Prof. F. Ll. and Mrs. Griffith, was declared open on January 21 by Sir Frederic Kenyon in the presence of the Vice-Chancellor, Mr. G. S. Gordon, president of Magdalen College, and a large assembly of distinguished guests. Sir Frederic, speaking as an old friend of Prof. and Mrs. Griffith, said that never had he known a man more single-minded and more tolerant of the work of others than Prof. Griffith. The Griffith Institute would fill one of the great gaps in the equipment of the archaeologist. The Vice-Chancellor and Mr. E. T. Leeds, keeper of the Ashmolean, also paid generous tribute to the memory and work of Mr. and Mrs. Griffith. The building in which the Institute is housed is of four floors, erected to the design of Mr. E. Stanley Hall. Three floors are allotted to Egyptology and Assyriology, while the ground-floor is given up to other activities of the Museum. The greater part of the Griffith library is housed in the Institute, and accommodation is provided for the professor of Egyptology and the reader in Assyriology. Space is available for the compilation of the topographical bibliography of Egyptian hieroglyphic texts and other research work, while a large store-room will provide for the Egypt Exploration Society's collection of papyri, which has been transferred from Queen's College, and the collections of ostraka and other material used for purposes of teaching. The University's collection of cuneiform tablets will be arranged in the rooms devoted to Assyriology.

Proposed Museum of Romano-British Archaeology

LORD EUSTACE PERCY, Rector of the Newcastle Division of the University of Durham, has issued an appeal for funds for the erection of a Museum of Romano-British Archaeology, devoted to the area of the Roman Wall at Newcastle-on-Tyne, in connexion with the University of Durham. The proposal arises

out of a recommendation of the Standing Commission on Museums and Galleries made two years ago, which had in view the need both of facilities for study of the area of the Wall and also of the requirements of the magnificent collections of Romano-British antiquities belonging to the Society of Antiquaries of Newcastle, the main source of information concerning the Roman frontier in Britain and settlements adjacent, which have been brought together in the course of the last hundred years, and are now somewhat inadequately housed in the medieval Black Gate of the Castle. The Society has generously expressed its willingness to place its collections at the disposal of the University for this purpose, subject to certain conditions. Although the erection of such a museum had been contemplated in the projected building scheme of the University, it had been set aside for the moment in view of more urgent needs; but it has now been brought within the range of practicable proposals by the offer of a grant of £5,000 from the University Grants Committee, provided the further sum required to make up the total estimated expenditure of £20,000 is raised within a period of two years. The Museum will not be confined to Romano-British antiquities but will include all relics obtained from the area of the Wall, both prehistoric and of post-Roman date down to the Norman conquest. Subscriptions are being received by Lord Eustace Percy at King's College, Newcastle-on-Tyne, 2.

Testing Electric Meters and Appliances

THE opening of large extensions by the Lancashire Electric Power Co. on January 16 of its department for testing electric meters and electric appliances shows how rapidly this branch of the firm's work is developing. That part of the firm's revenue which depends upon meter registrations now exceeds a million pounds per annum, while the number of meters issued has almost quadrupled during the last nine years. A great deal of the extra work done is in connexion with household appliances, offered by the firm on hire and hire-purchase terms. These are installed and maintained by the testing department. The number of domestic appliances connected, such as cookers, water heaters, fires, kettles, etc. increased in number from 400 in 1930 to 10,700 in 1934 and to 38,000 last year. In the last two years, 2,000 thermostatically controlled cookers have been issued to customers. Nearly all the domestic consumers pay on a two-part tariff with a power charge of 0.5-1d. per unit. All meters are tested when removed from service, after which they are reconditioned and certified. A small cleaning room is provided for exceptionally dirty meters, the equipment of which includes a powerful blower and an extractor fan. At the opening ceremony, it was stated that an electricity meter is not only one of the cheapest but also one of the most accurate things the firm has on the market. Since 1936, all cookers offered by the firm have had automatically controlled ovens. Their thermostats are checked for consistency and the enamel is tested for durability. Tests include temperature measurements every

minute at five different points in the oven; if satisfactory, these tests are repeated with food in the oven. The L.E.P. Co.'s experience is that the most critical practical test of an oven is the baking of plate pies, and the next most critical the baking of bread.

Thermionic Valves as Measuring Instruments

THE thermionic valve has long been recognized as a useful tool in many branches of science and engineering; but few, with the exception of experimenters, have realized that it can be usefully applied for measurement purposes. Until quite recently, engineers have regarded the valve as being rather an unknown factor and so have been reluctant to rely on it when precision measurements are required. In a paper presented to the Institution of Electrical Engineers on January 6, by Dr. E. G. James, G. R. Polgreen and G. W. Warren, the principles are outlined of various kinds of valves for the measurement of alternating voltages (including 'slide-back', peak, grid-leak and anode-bend voltmeters) and of voltmeters and electrometers for direct voltages. Methods of measuring very small values of current and power are described. Although the uniformity existing between the characteristics of valves of the same type is not quite perfect, the modern valve gives a very stable performance during its life, more particularly under the operating conditions imposed in measuring devices. Of all valve-measuring devices, the valve voltmeter probably is the most widely used instrument, especially for high-frequency measurements. It is sensitive and it can be designed to absorb negligible power from the source. In normal instrument practice, current is measured either by its magnetic or by its heating effect, and voltage is measured by measuring the current through a known resistance. In the case of instruments employing valves, the converse procedure is adopted. Voltage is measured by its controlling action on the electron current in the valve, while current may be determined by measuring the voltage produced across a known resistance. A simple and inexpensive valve voltmeter can be made to operate from pocket lamp batteries. It makes a useful self-contained instrument with the general advantage of very high impedance and wide frequency range. The paper is a communication from the Research and Engineering staffs of the General Electric Co., Ltd., the M.O. Valve Co., Ltd., at Wembley and the works of the Salford Instrument Co.

Progress of Medical Psychology

IN an address at a public luncheon arranged by the National Institute of Industrial Psychology on January 18, Dr. J. R. Reese, medical director of the Tavistock Clinic, said that this century has seen very great progress in both the science and the art of psychological medicine. Moreover, in the treatment of neurosis and nervous breakdown and in medicine as a whole, the introduction of the principles of medical psychology in the last few years has brought about a greater change than anything else in medicine. In the basic understanding of the processes

of mental disease, much is owed of course to Freud and his followers, but the work of Jung, McDougall, Adler, Rivers and Hadfield—to mention only a few—has been of an outstanding quality. The medical student can now be taught to understand the human beings with whom he has to deal without the use of any technical jargon and without any exclusive reference to a particular school of thought in psychology. In the actual treatment of the neuroses we are making steady advance. There is evidence from the careful follow-up work which has been done, first of all at the Tavistock Clinic and then at the Cassel Hospital at Penrhurst, that approximately 50 per cent of the patients treated, irrespective of the particular method, seem to be permanently relieved and socially adjusted. That is a very satisfactory figure in comparison with the figures for other diseases. More important perhaps than the provision of treatment for the definite neuroses is the fact that through recent research we are coming to realize that many of the illnesses which have always been supposed to be mainly physical, have in fact a very large emotional factor in their causation. Psychological medicine is now coming into its own place in the system of medicine and is showing itself to have the closest possible relation to the problems of general medicine. The General Medical Council has now insisted that medical psychology should become part of the regular training of every medical student.

Flora's League

BOTANISTS, nature-lovers and those who are concerned for the conservation of the native British flora will be interested to know that it has been decided to continue the activities of Flora's League, the national society for the preservation of wild flowers, trees and ferns, as a memorial to its founder, the late Sir Maurice Abbot-Anderson. Sir Maurice, a distinguished physician, founded the society in 1925 and was its president up to his death, when it had a following of more than twenty thousand members and a wide influence through the public and school lectures it organized as propaganda for the preservation of the British flora from vandalism and unscientific collecting. Lady Abbot-Anderson has undertaken to carry on her husband's work as president of the League, which is closely associated with the Council for the Preservation of Rural England, the office of which it shares, and an appeal is being made for a fund to continue this work. In a statement on its policy, the League clearly refutes any suggestion of mere sentimentality or crankiness in its methods, for it points out: "There are inevitable economic influences at work which mitigate against the preservation of our wild flora, and with which we cannot quarrel. Building, road-making, drainage, quarrying and the like, must, in the ordinary course of things, proceed. Methods of transport also are more easily available, and bring enormous enjoyment, as well as increased health, to the population". A by-law against the uprooting of any wild plants from roadsides and places to which the public has access, without authoritative

permission or a special permit for scientific purposes, is one of the chief aims of the League, and this has already been adopted by fifty-two counties and sub-counties in England and Wales. From 1925, the whole of the expenses were met by the founder.

Mathematical Films

IN connexion with the note in *NATURE* of December 31, p. 1151, Mr. Stefan Bergmann writes to point out how films might be used to illustrate the theory of functions of two complex variables. Each complex variable may be represented as a point in a plane, requiring two dimensions, so two such variables require four dimensions. We may obtain these by taking three dimensions in space and one in time, in fact by making a film showing a solid body the dimensions of which vary with the time. Full details were given by Mr. Bergmann some years ago (*J. Deutsch. Mathematiker Verein.*, 42, 238; 1932-33), but so far as we are aware no such films appear in current lists of those available for sale or hire.

Nutrition and Local Government

THE Children's Minimum Council, 72 Horseferry Road, London, S.W.1, has issued a pamphlet entitled 'Nutrition and Local Government—What Your Local Authority Can Do' (by Marjorie E. Green. Price 3d.). Although changes in legislation are still needed to ensure that no child shall suffer from malnutrition through the poverty of its parents, there are two Acts of Parliament, the Public Health Act of 1936 and the Education Act of 1921, which enable local authorities to provide supplementary nourishment, and this pamphlet sets out clearly what each local authority can do in its own area to solve this problem of child malnutrition.

Rheumatism Research in Naval Training Centres

THE Empire Rheumatism Council, in co-operation with the Admiralty, has set up a research foundation to investigate rheumatic disease in the training establishments of the Royal Navy. The research advisory committee has appointed a sub-committee consisting of Lord Horder, Sir William Willcox, Prof. George Hadfield, Dr. Mervyn Gordon and Dr. W. S. C. Copeman to supervise the work. Dr. C. A. Green, of the Bacteriological Department of the University of Edinburgh, is to take direct charge of the Foundation, and the Sir Halley Stewart Trust has appointed him to a research fellowship for three years for this task.

National Nutrition Conference

THE British Medical Association has decided to call a national conference on nutrition in its wider aspects—that is, in relation to national, including agricultural, policy—which will last three days, the dates provisionally selected being April 27-29. In addition to medical men, the conference will be representative of agricultural producers, home and over-seas, as well as of industry and education. The conference will take as its starting-point the recognized food needs of the individual, if health is

to be maintained. Questions to be considered include: How far are these needs satisfied in Great Britain at the present time? What increases are required in the production of particular foodstuffs, either at home or in the Empire, to fill the gap? How can the necessary increases in consumption be best secured—through a system of family allowances; education, including propaganda; or otherwise?

Micro-Methods for Medical Practitioners and Biologists

IN conjunction with the Institute of Scientific Microscopy and Applied Optics of the University of Jena, Messrs. Carl Zeiss, Jena, are organising a course of microscopy, microphotography, micro-cinematography, micromanipulation, luminescence microscopy, also absolute colorimetry, interferometry and spectral analysis, with particular reference to their significance in medicine and biology, to be held in Jena during March 27-April 1. During the lectures provided in the programme there will be talks by eminent authorities on optical methods. Of particular note is the fact that members will be offered the opportunity of widening their experience in the use of the apparatus and above all of trying out in practice the methods referred to during the lectures. Demonstrators and specialists will be available to answer all questions arising during the practical work in the laboratory. Further particulars and detailed programme can be obtained, in England, from Carl Zeiss (London), Ltd., Mortimer House, Mortimer Street, W.1.

New Comet and Super-nova

A TELEGRAM from Copenhagen reports that Peltier, at Delphos, Ohio, discovered a comet on Jan. 20.000 U.T., its approximate position being R.A. 21^h 20.0^m, Dec. + 28° 0', and its magnitude 8. A later telegram states that Beljawsky saw the comet several hours earlier and found that its daily motion was +5^m 48^s in R.A. and -0° 13' in declination. He gave the magnitude as 8 and estimated the tail to be about 1°. Other observations must have been available to Karstedt, who has computed the orbit and ephemeris given below; as the observations are very rough, the orbit cannot be regarded as more than provisional.

T	1938 Dec. 30.0 U.T.	
ω	125°	} 1939.0
Q	305	
i	37	
e	0.770	
Ephemeris		
	R.A.	N. Dec.
Jan. 21.0	21h 28m	27° 30'
25.0	22 30	26 36
29.0	0 39	18 42

Zwicky reports a super-nova, mag. 17 on January 14, 12.5 on January 20. It is 0.6' north-west of the nucleus of N.G.C. 4636.

The Night Sky in February

THE moon is full on February 4 at 7.9^h U.T. and new on February 19 at 8.5^h. Lunar conjunctions with the planets occur as follows: with Mars on February 12 at 13^h; with Venus on February 15 at 3^h; with

Jupiter on February 20 at 12^h and with Saturn on February 23 at 6^h. Jupiter, which has been a conspicuous object in the evening skies for some months, is now approaching conjunction with the sun, and in the middle of the month sets at about 18½^h. Mercury and Jupiter are close to each other on February 26. Saturn is an evening star in Pisces; in mid-February the planet sets at about 21¼^h. Venus is the bright morning star rising before 5^h; its stellar magnitude is from -4.0 to -3.9. Mars rises some two hours before Venus, and is 5° north of Antares on February 12. In mid-February, the constellation of Orion, which focuses attention on the most spectacular region of the whole sky, comes to the southern meridian at about 20^h. North preceding the Pleiades is the variable star, Algol, the light changes of which may be observed about 1½ hours before and after the following times of primary minima: February 9^d 0.1^h, 11^d 21.0^h and 14^d 17.8^h.

Announcements

PROF. G. INGLE FINECH, professor of applied physical chemistry in the Imperial College of Science and Technology, was presented at the Belgium Embassy on January 23 with the order of Commander of the Order of King Leopold II, which has been conferred on him by King Leopold III for services rendered to science in Belgium during his term of office as Fondation Francoqui professor in the University of Brussels during 1937-1938.

PROF. VICTOR F. HESS, formerly director of the Physical Institute of the University of Graz, has been appointed professor of physics in Fordham University, New York, as from November last. His address is: Department of Physics, Fordham University, New York City.

MR. A. S. E. ACKERMANN has been elected an honorary fellow of the Society of Engineers (Inc.) upon relinquishing the secretaryship of the Society, which he has held for thirty-one years.

It is announced that a sale by auction will take place at Stevens Auction Rooms on February 10, at 12.30, of the important collection of scientific instruments, the property of the late Edward Milles Nelson. They include microscopes by Leitz, Powell & Lealand, Swift, and other well-known makes, objectives, eyepieces, and other accessories, chemical balances and weights, a spectroscope, a telescope, drawing instruments; books, etc. Catalogues can be obtained from the Auctioneer, 38 King Street, Covent Garden, W.C.2.

At the annual general meeting of the Royal Meteorological Society held on January 18, the following officers were elected: *President*, Dr. B. A. Keen; *Treasurer*, W. M. Witchell; *Secretaries*, H. W. L. Absalom, W. Dunbar, and E. L. Hawke; *Foreign Secretary*, J. F. Shipley; *Editor*, Sir Gilbert Walker; *New Members of Council*, Lieut.-Commander T. R. Beatty, L. O. W. Bonacina, and G. Manley.

At a meeting of the Chemical Society on January 23, it was announced that Dr. H. J. T. Ellingham is resigning from the office of honorary secretary. The Council of the Society has nominated Prof. G. M. Bennett as honorary secretary and Mr. F. P. Dunn as treasurer, for election at the annual general meeting on March 30. The Council has also accepted with regret the resignations of Prof. F. Challenger and Dr. S. Glasstone from the office of local representative for Leeds and Sheffield respectively, and has invited Dr. J. W. Baker (Leeds) and Sir. A. W. Chapman (Sheffield) to fill these vacancies.

PROF. OTTO LOHWI has been appointed by the Fondation Francoqui as a visiting professor for eight months to a Francoqui chair in the University of Brussels. His address during that time will be: Fondation Universitaire, 11 Rue d'Egmont, Brussels.

PROF. OTTO MEYERHOF, For. Mem. R.S., of the Kaiser Wilhelm-Institut für Medizinische Forschung, Institut für Physiologie, Heidelberg, writes that his address from now on will be Institut de Biologie Physico-Chimique, 13, Rue Pierre Curie, Paris, 5.

DR. ROBERT FEULGEN, professor of physiological chemistry at Giessen, has been elected a member of the German Academy at Halle.

PROF. F. POTRUSKY, of Bonn, has been elected honorary president of the International Academy for Forensic and Social Medicine.

DR. LOUIS MARTIN, director of the Pasteur Institute of Paris, has been elected vice-president of the Paris Académie de Médecine and M. Gaston Louis Ramon, sub-director of the Institute, has been created a Commander of the Legion of Honour for his work on immunization against diphtheria and tetanus and combined inoculations.

On the occasion of the International Water Exhibition and the inauguration of the Albert Canal, the eighteenth session of the Congress, known as the Journées médicales de Bruxelles, will be held at Liège on June 24-28 under the presidency of Prof. Ernest Renaux, member of the Belgian Royal Academy of Medicine. Further information can be obtained from the general secretary, Dr. René Bekkers, 141 rue Belliard, Brussels.

THE Annual Congress of the Ophthalmological Society of the United Kingdom will be held at the Royal Society of Medicine on April 20-22, when the subject for discussion will be the problems of refraction.

THE University of Groningen will commemorate on April 29-30 the one hundred and fiftieth anniversary of the death of Peter Camper, the celebrated physician, anatomist, obstetrician and artist, who was for ten years a professor at the University.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 166.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The 'Thumb' of the Giant Panda

SOME reference has been made in the daily Press, during the past few days, to the extraordinary grasping power possessed by the giant panda at the London Zoological Gardens. It has been stated that "It is now seen that the fingers are used in conjunction with a thumb on each hand to grasp the bamboo. The thumbs are not tapered like the fingers. They are broad stumps, but they are connected with adductor muscles, by means of which they can be brought into contact with the fingers".

True opposable thumbs, capable of grasping, are possessed only by animals that have never ruined their grasping arboreal hands by using them to support the body weight in terrestrial pronograde progression. The giant panda is apparently a non-arboreal, quadrupedal pronograde, and should it have retained a truly opposable thumb, it would be a very remarkable circumstance: should it have re-developed an opposable thumb (for the purpose of grasping bamboo shoots) from one that had lost its structural basis of opposability, it would have performed a miracle. Not even the giant panda could be expected to reverse structural evolution to the extent of making an opposable, grasping thumb from one in which all the structural adaptations to this functional end had been lost. But the giant panda has done something that is almost equally remarkable. It has developed a new and thoroughly efficient pseudo-thumb. For the 'thumbs' which are 'broad stumps' are not thumbs at all, though they have attained, with great perfection, to their functional role. In addition to the pseudo-thumb, there is a true first digit, followed by four other digits: and the true thumb is in no way differentiated from (but is smaller than) the rest of the digits.

Upon the radial side of the carpus, there is developed in many mammals a sesamoid bone corresponding to the pisiform upon the ulnar side. In the true bears, the radial sesamoid is a small nodular mass; in the giant panda it has been developed into an elongated bone articulating with the scapho-lunar and projecting from the radial side of the hand after the fashion of a true thumb. Moreover, many of these muscles, which in normal mammals are inserted to the first digit, gain their insertion, in the giant panda, into the radial sesamoid, which thus usurps the place of the true thumb and simulates all its movements. The anatomical details of this curious adaptation will form the subject of a communication to the Zoological Society of London, to the authorities of which I am indebted for the opportunity of dissecting the fore-limb of this animal. In the meantime, it seems worth while to record this curious example of adaptation, by which an animal in which the thumb had lost its structural modifications for opposability and general mobility, has created a new and extremely serviceable 'thumb' in response to a

special need in its economy. It would seem that what is commonly known as Dollo's Law of the Irreversibility of Structural Evolution was sufficiently rigid to make the creation of a new mobile thumb an easier matter than the remodelling of one that had lost its original structural adaptation to mobility. But it is surely a very definite triumph that the giant panda has been able to make so perfect a new thumb as to deceive those who have admired the perfection of its grasp.

FREDERIC WOOD JONES.

Department of Anatomy,
University,
Manchester.
Jan. 17.

The Electronic Charge

WE have made modifications in the drop method for measuring the electronic charge, e , which enable a higher degree of accuracy to be obtained.

The method is also convenient for measuring the number of elementary charges, n , which are carried by a drop when it is detached from a volume of oil. Results of such measurements are given below.

The method used is that of H. A. Wilson, modified by (1) the use of a horizontal electric field; (2) recording photographically the motion of the drop.

Following Millikan, to reduce the evaporation of a drop, one of oil is used. The drop moves in air between the vertical plates of a condenser. During the first part of its motion it is acted upon only by its weight; then an electric field, X , is established, and a horizontal force, neX , acts too on the drop. If v is the vertical, and u the horizontal component of its velocity, and if Stokes's law applies, then

$$ne = k\mu^{1/2}v^{1/2}u/X,$$

where $k = 9\pi\sqrt{2}/\sqrt{g(\rho-\sigma)}$, and μ is the viscosity of the air at the temperature of the experiment. This value of e requires correction, according to the method devised by Millikan, to allow for the departure from Stokes's law.

The drops of apiczon and castor oil used have had a diameter, $2a$, of 0.0002-0.0010 cm. They are illuminated by a carbon arc with a dark-ground condenser designed for the purpose. The exposure is 0.0008 sec. at intervals of 1/25 sec. A low-power microscope objective and a fine-grained photographic plate is used. An example of a photograph obtained is reproduced in Fig. 1.

With this method, displacements correct to about 0.00003 cm. can be measured, and if the velocity is 0.3 cm./sec., intervals of time measured are correct to 0.0001 sec. It enables the velocities of drops to be measured which, on account of their large radius, move too quickly for accurate visual observation. For these drops, the correction factor to Stokes's law

$(1 + A/\rho a)$ is more nearly 1 than for smaller drops, and the error in the value of e due to Brownian motion is diminished.

The vertical and horizontal velocities of a drop can be observed, too, with sufficient precision to make possible the verification of the assumptions made in deriving the expression given above. We have in this way detected small errors which have been removed by experimental improvements.

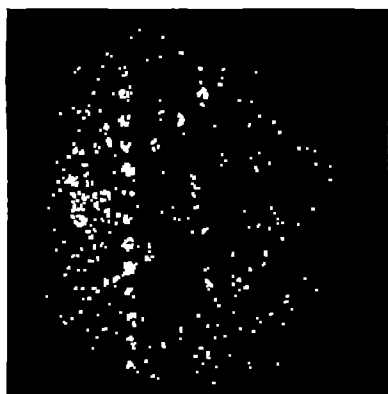


Fig. 1.
PHOTOGRAPH OF DEFLECTED DROPS.

It would be premature to state the value of e which has been obtained in our preliminary measurements, but so far it is slightly lower than that of Millikan. (The increase in his value from 4.77×10^{-10} to 4.8×10^{-10} e.s.u. is made necessary by recent determinations of μ for air.)

Drops of oil formed by detachment from the steel wires of a brush are found to be electrically charged.

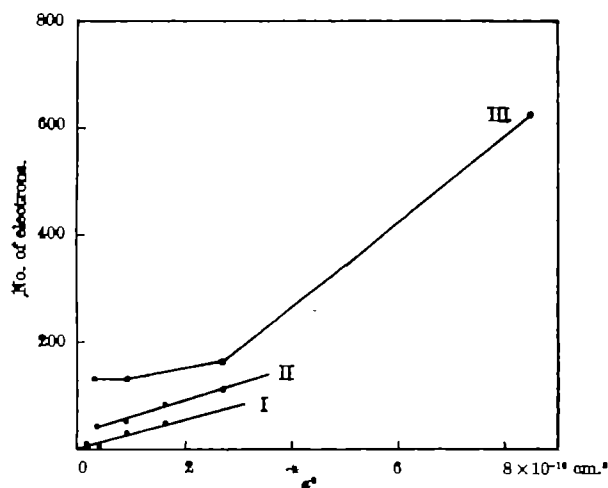


Fig. 2.
RELATIONSHIP BETWEEN CHARGE ON AND VOLUME OF OIL DROP. I, APIEZON OIL, SAMPLE A; II, APIEZON OIL, SAMPLE B; III, CASTOR OIL.

The values observed for three oils are shown in Fig. 2, in which n , the average number of electrons per drop, is plotted against the cube of the radius, a^3 . For these three oils n is apparently proportional to a^3 . Drops of castor oil to which more than 1,000 electrons were attached have been photographed. Long-chain molecules of glycerides of ricinoleic acid, $C_{18}H_{33}O_2$, $CH(OH).C_2H_5$; $C_{18}H_{33}O_2$, $COOH$, and of the free

acid are present in castor oil. Presumably a number of these chain molecules are broken in the formation of a drop, thus causing it to be charged.

We are indebted to Mr. T. P. Gill for valuable assistance in the electrical measurements.

T. H. LABY.
V. D. HOPPER.
Natural Philosophy Laboratory,
University of Melbourne.
Nov. 23.

The Expanding Universe and the Origin of the Great Nebulae

Prof. G. Gamow and Dr. E. Teller have propounded¹ an interesting view of the genesis of the nebulae, but I doubt if either their arguments or their calculations can survive criticism. In brief, they think that the average density of matter in the present universe is about 10^{-28} ; that matter of this density, spread uniformly as a gas through space, could only condense into the present nebulae if the gas-molecules were at a temperature of "several million degrees, which seems to be very unlikely"; that for condensation to have taken place in the past, inter-nebular distances must have been less than now by a factor of about 1,000. "Since the present average distance between the nebulae is just about 1,000 times larger than their diameters, we conclude . . ." and so on. Their whole cosmogony is based on the supposed equality of these two factors of 1,000. I believe both to be wrongly calculated.

The average inter-nebular distance is about 2,000,000 light-years², but the average diameter of a nebula³ is certainly more than 2,000 light-years. The true ratio here is probably nearer to 100 than to 1,000.

Recent investigations by Sinclair-Smith, Holmberg and others suggest that Hubble's estimate of 10^{-28} for mean density (which was anyhow only given as a lower limit), is emphatically on the low side. The average nebula appears to have a mass of at least 10^{11} suns. This gives a mean density, for nebular matter alone, of 2.5×10^{-28} , which reduces the needed contraction from 1,000:1 to 40:1. But this is not all; in calculating the criterion for the formation of condensations, the authors neglect the gravitational field of all uncondensed matter outside the incipient condensation. My own calculations⁴ indicate that this introduces a further wrong factor of $8\pi^2/9$, or about 9.

When all this is put straight, I find that the present universe, as it now stands, could be formed by the condensation of a gas with a 'thermal' velocity of about 20 km. a second. To obtain this velocity, we need not postulate gas molecules (!) "at temperatures of several million degrees"; we can get it from hydrogen atoms at 19,000° C., or from free electrons at -260° C., or from a mixture of atoms and electrons at any temperature we choose between -260° C. and 19,000° C. The range is so wide that nothing can be ruled out as impossible.

The range of universes which could be formed by gas-condensation would appear, then, to include the actual present universe. If so, we cannot form any estimate of the epoch, or any picture of the manner, in which our universe was formed, from the considerations proposed by Gamow and Teller.

I believe other objections can be brought against their arguments without being hypercritical. For example, in the expanding universe of the theory of relativity, material particles gain kinetic energy during the process of expansion. But this gain must

not be included in the equation of energy; if it is, there is no longer conservation of energy. This makes me think that the authors' arguments about velocity of escape are invalid.

Cleveland Lodge,
Dorking.

J. H. JEANS.

¹ NATURE, 143, 116 (1939)

² Hubble, "The Realm of the Nebulae", 189.

³ Loc. cit., 178.

⁴ "Astronomy and Cosmogony" (second edit.), 348.

Glaciological Results of the Jungfraujoch Research Party

LAST spring a note was published in NATURE on the aims of our expedition to the Jungfraujoch to study glaciological problems. The working out of our results has now progressed so far that we are able to give a brief account of them.

The main part of the work was concerned with the study of the transition of snow into ice in glaciers, but the results obtained also threw considerable light on the mechanism of glacier flow.

The general scope of the work and results may be outlined as follows:

(1) *Transition of snow into glacier ice.* Specimens of firn and ice were removed from the walls of deep crevasses and artificial shafts in the interior of the glacier. Depths one hundred feet below the surface were explored. The samples were examined in a laboratory which had been excavated in stationary ice at the Jungfraujoch. The temperature of the laboratory remained at about -4°C . throughout the summer. The change in density with depth was determined at various points between the source and firn line of the Great Aletsch Glacier. From these results it was possible to draw a profile of the density distribution in the glacier and to define a transitional plane between firn and glacier ice. Usually the density increase on passing from early firn to glacier ice was found to be a gradual one. However, a transition point between the two could be distinguished at a density of about 0.84, since here the hitherto porous firn becomes impermeable to water by the freezing out of descending melt water and by a slow process of settling. Measurements indicate that the latter process is an important factor in increasing the density.

(2) *Névé temperatures.* By means of thermocouples buried at depths down to 30 m., it was found that the winter cold wave penetrated to about 15 m. depth. Below this depth it was concluded that the whole glacier was at the pressure melting temperature. The heating of the firn in summer is attributed to a downward percolation of melt water from the surface and it was found that the rate of temperature rise depended on the firn structure and its permeability to water.

(3) *Crystallographic studies.* Using the standard methods of optical crystallography, the size, shape and orientation of the crystals and the distribution of the air spaces were studied in thin sections cut from specimens which had been taken from the interior of the glacier. A statistical survey of the orientation of a large number of crystals in these sections gave evidence of the presence or absence of any preferred orientation. Although firn near the surface showed orientation due to growth in a uni-directional cold wave, this orientation was observed to disappear gradually at greater depths by the independent movement of firn grains during glacier flow and settling. Preferred orientation of crystals

by plastic deformation due to shear was found in several places on glacier tongues.

(4) *Stratification bands.* Two types of bands are distinguishable in the *névé*, (a) dirt bands, which form on the surface and represent the boundary between the accumulation of successive years, and (b) ice bands, which are also of sedimentary origin; the crystal orientation of these is similar to that of pond ice. Other types of bands are to be seen in glacier tongues; of these the most important are the 'blue bands' which are of tectonic origin. Bands of sedimentary origin are also found in the glacier tongues.

(5) *Glacier flow.* Fundamental differences were observed between the mechanism of flow in the *névé* region and in the ice of the tongue. Measurements of the differential movement in firn together with the crystallographic evidence showed conclusively that flow takes place by the haphazard motion of crystals or small crystal aggregates. Below the firn line, where the interlocking of crystals prevents their relative motion, the glacier flows by plastic deformation and also by laminar movement along thrust planes. Plastic deformation involves the slip of crystals along their basal glide planes and is accompanied by the growth and reorientation of crystals due to a molecular transfer across their grain boundaries.

Full accounts of the work will be published in the near future.

T. P. HUGHES.

Laboratory of Physical Chemistry,
Cambridge.

M. PERUTZ.

Crystallographic Laboratory,
Cambridge.

G. SELIGMAN.

The Athenæum,
London, S.W.1.

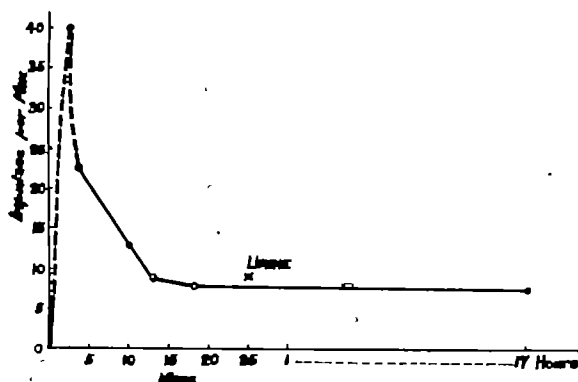
Distribution of Radioactive Sodium after Injection into the Rabbit

RADIOACTIVE sodium has been administered to rabbits in the form of sodium chloride and the subsequent distribution of the Na^{24} investigated by measuring the activity of samples of ached blood and tissues with a Geiger counter. The radioactive sodium (Na^{24} ; 14.8 hours period) was obtained by irradiating magnesium or sodium hydroxide with neutrons from a radon-beryllium source of about 500 mc. The total activity so produced corresponded to 2000–4000 impulses per minute on the counter used for recording.

After intravenous injection of the radioactive salt, the Na^{24} in the blood was found to reach a constant level in about 15–20 minutes (see accompanying graph). A similar constant level was reached in about the same time after intraperitoneal injection. Equilibrium was obtained more slowly following injection of the salt into the colon. Assuming that the sodium is evenly distributed in a fluid medium¹, it is possible to estimate from the ultimate constant level of the Na^{24} in the blood the volume in which it is dissolved. Thus, for example, in one animal (weight 3000 gm.) 22.5 minutes after intraperitoneal injection of Na^{24} , 5 c.c. of blood contained an amount of radioactive sodium corresponding to 15 impulses per minute. The total radioactive sodium in the body at this time, allowing for the overflow into the urine, would have given 2500 impulses per minute. Hence the volume of fluid in which this Na^{24} was dissolved must have been about 830 c.c., that is, 36 per cent of the body weight in water. Similar results

were obtained in the other animals examined, the fluid in which the Na^{24} was dissolved being about 30–35 per cent of the body weight in water.

There is accumulating evidence that most of the sodium of the animal body is distributed outside the cells, so that the volume calculated above may be taken as representing the extracellular fluid content of the rabbit. These results compare favourably with those obtained by other workers by direct chemical analysis of the tissues¹. Samples of ashed tissues have given similar results; for example, liver contained 85 per cent of its weight of extracellular fluid, muscle 35–40 per cent, etc. In two animals the heart muscle was found to be exceptional, the radioactive sodium present in this tissue after injection being more than that representing 100 per cent of the weight of the muscle in terms of water. This corresponds to a three-fold concentration of the Na^{24} in the heart as compared with other tissues, and is probably to be interpreted as absorption of the radioactive sodium into the cardiac muscle cells.



The method of preparing Na^{24} used in these experiments is tedious and produces too little activity to allow of very accurate measurements, but with sufficiently active sodium produced by a suitably powerful apparatus, the injection of Na^{24} into the animal body may provide a useful method for the estimation and study of the extracellular fluid content of the tissues. Such a technique might be useful in other physiological experiments, or as a clinical guide to extracellular fluid in such conditions as oedema, Addison's disease and the post-operative administration of fluid.

J. H. E. GRIFFITHS.

Clarendon Laboratory,

B. G. MARGRAITH.

Sir William Dunn School of Pathology,
Oxford.

Dec. 26.

¹ Peters, J. P., *Harvey Lectures*, 23, 112 (1938).

² Fenn, W. O., *Physiol. Rev.*, 18, 450 (1936).

A Difference of Effect Between the Oestrogenic Hormones and Diethylstilboestrol

In a previous investigation¹ it was shown that the oestrogenic hormones and progesterone are able to inhibit the comb-growth action of the male hormone. This action was described as antagonistic. The control determinations, carried out simultaneously, showed that in this case it was a question of a specific activity of the hormones, the mechanism of which is not yet

clear. The antagonism shows itself both on injection of the hormone and on smearing on the comb.

After the discovery of the oestrogenic activity of diethylstilboestrol by Dodds, Golberg, Lawson and Robinson² this substance was also investigated as to its antagonistic action (Mühlbock)³. By injecting this substance along with androsterone, it was demonstrated that the comb-growth activity could be suppressed in the same way as with oestradiol. No antagonistic action was observed, however, with diethylstilboestrol when it was smeared on the comb. Thus in this way it is possible to demonstrate biologically a difference between the oestrogenic hormones and diethylstilboestrol. It has not yet been explained why diethylstilboestrol fails to act when applied to the comb; possibly it is not resorbed.

This biological difference between the oestrogenic hormones and diethylstilboestrol, besides being of theoretical interest, may also be of practical importance in so far as this method makes it possible to establish what type of substance is responsible for the oestrogenic action. For practical purposes, only the following oestrogenic substances come into question: oestrone, oestrone benzoate, oestradiol and oestradiol benzoate. Hence these oestrogenic substances were examined as regards their antagonistic activity and compared with diethylstilboestrol.

Experimental method. When 0.4 γ of testosterone dissolved in 0.2 c.c. of oil is smeared twice daily (0.1 c.c. each time) for four days on the comb of a capon, on the average, a comb-growth of about 15 per cent is observed in five days. Six capons were always taken for each experiment and six other capons always served as controls. The combs were measured by the photo-electric process worked out in the Amsterdam Institute⁴. In the actual experiments the oestrogenic substances were smeared together with 0.4 γ of testosterone on the combs of the capons.

In order to bring about a complete suppression of comb-growth activity of the testosterone, 5,000 International Units of the oestrogenic hormones are sufficient.

Daily dose in 0.2 c.c. oil	Average percentage comb-growth in 6 capons after 5 days	Result
Experiment 1		
0.4 γ Testosterone	+ 13	Control
0.4 γ Testosterone + oestradiol 5,000 I.U. = 250 γ	0	Total suppression
0.4 γ Testosterone + oestradiol benzoate = 650 γ	+ 3	Total suppression
0.4 γ Testosterone + oestrone 5,000 I.U. = 500 γ	- 7	Total suppression
0.4 γ Testosterone + oestrone benzoate = 2,000 γ	- 4	Total suppression
0.4 γ Testosterone + diethylstilboestrol 5,000 I.U. = 250 γ	+ 12	No suppression
Experiment 2		
0.4 γ Testosterone	+ 21	Control
0.4 γ Testosterone + diethylstilboestrol 10,000 I.U. = 500 γ	+ 18	No suppression
0.4 γ Testosterone + diethylstilboestrol 20,000 I.U. = 1 mgm.	+ 21	No suppression

In the accompanying table, only one example of each oestrogenic substance is given. In the first experiment with testosterone, we obtained an average comb-growth of 13 per cent. The same comb-growth (12 per cent) was obtained when simultaneously with testosterone diethylstilboestrol was smeared. Contrary to this result, all the other oestrogenic substances suppressed the comb-growth

completely. Thus this method of working provides us with the possibility of distinguishing these two groups of substances biologically from one another. The cause of the different action of diethylstilbestrol is at present being investigated more closely.

O. MÜHLBOCK.

Pharmaco-therapeutic Institute,
University, Amsterdam.
Dec. 19.

¹ Mühlbock, *Acta Bravae Neerland.*, 8, 50 (1938).

² Dodda, Golberg, Lawson and Robinson, *NATURE*, 141, 247 (1938).

³ Mühlbock, *Acta Bravae Neerland.*, 9, No. 1 (1939).

⁴ Comprehensive description by Freund, *Abderhaldens Handbuch*, 5, 3B, 1667 (1938).

Cycle of Responsivity of Castrated Albino Mice and of Human Beings to Oestrone Injection

In her recently reported observations on seasonal rhythm in the responsiveness of castrated mice to injections of oestrone, Dr. J. Duszyńska states that the response is more than three times as great in May as in November¹. She raises the question as to whether a similar rhythm exists in the human.

Such an observation, of course, is somewhat difficult to correlate with studies made on the human female whose gonads are still present and functioning cyclically. There does appear to be a seasonal rhythm, however, in the values for blood oestrogens found in normal males². Moreover, it is much more common to find high values for blood oestrogens³ in pregnant women in the late winter and spring than in the summer, in this part of Canada at least. This can be correlated with an increase in the late winter and a decrease in summer in the incidence of pathological states closely related to high values of blood oestrogen, such as certain pregnancy toxemias and abortion. We have postulated, on account of the reciprocal relation existing between ingested vitamin E and the blood oestrogen, that this is due to the seasonal tides in intake of this vitamin. In administering anti-oestrogens it is essential to take this variation into consideration⁴.

If Duszyńska means that only one third as much oestrogen has to be administered in May as is required in November in order to produce the same degree of response, her data parallels ours.

E. V. SHUTE.

University of Western Ontario,
London, Canada.
Dec. 6.

¹ Duszyńska, J., *NATURE*, 140, 678 (1938).

² Shute, E. V., *Amer. J. Ob. and Gyn.*, 25, 609 (1938).

³ Shute, E. V., *J. Ob. and Gyn. Br. Emp.*, 43, 74 (1936).

⁴ Shute, E. V., *Can. Med. Assoc. J.* (in the Press).

Effect of Zinc on the Iodine-Consuming Power of Insulin

THE duration of the blood sugar lowering action of insulin injected by the subcutaneous route is prolonged by the addition of zinc salts¹. The action of crystalline insulin containing zinc is of longer duration than that of an equal number of units of a preparation free from zinc.

This zinc effect is not found when rabbits are used, since apparently no difficulties are encountered in the assay of insulin of varying zinc content by the widely used rabbit method. Experiments with diabetics, however, have shown that this zinc effect is readily demonstrable^{2,3}, and rather severe clinical

disturbances were observed when a crystalline insulin was substituted for a zinc-free preparation (insulin containing less than 0.1 mgm. zinc per 1000 units is considered zinc free)⁴.

As the onset of the action of insulin appears to be retarded in the presence of zinc⁵, one is led to the assumption that the insulin cannot become fully active unless the zinc, which shields an active part of the molecule (by the strong hydration of the zinc ion⁶), is split off.

With the view of finding out whether zinc exerts a protecting action also *in vitro*, I examined the action of iodine on insulin. The iodine-consuming power of insulin was measured at pH 7.2 in the presence of calcium, aluminium, cadmium, zinc and lead.

It was found that the addition of zinc (and to a smaller degree probably also of cadmium) decreased the iodine consumption. Calcium, aluminium and lead showed no effect. The magnitude of this zinc effect is a function of the physiological activity of the insulin preparation used. These findings suggest the possibility of a purely chemical explanation of the physiological effect of zinc on the action of insulin. Moreover, a chemical method of assay of insulin appears to be made possible by the fact that my experiments showed the existence of a definite relation between the iodine-consuming power of insulin and its physiological action as measured in units.

Details of the experimental results will be published elsewhere.

E. H. VOGELIENZANG.

Pharmaceutical Department,
Municipal and University Hospital,
Utrecht.
Dec. 23.

Scott, Fisher, *J. Pharmacol. and Exper. Therap.*, 55, 206 (1935).

² Rabnowitch, Foster, Fowler and Corcoran, *Canad. Med. Assoc. J.*, 36, 230 (1936).

³ Hulst and Vogelienzang, *Nederl. Tijdschr. v. Geneesk.*, 81, 1916 (1937).

⁴ Vogelienzang and Hulst, *Acta Med. Scandinav.*, 87, 307 (1938).

Chlorophyll Formation and Development of Photosynthetic Activity in Juvenile Leaves of Mango (*Mangifera indica*)

THE question how far the development of photosynthetic activity is concomitant with chlorophyll formation has not been definitely answered; the investigation in higher plants being mainly along two lines: (1) relationship between rates of photosynthesis and chlorophyll formation in leaves in different stages of development; and (2) relationship between the two during the greening of etiolated seedlings.

(1) Willstätter and Stoll¹ observed that in the developing leaf both the chlorophyll content and photosynthetic rate increase but not in any definite proportion. Singh and Lal² noted that mature and old leaves, although containing a greater amount of chlorophyll than the younger, fail to show a proportionate increase in the photosynthetic rate. Briggs³ finds in seedlings developing a specialized photosynthetic organ different from the storage, the activity is not developed until some time after germination, while in those with the storage and the first assimilatory organ the same, there is no lag between the development of chlorophyll and that of full photosynthetic activity.

(2) Irving⁴ concludes that chlorophyll is not a limiting factor in the earlier stages of the developing

assimilatory organs; the beginning of photosynthetic activity being controlled by some other component part not developed by illumination as rapidly as the green pigment. Briggs¹ found that the assimilatory power of young shoots depends on their age rather than on chlorophyll content.

Emerson², using *Chlorella*, demonstrated that chlorophyll content was a limiting factor. However, as mentioned previously³, *Chlorella*, being a unicellular organism with the simplest mechanical arrangement for carbon dioxide diffusion, is not strictly comparable with multicellular leaves.

The results recorded by us with respect to chlorophyll formation, photosynthetic activity and absorption of radiant energy at different stages of juvenescence in the leaves of the perennial tropical plant, mango, appeared to throw interesting light on the question. Photosynthetic rate and chlorophyll content were determined by methods outlined before^{3,4} and absorption of radiant energy by a new method to be described elsewhere.

In the earliest stage, the primordial (leaf bud), the true assimilation rate (mgm. of CO₂ per 10 gm. fresh weight) is 0, the chlorophyll content (mgm. per 10 gm. fresh wt.) being 0.12. After three days, the assimilation rate rises to 0.9 and chlorophyll content to 1.10. The assimilation number of 0.82 at this stage increases to 6.17 at the tenth day, when assimilation rate is 18.5 and chlorophyll content 3.00. On the twenty-fifth day, the assimilation rate is 51.6, chlorophyll content 14.10 and assimilation number 3.65. Thus assimilation rate increases continuously but not in proportion to the chlorophyll content as evidenced after the tenth day by decreasing assimilation numbers. The leaves until the tenth day show increasing shades and after that decreasing shades of red coloration, being completely green only at the twenty-fifth day. On the thirtieth day, that is, the mature stage of the leaves, the assimilation rate falls to 48.4 although chlorophyll still shows an increase (16.50 mgm.). At the earliest stage, 0.5 per cent of the incident energy in the red region of the spectrum and 0.3 per cent in the blue only are absorbed; at the stage of active photosynthesis, that is, the tenth day, the absorption being 8.0 per cent and 4.1 per cent, and at the mature stage, that is, the thirtieth day, 27 per cent and 18.4 per cent in the red and blue regions respectively.

There is thus no proportionality between the development of photosynthetic activity and chlorophyll formation. According to Irving⁵, probably the youngest leaves (until the third day), although possessing chlorophyll, lag behind in some other part of the photosynthetic machinery. The latter, as suggested by Willstätter and Stoll⁶, may be then having a controlling influence resulting in increasing assimilation number, and after the tenth day when the red colour is disappearing this factor may be less active.

On considering the above results in conjunction with the findings of Briggs¹, the juvenile leaves of the perennial mango appear to conform to the type of those of the seedlings in Briggs's experiments, where the storage organ is different from the first assimilating organ; the photosynthetic activity in consequence lagging behind chlorophyll formation. The lack of immediate necessity for active photosynthesis by these young leaves is evidenced by the fact that at this stage the mature green leaves of the previous season are still present with active assimilatory power.

The evidence of a stage in the development of a leaf with no photosynthetic activity, a marked lag in the same as compared with chlorophyll formation and a corresponding lack of absorption of photosynthetically active components of radiant energy until the stage of active photosynthesis in a perennial plant like the mango, is interesting and appears to bring into unison the conclusions of the two main lines of investigation discussed above.

B. N. SINGH.

J. D. JHA.

Plant Physiological Laboratories,
Institute of Agricultural Research,
Benares Hindu University.
Dec. 8.

¹ Stiles, W., "Photosynthesis" (1925).

² Singh, B. N., and Lal, K. N., *Ann. Bot.*, 44 (1935).

³ Briggs, G. H., *Proc. Roy. Soc., B*, 94 (1932).

⁴ Irving, A. A., *Ann. Bot.*, 94 (1910).

⁵ Briggs, G. H., *Proc. Roy. Soc., B*, 81 (1930).

⁶ Emerson, R., *J. Gen. Physiol.*, 19 (1929).

⁷ Singh, B. N., and Anantha Rao, N. K., *NATURE*, 140, 723 (1937).

Behaviour of Mature Male Salmon Parr, *Salmo salar* juv. L.

IN a recent account of early and normal sexual maturity in male salmon parr in the Welsh Dee¹, we directed attention to the possibility of these young mature males behaving differently in their river movements from other young parr of the same age, immature males and females. The absence of mature males from one tributary, Hirnant Brook, at the time of examination indicated that they might have migrated; but as the sample was a very small one consisting of eleven individuals, the discriminating behaviour of the mature male could only be regarded as a possibility. In November, however, significant information was obtained. Pure samples of mature male parr were found on November 14, 16 and 18—coincident with the ascent of the last batch of adult spawners up the River Alwen—to have collected in numbers (twelve, sixteen and twenty respectively) in the stream-like race or overflow from a set of salmon-keeping tanks built into the bank of the River Alwen at Pont Barcar Weir. The race runs alongside the river and is separated from it only by a revetment wall, around the lower end of which the race runs into the river with a fall of a few inches.

No other parr than these forty-eight mature males, all of which were running ripe, were found in the race. But it may be mentioned that, when the earlier batches of salmon were 'running', salmon parr were occasionally found temporarily stranded in their efforts to negotiate one side of the weir at Pont Barcar. It would appear, therefore, that either the mature males are much more active than other parr, or that mature parr had approached the weir on an upstream migration and had entered the race in numbers as a promising easy upstream path.

An alternative or additional attraction of the race may lie in the fact that large mature females and males were being stored in the tanks from which the race water was derived. If mature male parr are attracted to the mature females chemotactically, they would tend to accumulate in the race while females were in the tanks.

A solution to the problems may be found experimentally in the future, but it is clear that the movements of mature male parr at spawning time can be different from those of other parr, and that upstream

or downstream migration and positive chemotaxy may possibly occur. Differential movement in mature male parr helps to account for their congregation on redds with spawning females. Many unpublished observations on the latter phenomena have been communicated to us since the publication of the paper noted above. Definite proof of the actual spawning of male parr with adult females is still nevertheless awaited, however probable it may seem. The probability is perhaps rendered greater by the fact, noted by Pearson² (after Worth), that in another anadromous fish, the striped bass, *Morone saxatilis* (Walb.), 20-50 young males each of not more than 2 lb. in weight may spawn with one large 5-20 lb. female in the rapid rivers which this species frequents for spawning.

G. M. KING. } Dee Fishery Board.
J. W. JONES. } Department of Zoology,
J. H. ORTON. } University, Liverpool.
Dec. 18.

¹ Orton, J. H., Jones, J. W., and King, G. M., *Proc. Roy. Soc., B*, 128, 108-114 (1935).

² Pearson, J. C., *Bull. Bur. Fish.*, 40, 825-851; *Bulletin* 28 (Washington, 1928).

Thermostatic Action of Textile Fibres

THE part played by heat evolved during absorption of water vapour by a porous body on rate of diffusion of water vapour into the body has been examined mathematically by P. S. H. Henry¹. In the laboratories of the Wool Industries Research Association similar problems have been studied, and experimental results obtained indicate that in addition to control of rate of conditioning (establishment of moisture equilibrium), absorption of water vapour by fibres and the attendant evolution of heat have an important significance in determining rate of propagation of temperature changes through fabrics. This effect is such that it cannot fail to have a bearing on the relative hygienic properties of textile fibres.

Our experiments have eliminated diffusion through air by evacuation, and under these conditions the time-regain (percentage moisture content relative to dry weight) curves obtained can be accounted for by change of temperature of the fibres alone; that is, the time required for equilibrium-regain to be attained when relative humidity is changed is small compared with the time required for appreciable heating or cooling of the fibres.

The time required in air at atmospheric pressure for change of regain is also small enough to be taken as zero compared with that required for any thermal change when allowance is made for diffusion effects. In normal atmospheres, water vapour pressure is roughly constant; for example, it is roughly the same indoors and outdoors on any given day. Consider a fabric taken from a hot to a cold region in this atmosphere. When the fabric temperature decreases, the relative humidity relative to the fabric increases, since the water vapour pressure is constant, and it begins to absorb water vapour. Heat of absorption is evolved and this tends to bring the fabric back to its original temperature. Resistance to temperature change from this source is very much more than can be obtained from ordinary diffusivity, because the specific heat factor is virtually replaced by a latent heat one, and the effective diffusivity becomes small.

This of course is only true if the fibres absorb water rapidly, which most textiles used for clothing are able to do in virtue of the small diameter of their

fibres. Differences between their thermostatic action will be determined by the quantity of water absorbed for a given change in relative humidity.

The relative importance of specific heat and regain may be readily appreciated from the example of a kilogram of wool fabric taken from an indoor temperature of 18° C. and 45 per cent relative humidity to an outdoor one of 5° C. and 95 per cent relative humidity. It must lose 4,000 calories because of the specific heat of the fibres, but it must lose 100,000 calories because of change in regain. A human body per cent before its temperature reaches the exceptional value. The latter is as much heat as a man can normally lose in one hour, and shows that the additional thermostatic action that textile fibres have in ordinary atmospheric conditions provides they absorb water vapour sufficiently rapidly.

The importance of water vapour to the thermostatic action of textiles has been demonstrated in these laboratories by comparison of the time required for propagation of temperature changes through fabrics in normal atmospheres and in dry air. Details of this work and its theoretical and practical implications will be published elsewhere.

Wool Industries Research
Association,
Torridon, Headingley,
Leeds 6.

A. B. D. CASSE.
B. E. ATKINS.
G. KING.

¹ *Proc. Roy. Soc. Abstracts*, November 1938

Structure of Metals under Deformation

IN recent work on the deformation and fracture of metals under static and fatigue tests, it was shown that originally perfect grains were systematically dispersed into crystallites. The interesting feature of the process was the appearance of a lower limiting size, about 10⁻⁴ cm., below which the crystallites could not be broken down further by the modes of deformation employed¹.

Other work has now been carried out on metals of high purity under greater degrees of deformation than those occurring in the usual mechanical tests, and this work, whilst in general confirming the above principle, has brought out the following new points. In the first place, the lattice size, defining the interatomic distance within the crystallites, is not necessarily the same as that of the original perfect grains. In pure copper, the lattice expands. The effect may be measured easily by the X-ray diffraction spectrum of the metal, and is illustrated by the accompanying photographs obtained by a back-reflection method specially adapted for precision work. Fig. 1 is from the initial annealed material; this photograph corresponds to one given when the incident X-ray beam covers sufficient large grains to give continuous spectral lines, and is reproduced merely to show what the relative sharpness and positions should be of the characteristic (400) α_1 , α_2 doublet and (331) β lines under the experimental conditions employed. Fig. 2 is from the same specimen after 81 per cent reduction in thickness by cold rolling; this shows clearly that apart from the great diffusion of the lines (due to the onset of the crystallite formation), there is a bodily shift of the (400) line to the right; the effect may be seen conveniently by eye on noting the difference in separation of the (400) line from the (331) line, the latter being much less affected as it occurs at a smaller diffraction angle. The direction of the shift corresponds to an increase in lattice size.

A further point is illustrated by Fig. 3, obtained after continuing the reduction of the specimen to 90 per cent. It will be seen that the extra working has caused a reversion of the lines towards their original positions, and, at the same time, has produced some decrease in the breadth of the lines. This dual change corresponds to partial recovery in internal deformation and overall size recovery in internal deformation. Actually, these effects are to be noted at a much earlier stage, after some 20 per cent reduction; then, further working of the specimen to 90 per cent reduction; then, leads to the abnormal partially recovered state again recovers, the internal deformation, and this in turn structure varying between the two



RELATIVE SHIFT AND DIFFUSION OF (400) AND (331) X-RAY LINES OF COPPER ON DEFORMATION.

limits according to the balance at the moment of examination. This result indicates directly that the greater breakdown represented by Fig. 2 is in unstable equilibrium, whereas the partially recovered state is comparatively stable, and thus gives a meaning to the lower limiting size referred to in the earlier work.

These changes in structure may have a bearing on the mechanism, still to be elucidated, of the formation of the first cracks which precede and precipitate failure of a metal under strain, for it is reasonable to expect that the change in volume of the crystallites as they are formed along the slip bands will produce an internal stress tending to separate the neighbouring less deformed regions.

W. A. WOOD.

Physics Department,
National Physical Laboratory,
Teddington,
Middlesex.

¹ Gough, H. J., and Wood, W. A., *Proc. Roy. Soc. A*, **164**, 510 (1938).
Wood, W. A., *Trans. Far. Soc.*, **31**, 1248 (1935).

Differential Threshold for Viscosity

IN the course of some experiments on the capacity of the human senses to distinguish certain physical properties of colloidal materials, we have had occasion to determine the differential threshold for viscosity, using truly fluid bitumens* having viscosities of the order of 10^6 poises at 18°C .

Thirteen subjects were chosen having widely different experience and training. The samples of bitumen were presented in pairs to each of them with a request for a report as to which sample, if either, was the softer. The samples were squeezed by the subject under water kept at constant temperature. The thirteen subjects between them judged twenty-five pairs of bitumen samples thirty times in all. The samples differed from each other by 0, 7.5, 15, 22.5 and 30 per cent in viscosity. The viscosities were determined by the method of rheograms, slightly modified¹.

There was no significant difference in ability to distinguish viscosities between subjects differing in technological experience, scientific training and general education, although it is possible that age and sex may have had a very slight effect.

The results from the different subjects are combined in the accompanying table:

	Pairs differing in viscosity by:				
	0%	7.5%	15%	22.5%	30%
% correct	22	50	63	71	80
% given as equal.	22	28	20	15	12
% given in reverse order	—	27	17	14	8

This table shows that the percentage of correct judgments becomes significantly above 50 per cent for a viscosity change of about 10 per cent, and reaches an 80 per cent level at a difference of about 30 per cent.

Experiments on the threshold for shear modulus in elastic materials are in progress. Details will be published elsewhere.

G. W. SCOTT BLAIR.
F. M. V. COPPEN.

National Institute for Research in Dairying,
(University of Reading),
Shinfield, Nr. Reading.
Dec. 15.

* We are indebted to the Lamm and Trinidad Lake Asphalt Co. Ltd., for their kindness in supplying these samples.

¹ Schofield, R. K., and Scott Blair, G. W., *Proc. Roy. Soc. A*, **124**, 657 (1933).

Excitation of Nebular Lines

THE note which was added in proof by Menzel to his letter in NATURE regarding the effect of collisions on the intensities of nebular lines¹ prompts me to make the following remarks. In presenting the results to which he refers to the San Diego meeting of the Astronomical Society of the Pacific last June, I pointed out that a probable reason for the increase in intensity with pressure of the forbidden transitions in nitrogen is that the rate of production of the metastable states increases more rapidly with pressure than does the rate of de-excitation. It is quite probable that the process of excitation of the metastable nitrogen molecules and atoms in the afterglow is a much more complex process than the production of excited states in nebulae.

Regardless of this difference, however, it seems that Menzel's use of my experiments as observational proof of the points raised in his letter is a proper one. In fact, experiments at higher pressures and in smaller tubes have resulted in even higher relative intensities for the metastable transitions than those reported last spring. It is gratifying to see that my prediction of the possible astrophysical interest of these results has already been justified.

JOSEPH KAPLAN.

Departments of Physics and Astronomy,
University of California at Los Angeles.

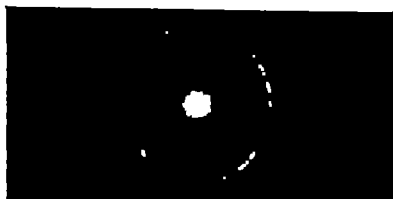
¹ Menzel, D. H., *NATURE*, 142, 644 (1938).

Conversion of Vitreous and Monoclinic (α) Selenium to the Hexagonal Modification

SELENIUM is known to exist in several stable allotropic modifications, of which the structures of the hexagonal and the monoclinic varieties (α and β) have been determined by Bradely¹ and Klug² respectively.

Prins and Dekeyser³ have investigated the gradual conversion of vitreous or amorphous selenium into the hexagonal variety at high temperatures and have also studied the influence of tension on this conversion. From their experiments they concluded that:

(a) The transformation of vitreous selenium into the hexagonal variety may take place at as low a temperature as 60° C., if a thread of vitreous selenium is kept under tension at that temperature.



(b) In the absence of tension, the crystallization does not take place below 73° C. The tension, therefore, helps the devitrification of vitreous selenium; and the fact that the degree of crystallization is most marked in the surface layers of a heated selenium stick and gradually becomes less in the deeper layers has also been suggested by them as due to the presence of mechanical stress, already present in the surface layers owing to the 'quenching' method of its preparation.

In the course of our investigations on selenium, we have obtained results which in many respects deviate from those of the previous authors. We find that, if thoroughly powdered specimens of vitreous selenium be maintained at a temperature even as low as 43° C., devitrification of the specimen sets in and gradually progresses with the period of heating, and after a considerable period, say about two weeks, a complete transformation into the hexagonal variety is clearly indicated by the appearance of only sharp diffraction rings on a clear background in its X-ray powder diagram. The powder-pattern obtained in this final stage is reproduced in the accompanying figure (taken with a hemicylindrical camera).

In the experiment mentioned above, we used powdered sticks of vitreous selenium; the diffracting specimen evidently consisted mostly of particles lying in the deeper layers or in the body of the sticks,

where the material is supposed to be free from any mechanical stress. Thus the experiment shows that even in the absence of tension, crystallization of vitreous selenium is possible at 43° C., if not at still lower temperatures. Insufficient period of heating the specimen is undoubtedly the cause of failure of the previous authors³ to detect the crystallization, which is extremely slow at lower temperatures.

In the case of monoclinic (α) selenium, we also find that the transformation into the hexagonal variety is quite rapid at 100° C. and may be detected after 24 hours of heating, whereas the same process is so slowed down at 80° C. that it cannot be detected before several days have passed.

Experiments are in progress to determine the lowest temperature at which these transformations take place. We are of opinion that in every case of monotropic structural transformation there is a critical temperature, below which the transformation in question cannot take place. At this temperature the molecules of the substance acquire the mobility which is required for their correct marshalling in the new structure.

A rise of temperature in all these cases increases the time-rate of conversion and thus minimizes the time required for the complete conversion of the whole specimen. Another example of this type of monotropic change which has been thoroughly studied by one of us⁴ is the conversion of Se or white sulphur into S₂ or orthorhombic sulphur. Here both Se and S₂ are the two different crystalline phases of sulphur.

Results of the investigation on selenium will be published in more detail in the *Indian Journal of Physics*.

S. R. DAS.

K. DAS GUPTA.

Khaira Laboratory of Physics,
92 Upper Circular Road,
Calcutta.

¹ Bradely, *Phil. Mag.*, 48 (1924).

² Klug, *Z. Krist.*, 88 (1934).

³ Prins and Dekeyser, *Physics*, 4 (1937).

⁴ Das, *Ind. J. Phys.*, 12 (1938).

Spectrum of Potassium Deuteride

A PRACTICALLY uncontaminated KD spectrum was obtained in an arc between potassium (negative) and nickel (positive) electrodes burning in a deuterium atmosphere of 50–30 cm. mercury pressure, and was photographed in the first order of a 15-ft. grating spectrograph having a dispersion of 3.7 Å. per mm.

In the strongest part of the many-lined spectrum between 4300 Å. and 5100 Å., the $v' = 0$ progression bands $7 \rightarrow 0$, $8 \rightarrow 0$. . . $20 \rightarrow 0$ of the KD $^1\Sigma \rightarrow ^1\Sigma$ system were found and analysed. At this dispersion, overlapped lines are still numerous and reach up to half the number of lines (60–80) in each band.

The rotational functions of both upper and lower states are anomalous in having a maximum in $\Delta_2 T_r/4J + 2$ at about $J = 20$, and $T_r(v, J)$ must be expressed by terms with positive D_2 , negative F_2 , etc. However, this point should be examined with a larger dispersion, and preliminary values of rotational constants were calculated according to the usual three-term formula adjusted to the $J > 20$ regions. B'_2 can be given by $B'_2 = 0.673 + 0.00391(v' + 1/2) - 0.000281(v' + 1/2)^2$ within ± 0.005 , $D'_2 = -1.4 \times 10^{-4}$, and $B''_2 = 1.641$, $D''_2 = -1.8 \times 10^{-4}$.

As the result of vibrational analysis, null-lines of the observed fourteen bands, evaluated from small

	KD upper state	KH upper state	ρ^a
ν_4'	180.26	254.5 (Almy and House) ¹ 240.18 (Hori)	0.5017 0.5053
ν_4''	0.573,	1.844 (Almy and House) 1.311 (Hori)	0.5013 0.5139
		Theoretical	0.5129

J lines to minimize the possible errors in computing rotational energies, can be expressed by

$$\nu_0'' = 19,229 + 180.26(\nu' + 1/2) + 2.204_4(\nu' + 1/2)^2 - 0.05281(\nu' + 1/2)^3,$$

within $\pm 2 \text{ cm}^{-1}$. Here again the vibrational function $G''(\nu)$ is characterized by positive x_2 . From the above given constants the isotope coefficient ρ comes out as indicated in the table.

Further analysis of the system is under way and will be published in the *Scientific Papers* of this Institute.

SUNAO IMANISHI.

Institute of Physical and
Chemical Research,
Komagome, Hongo,
Tokyo.
Nov. 29.

¹ Almy, G. M., and House, C. D., *Phys. Rev.*, **48**, 243 (1932).

² Hori, T., *Kem. Repts. Col. Eng.*, **3**, 1 (1933).

Points from Foregoing Letters

THE movable 'thumb' of the giant panda, which it uses for the purpose of grasping bamboo shoots, is not a true first digit, writes Prof. F. Wood Jones. The actual thumb of the panda, as of all animals which use all four limbs for supporting the body on the ground, has lost its movability and the animal has developed a new movable digit, rather than reverse its structural evolution (Dollo's law).

A modified method for determining the electronic charge on an oil droplet is described by Prof. T. H. Laby and V. D. Hopper. A horizontal electric field is employed and the movement of the droplet is recorded photographically, so that a displacement of $3 \times 10^{-5} \text{ cm.}$ can be measured. Experiments of a preliminary nature indicate for the electronic charge a value slightly lower than that found by Millikan.

Sir James Jeans criticizes the assumptions of Gamow and Teller in their discussion of the genesis of the great nebula. He concludes that the universe as it now stands could be formed by the condensation of a gas with a 'thermal' velocity of about 20 km./sec., that is, from a mixture of atoms and electrons at any temperature between -260° and $19,000^\circ \text{ C.}$

The volume of extra-cellular fluid in various organs has been calculated by Dr. J. H. E. Griffiths and Dr. B. M. Macgraith from determinations of the radioactivity of blood and tissues of a rabbit after injection of radioactive sodium chloride—assuming that the sodium is mainly distributed outside the cells. They find, however, that a certain amount of radioactive sodium is absorbed by the cardiac muscles.

Dr. O. Mühlbock finds that diethylstilboestrol, unlike the oestrogenic hormones, does not suppress the comb-growth action of the male hormone, progesterone.

Commenting on Dr. Duszyńska's observation that the response to oestrone in albino mice is three times as great in May as in November, E. V. Shute states that there appears to be a seasonal rhythm in the proportion of oestrogens found in normal males; also the blood oestrogens in pregnant women are greater in late winter and spring than in summer; this can be inversely correlated with the intake of vitamin E.

Dr. E. H. Vogelensang finds that the addition of zinc decreases the iodine consumption of insulin. The magnitude of the zinc effect is a function of the physiological action of the insulin preparation, and the author believes that it may eventually serve as a basis for the chemical estimation of insulin activity.

Prof. B. N. Singh and J. D. Jha find that in the young leaves of the mango the assimilation rate of carbon dioxide increases continuously but not in proportion to the chlorophyll content. The behaviour is similar to that observed by Briggs in the case of seedlings where the storage organ is different from the first assimilating organ and the photosynthetic activity lags behind chlorophyll formation.

Observations on the movement of mature male parr in the Welsh Dee are reported by G. M. King, J. W. Jones and Prof. J. H. Orton, suggesting that at spawning time such movements can be different from those of other parr, and that upstream and downstream migration and positive chemotaxy may occur.

Rate of absorption of water vapour by wool fibres is rapid when the external restrictions of diffusion and thermal change due to heat of absorption are removed. It is suggested by Dr. A. B. D. Cassie, Dr. B. E. Atkins and G. King that this fact is of importance for the hygienic properties of textile fibres and the propagation of temperature changes through fabrics in ordinary indoor-outdoor atmospheres.

Photographs of the X-ray diffraction spectrum of annealed and of subsequently cold-rolled copper at different stages are submitted by W. A. Wood, showing a relative shift and diffusion of the (400) and (331) lines. These indicate a breakdown into small crystallites, followed by a partial recovery in internal deformation and overall size of crystallites.

By comparing the judgments of thirteen subjects concerning the relative softness of samples of bitumen with the actual viscosity of the samples, Dr. G. W. Scott Blair and Miss F. M. V. Coppen find an 80 per cent correct judgment for viscosity differences of 30 per cent.

Research Items

Ancient Eskimo Houses of East Greenland

OWING to the inaccessibility and dangers of the East Greenland coast it has been infrequently visited by Europeans. The Anglo-Danish East Greenland Expedition of 1935, conducted by Mr. Augustine Courtauld, afforded an opportunity for supplementing previous inadequate archaeological information. An account of the excavations of house sites and graves and of the objects found at Skærgaardshalve, Ivnamut, I. C. Jacobsens Fjord and Cape Irninger in Knud Rasmussen Land has been prepared by Dr. Helge Larsen (*Medd. om Grønland*, København, 119, 8; 1938). At Skærgaardshalve, a well-known archaeological site, seven ruins were examined. These differed much from one another in shape and in state of preservation. In their interiors they were rectangular in plan, with somewhat rounded corners, and a house passage. They were built entirely of stones, more than one metre thick, which on the inside formed even perpendicular walls up to at times as much as nine courses of flat stones. On the outside the stones lie about loosely, giving the impression of a random heap of stone. The internal dimensions of the house first examined were 2.0 m. long by 2.10 m. broad. Of a different type, in which the greatest length of the structure is at right angles to the passage, was the 'common-house' form, in which two rooms adjoined with a dividing wall. The length of the first example found of this type was 7.5 m. At I. C. Jacobsens Fjord one house proved to consist of three houses, built one within the other. A common-house was evidently the oldest, as well as the largest, containing the others. It is concluded that the size of the habitation was reduced from time to time to meet the needs and convenience, for example, in heating, of a decreasing population. Analysis of the types of houses excavated and of the contained objects leads to the conclusion that they belong to the Inugsuk culture of West Greenland with elements from a later cultural stage in Angmagssalik. Its entry into East Greenland dates probably from the fifteenth or sixteenth century and it probably became extinct in the nineteenth century.

Avitaminoses and Endocrine Glands

B. SURR (*Endocrinology*, 23, 575; 1938) has investigated the influence of various avitaminoses on the weights of endocrine glands in animals (pigeons and rats). He found that in vitamin A deficiency there was a hypertrophy of the pancreas amounting to 40 per cent. In vitamin B deficiency there was a marked hypertrophy of the thyroids and adrenals. The most noteworthy change in endocrine weights was the marked atrophy of the thymus in vitamin B deficiency which occurred in 100 per cent of the animals. Hypertrophy of the pituitary was found in vitamin B₁ and vitamin B₂ deficiency to the extent of 40 and 25 per cent respectively. Repeated vitamin B₂ depletions of endocrine weights had the following effect: the hypertrophy of the pituitary entirely disappeared; in the thyroid it was reduced to insignificant proportions (9.1 per cent) and in the adrenals from 50 to 20 per cent.

Hypersensitiveness in Experimental Tuberculosis

R. H. FOLLIS, JUN. (*Bull. Johns Hopkins Hosp.*, 23, 283; 1938) has studied the effect of preventing the development of hypersensitiveness in experimental tuberculosis in guinea pigs as follows. He found that the lesions in guinea pigs infected with tubercle bacilli and prevented from becoming hypersensitive by subcutaneous injection of old tuberculum showed less caseation than those of control animals which developed hypersensitiveness. In some of the non-hypersensitive animals, pulmonary lesions developed which were marked by an extraordinary proliferation of acid-fast bacilli. Since these lesions did not develop in most of the non-hypersensitive animals and the same lesions were found in some animals of the control groups shown to be hypersensitive, Follis concludes that lack of hypersensitivity does not play a part in producing lesions of this type.

Improvement of Forage Plants

THE possibility of improvement of crop plants by hybridization has received a new impulse from the intensive work carried out within recent years in the U.S.S.R., where, among others, various *Triticum-Agropyron* crosses have been carried far enough to indicate possibilities of obtaining constant, perennial forms with advantageous qualities not possessed by annual wheats. L. P. V. Johnson now publishes the results of further crossing experiments between these genera which have been carried out with the view of obtaining improved forage plants, suited to the drier areas of western Canada (*Can. J. Res.*, 16; 1938). An extensive selection of *Triticum* types has been used as the ovule parents, with *Agropyron elongatum* or *glaucom* as pollen parents; the F_1 hybrids show a predominance of *Agropyron* characters. So far, all crosses with *A. glaucom* have proved sterile, but some fertile types occur amongst the *A. elongatum* hybrids. Russian investigators have already isolated types which are constant, fertile, drought and cold resistant, and productive—all qualities of value in forage plants; also types with high protein content of the grain, which suggests that possibly a plant might be obtained with good forage qualities combined with grain suitable for feeding purposes. In the present experiments some hybrids combine the extensive root system of *Agropyron* with the finer root texture of *Triticum*, a promising feature for growth in an arid zone, and the structure of leaves in some hybrids also suggests lines along which useful results may be obtained. The experiments need to be carried further before definite results can be stated, but the progress report augurs well for the final results.

Direct Oxidation of Soil Humus

MR. O. B. GREENING has published a preliminary account of the use of potassium permanganate for the oxidation of soil humus (*J. Roy. Hort. Soc.*, September 1936). He has now followed it by a more extensive paper (*J. Roy. Hort. Soc.*, 63, Pt. 12, December 1938). Garden refuse can be oxidized to organic manure by treatment of a heap with permanganate solution (1 oz. per gall. of water). More dilute solutions were applied to lawns, where they stimulated the growth

of grass, eradicated moss, destroyed 'mat' and controlled earthworms. Tomatoes and zonal pelargoniums grew better than normal when treated with still weaker solutions. The action of oxidizing agents might vary with soil type, or with acidity, and such possibilities have still to be appraised. Effects of the treatment have as yet, moreover, been estimated by the unaided eye; but a promising field of practical application is undoubtedly commended for further detailed investigation.

Properties of Broad-Bean Mosaic Virus

A MOSAIC disease upon broad beans was recorded from Japan in 1928, and has since appeared frequently. Characters of the causal virus have been studied by Daiki Murayama (*J. Fac. Agric. Hokkaido Imp. Univ.*, 44, Pt. 1, pp. 32 and 1 pl., Oct. 1938) who considers it to be similar to the pea virus 2 of Osborn, or pea virus 3, Pierce. The virus extract appears to be of medium virulence, and will not pass even coarse ultra-filters. It is inactivated by heating for 10 min. at 63° C., by ageing for 25 days and by 50 per cent alcohol or 1 per cent formaldehyde acting for 30 min. Extracts were also inactivated when acidified to pH 3.0, or when their alkalinity was increased to pH 9.5. A precipitation which deprived the extract of its power to infect, occurred under the latter conditions. Symptoms of the disease are given, and a useful table of comparison of the physico-chemical properties of numerous mosaic diseases of leguminous plants also appears in the paper.

New Dermatophyte Fungi

Mosses. K. B. Boedyn and J. A. Verbunt have undertaken the examination of dermatophyte fungi on cases in the Medical School at Batavia since 1935. Their investigations (*Mycopathologia*, 1, Fasc. 3, Sept. 1938) have led to the recognition of three new species of fungi which attack human skin. *Proteomyces variabilis* causes red spots in the trigonum scarpæ of the male. *Favotrichophyton decipiens* attacks hair, causing a white sheath composed of spores of the fungus. *Piedraia javanica* is an interesting ascomycete which forms hard, black nodules upon affected hairs. *Piedraia* is a genus formed by the removal of the conidial form *Trichosporum* from the Fungi Imperfecti, upon the discovery of the ascigerous stage.

The Earth's Crust near New Zealand

K. E. BULLEN has recently made considerable progress in the study of the crustal layers near New Zealand by considering afresh in the light of all the available evidence the Wairoa earthquake of September 15, 1932 (Dominion Observatory, Wellington, W.1, New Zealand, *Bull.*, No. 136; 1938). Taking the S_1 reading at Arapuni to be really S^* , an analysis of the P and S readings from all stations indicates an epicentre for the shock at 38.9° S., 177.55° E. and an origin time 13 h. 55 m. 0 s. G.M.T. These are confirmed by P' readings in the opposite hemisphere and macroseismic evidence, and the epicentre is accurate to within 0.2°. The new evidence, along with other considerations, leads the author to a structure from the earth's surface downwards as: sedimentary layer several kilometres thick with P and S velocities 5.0 and 3.0 km./sec. respectively; granitic layer very thin; intermediate layer probably double with a P_y velocity in the upper part of 6.0 km./sec., and the lower part 15 ± 5 km. thick with normal P^* and S^* velocities. This P_y velocity

is similar to that observed in California. These results are stated to be tentative, and the results of further work on near earthquakes in New Zealand are awaited with interest.

Design of Small Induction Motors

IN a paper read by Mr. N. F. T. Saunders on January 19 to the Institution of Electrical Engineers, the design of small motors was discussed, and it was pointed out that methods of designing large induction motors are not applicable to machines of less than about one horse-power, called fractional horse-power motors. The author, using analytical methods, establishes simple formulae for the performance data required in connexion with single-phase induction motors. He then uses correction factors which make the results accurate. He also discusses polyphase induction motors and shows that similar correction factors can be used in their case. These correction factors are based on the conditions usually existing in small motors, which differ appreciably from those found in large motors. For small motors the main factors to be considered are a powerful starting torque and high overload capacity. The modern tendency is to demand silent running, and so the steps necessary to eliminate noise of electrical origin are important factors in the design. As the majority of small machines have to operate at 1,500 r.p.m., that is, they have four poles and run at 50 cycles per second, it is customary to develop standard designs having ratings of an eighth, a sixth, a quarter, a half and three-quarters horse-power with the maximum economy in material. For other speeds the same frames with modified stampings can be used. Several different starting methods for single-phase motors are in use. The most popular at the present time is the capacitor (condenser)-start, the success of which is due to the advance in the technique of electrolytic condensers. An important conclusion arrived at is that the difference between the e.m.f.s at full and no loads will generally produce a marked difference in the iron loss. Hence if the full load efficiency is computed by the 'summation of losses' method the result obtained for the efficiency is too low. For this reason it is recommended that fractional horse-power motors should be tested by a brake method.

Inclination of the Spiral Nebulae to the Line of Sight

F. G. BROWN showed a year ago that the inclinations to the line of sight of the planes of the extragalactic nebulae which were more than 2' in diameter were small, and that the preponderance of small inclinations was due to a systematic orientation of the planes in space. Knox-Shaw examined the objects in the Shapley-Ames catalogue and came to the conclusion that the excess of small inclinations is non-existent. Brown (*Mon. Not. Roy. Astro. Soc.*, 99, 1; Nov. 1938) now shows that Knox-Shaw excluded an undue proportion of spindles more than 2' in diameter, owing to the integrated magnitudes of many of them being less than 13.0. For spiral nebulae not less than 4' in diameter, the Shapley-Ames catalogue confirms the apparent excess of small inclinations which Brown found by examining the Reinmuth catalogue. In addition, the Reinmuth catalogue shows the persistence of the excess down to 2' in diameter, and its existence is confirmed by the small nebulae down to at least 30" found in Fath's list. It seems certain that Brown has proved his point, and that there is a decided preponderance of small inclinations of the nebulae under discussion.

Geographical Aspects of Current Problems

ON January 3, Sir Thomas Holland delivered his presidential address to the Geographical Association, on the occasion of its annual conference at the London School of Economics. Taking as his title "The Geography of Minerals", Sir Thomas gave a penetrating analysis of economic and political effects of the unequal distribution of mineral wealth.

Until the Industrial Revolution, little interest had been taken in mineral wealth other than the precious metals, and world development was on an agricultural basis. Political boundaries took no notice of mineral fields. The Industrial Revolution placed a new emphasis on coal and iron, and later the development of steel-making and the more recent discoveries of the uses of alloy steels, together with the expansion of the electrical trades with their great demand for non-ferrous metals such as copper and lead, re-oriented the political outlook on minerals. More minerals were actually produced between 1900 and 1925 than during the whole previous history of the world, and although production is still lower in value than that of the field and forest products, it is increasing rapidly, and its effect on political geography is becoming more and more evident.

• The possession of, or free access to, a wide variety of minerals is now an essential to the well-being of a great nation, and the unequal distribution of resources, together with the post-War tendency to frustrate the normal or natural movement of raw materials, is at the bottom of much of the present unrest in the world. Both Germany and the Italian Empire are lacking in many of the essential minerals.

It is a striking fact of mineral geography that some seven tenths of the world's iron and steel industry is situated in the countries that border the North Atlantic Ocean. In no other area of the world do coal and iron come together in sufficient quantities ever to give rise to other great steel-producing regions like those of the eastern United States and western Europe. It is this industry which has so largely affected the accessory mineral industries (manganese, chromium, nickel, cobalt, tungsten, etc.). Between them, the United States and the British Empire own about two thirds, and control about three quarters, of the world's mineral industries.

The need for such a wide variety of minerals has meant that the former self-sufficiency of nations in respect of mineral requirements has gone for ever. More than ever before the nations are now inter-dependent. Here again it is noteworthy, however, that a wide variety of resources occurs in the areas which lie around the North and South Atlantic Oceans. Thus with the British Empire and the United States on friendly terms, and the Atlantic shipping routes under their control, neither Britain nor the United States need have any fears about the supply of any mineral at present considered as vital to industry, whether peaceful or warlike. This rather one-sided position only seems to emphasize the necessity for the interchange of mineral products between the nations, if civilization is not to be destroyed in the revolt of the 'have-nots' against the 'haves'.

In a symposium on India, at the same Conference, Sir Thomas Holland contributed a short survey of

India's mineral resources, dealing especially with coal and iron, manganese and chromite. Another contribution was from Lord Meston, who described in vivid terms the superimposition of British autocracy, which has converted a congeries of almost medieval peoples into a modern democratic State of 350 million souls, and the difficulties which rapid progress has brought. Dr. L. Dudley Stamp, in suggesting a division of India into physiographic regions, emphasized that the study of modern geography is still in its infancy in India, and that although the universities are now taking a lead, a vast field of work awaits the geomorphologist in utilizing and correlating the mass of material available in the publications of the Geological Survey and elsewhere. In the meantime, it is important that the main physical features of each of the major regions of India should be understood and regarded as an essential background to human and economic geography. Prof. H. J. Fleure finally gave a brief introduction to the study of the nature and origin of some of the Indian peoples.

Another topical item in the Conference was a lecture by Dr. Hilda Ormsby on the 'Sudeten' lands. Dr. Ormsby also spoke on the problem of Czechoslovakia to the annual meeting of the Institute of British Geographers, which was in session during the same week. Dr. Ormsby presented a clear picture of the geographical background of the recent crisis. Before the Great War, Bohemia was an outpost of Slavdom, forming the industrial core of the Austrian Empire, and fringed with a population of Germans who had filtered across the mountains from the west during many centuries. The Treaty of Versailles allied the Czechs to the Slovaks and Ruthenians, and cut off the 'Sudeten' Germans of the northern and western fringes of the new State from their Austrian motherland. This Bohemian 'salient' of Slavdom became a violent aggravation to the new Reich after the *Anschluss*, thrusting a spear-head into the heart of Greater Germany. The curious nature of many parts of the 'Sudeten' frontier, which, instead of following sparsely populated, forested country, frequently cut across populous areas, was a natural incitement to the reunion of the German-speaking peoples on either side.

The 'post-Munich' frontier, however, cannot undermine the essential geographical unity of Bohemia. The similarity of the industrial occupations on both sides of the highland frontier of Bohemia (the Ore Mountains, Giant Mountains and Sudetes) means that the 'Sudeten' lands are economically tributary to the interior of Bohemia rather than to Saxony, and the fact that the Czechs, for some years, had been removing industry from the 'Sudeten' regions into the heart of Bohemia, has rendered these areas poorer and more liable to unemployment. The new Czechoslovakia, although far more homogeneously Slav than ever before, can scarcely be regarded as anything but a puppet State, held together by the power of Germany. The new German motor-road along the Moravian corridor will sever completely the western and eastern parts of the country, and the main lines of rail communication between east and west have already been cut by the new frontiers in several places.

S. H. BRAVER.

Research in Fuel Technology*

THE growth in size of the annual report of the Fuel Research Board is an indication of the expanding work of this section of the Department of Scientific and Industrial Research, which was established in 1917.

This year special attention is directed to the progress made in the physical and chemical survey of the national coal resources, which was the first task undertaken by the Board. Looking back twenty years, it may surprise some to recall how meagre was the reliable information publicly available about the properties of British coal, considering the magnitude of the industry. Collieries usually had no use for a chemist, and such analytical figures as they possessed were commonly made on a few selected and unrepresentative samples. The larger industrial users often accumulated considerable information about their own fuels, but for their own use only. Conditions might be likened to an unmapped forest traversed by routes known only to local guides. The organization of the survey, which has no counterpart in any other coal-producing country, was not completed until 1932, when all the coalfields were brought under examination. Now complete surveys have been made on sixty-five seams, representing 30,000 million tons of coal, giving detailed and reliable data on one fourth of the proved British coal reserves.

The value of this information grows as the scheme progresses, particularly as regards processes of coal treatment prior to combustion. The more refinement is given to the utilization of coal, the more important it is to know exactly the idiosyncrasies of the raw material. Coals vary in a bewildering degree in properties which vitally affect their uses. Many processes of low-temperature carbonization have broken down on account of swelling or caking power. Again, the quantity and kind of ash or sulphur influences many applications. The behaviour of coal ash is still inadequately treated. There is no standard method of assessing and recording the density of coal ash although this affects the value of coal for many uses—especially as domestic fuels.

* Report of the Fuel Research Board for the Year Ending March 31, 1936. Pp. x+255. (London: H.M. Stationery Office.) 4s. net.

Further work is reported on the problem of dust-proofing coal, which has acquired prominence first in the United States. Coal is dusty to handle, and this dust production is both a domestic and an industrial nuisance. Marked effects in suppressing dust result from spraying oil upon the coal in quantities of the order of 1 gallon per ton. Investigation shows that some 'younger' coals need much more oil than those of older formation. Oil does not produce marked effects on the behaviour on combustion.

It has long been recognized that coal dust can serve as a fuel for internal combustion engines instead of fluid fuels. One of the main obstacles is the problem of getting the solid fuel into, and the ash residue out of, the engine cylinder after combustion, owing to the abrasive action of the latter on the engine parts. In spite of the difficulty, a solution of the problem would have immense value to a coal-rich country like Great Britain, and the task should not be lightly abandoned. Experiments are reported on the wear on cylinder parts produced in a petrol engine when coal ash is fed into the carburettor. The results suggest that by choice of materials it may be possible to reduce the wear to reasonable proportions. A Diesel engine has been installed at the Station and converted for use with coal dust fuel.

Work on the hydrogenation of coal and coal oils is being continued. It is often too easily assumed that tars and oils obtained by carbonizing coal at low and high temperatures are immediately valuable as substitutes for imported mineral oil. This is far from the truth, especially as regards the production of lubricants where molecular structure plays an important part in determining behaviour. By synthesis of hydrocarbons from water gas and polymerization, it is believed that products with satisfactory lubricating properties will be obtained.

These are only a few of the many subjects touched in this report, the 255 pages of which range over the whole field of fuel technology.

H. J. HODSMAN.

Earthing of Electrical Installations to Water-Mains

IT is well known that direct current causes electrolytic corrosion when it leaves a metal conductor or pipe to enter the earth, but there is still a difference of opinion as to whether alternating current has a similar deleterious effect. The very rapid expansion of the use of electricity in Great Britain, for motive power, for domestic applications, for use with radio sets and for agricultural applications has made it advisable that the whole question of earthing be discussed. It is known that electrolytic corrosion proceeds as a rule very slowly, and until large leakage currents have been flowing for many years, in several cases no apparent damage can be detected. A further point that needs discussion is the cause of

the electric shocks which are sometimes experienced by workmen when repairing water-mains. It was obvious that some agreement as to the conditions under which earthing-connections should be allowed was highly desirable.

The whole question was considered by a joint committee of the Institution of Electrical Engineers and the Metropolitan Water Board, as a result of which a draft memorandum on "Earthing to Water-Mains" was issued in December 1926. It was impossible, however, to conclude the negotiations by that committee alone. The rapid expansion of the applications of electricity to factories of all kinds in all parts of Great Britain made the question an urgent one.

In these circumstances, a sub-committee of the Institution of Civil Engineers Research Committee was formed in March 1936, to investigate the existence and extent of damage due to leakage currents, to carry out research work, if necessary, and particularly to obtain mutual agreement on the conditions under which earthing connexions to metal water-pipes might be made and to try, if possible, to formulate a set of regulations. The sub-committee included nominees from the various engineering associations chiefly concerned, and Mr. H. W. Swann, senior electrical inspector of factories of the Home Office.

The sub-committee has been successful in obtaining unanimous agreement on the conditions under which earthing connexions may be made, and has now issued its report*.

The first clause in the report is that an earth-wire connecting an electrical installation to a water-main or water-pipe is to be used only as a safety measure, for the purpose of returning to the source of supply such leakage current as may flow from the electrical installation, for radio currents, or currents from radio-interference suppression devices. In the second clause, it is forbidden to cut or drill or break a water-main or water-pipe. The third clause states that every device used must be of 'approved' design. The fourth clause states that due notice must be given to the water authority concerned when an earth-connection is made to a buried water-pipe. The fifth clause states that wherever an earth-connection is made to a water-main or water-pipe on any premises

* Regulations for Earthing Electrical Installations to Metal Water-Pipes and Water-Mains. Pp. 6. (London: Institution of Civil Engineers, 1938.) 6d.

in which a water-meter is installed, a suitable bond must be placed across it by the user, free of expense to the water authority. Finally, if the water supply authority has reason to believe that damage to water-mains or water-pipes is being caused by an excessive flow of electric current through the earth-connection, it can ask the electricity supply authorities for the district to test the installation in the presence of a representative of the water company. The water company can, if it requires, make its own test after advising the electric supply company.

Post Office installations, other than those for power and lighting services, are specially excluded from the application of these regulations, but are subject to agreement between the authorities concerned.

In the course of its work, the sub-committee came to the conclusion that there are certain other aspects of the problem which could with advantage form the basis of research. Funds have been subscribed for this research by the interests concerned, and the investigation has been undertaken by the British Electrical and Allied Industries Research Association. The programme of research so far approved is as follows: (1) The amount and effect of aggregate leakage currents on water-pipes. (2) The possibility of partial rectification of alternating currents in underground water supply systems, (a) at earthing connexions and (b) between metal pipes and the soil. (3) The possibility of primary cell effects in water supply systems. (4) The relation of all the above to the question of corrosion. The sub-committee is to be congratulated on its very practical report.

Social Science at Liverpool

THE publications of the Statistics Division of the Social Science Department of the University of Liverpool provide an admirable illustration of the valuable work which the universities can undertake in the field of social science. The latest addition to the New Merseyside Series ("Handbook of Social Statistics Relating to Merseyside": University Press of Liverpool. 1s. net) is no exception and indeed in some matters indicates a further function or responsibility of the university which undertakes such local studies—that of educating local opinion to secure requisite action on the facts disclosed.

This responsibility is very clearly implied in the opening section of this handbook, in which Mr. D. Caradog Jones directs attention to the marked tendency for the population of all four Merseyside boroughs to decline. The rate of natural increase in Liverpool is already less than one half the increase in the early years of the present century, and the rate of increase in Birkenhead is only one quarter of what it then was. He asks the pertinent question whether the serious effect of the anticipated decline upon the demand for houses, for schools, for transport, and upon the need for social services, has been fully appreciated by the local authorities, and, if or whether they are taking steps to deal with a situation that is likely to change rapidly.

In the face of these facts, local authorities will bear a heavy responsibility if on the contrary they

continue to legislate on the assumption that the talk about fall in numbers does not concern them, or that if it does there will be plenty of time to set their house in order when the fall begins to take place. None the less, having disclosed the true situation, scientific workers have some measure of responsibility for seeing that the facts are brought to the notice of those concerned with action in a sufficient, definite and convincing manner.

It would not be easy to improve on the lucid but brief presentation which Mr. Caradog Jones uses in this handbook. The section on trade gives an analysis of the trade of the Port of Liverpool in comparison with that of London and the next three most important ports of the United Kingdom. Liverpool showed a greater relative improvement than London in 1936 as compared with 1932 in the value of goods imported, but for exports the position is reversed. Cotton, imported raw and exported as manufactured textiles, holds an outstanding place in the trade of Liverpool and the figures indicated an appreciable increase between 1932 and 1936 in the home demand for manufactured cotton textiles as well as of woollen manufactures.

Statistics of employment alone at first suggest that the position on Merseyside is not discouraging. Actually Merseyside found employment in 1937 for 13,000 more insured workers than in 1929, which is generally regarded as the best all-round post-War

year. This figure, however, represents an increase of only 4 per cent as compared with a 12 per cent increase in Great Britain as a whole, and a 38 per cent increase in unemployment on Merseyside as compared with 18 per cent in Great Britain. Moreover, although the high level of unemployment on Merseyside has not altered very much in the last twelve months, the August figures indicating an increase of less than 2 per cent, the cost of its relief has increased. Unemployment insurance payments in August 1938 were nearly a fifth greater than in August 1937, while unemployment allowances were more than 5 per cent less. Although this position is due partly to the increases in benefit made this year by the Beveridge Committee and the fall in the cost of the means test, to long-standing cases getting work, to final 'cuts' under the 'Standstill Act', and to the revised system of relieving casual labour, the fact that the means test is costing less and benefit more, while unemployment remains much the same, is unexpected.

The cost of outdoor relief decreased between June 1937 and June 1938, but able-bodied unemployed still cost the ratepayers of Merseyside £38,000 a

month, £6,200 of which goes to insured workers. Mr. Caradog Jones refers once more to an unfortunate gap in the social services. If an insured person falls sick, he ceases to qualify either for unemployment benefit or for unemployment allowance; he is entitled to sickness benefit, but this takes no account of dependants, and he is therefore frequently driven to apply for poor relief. This is an additional trial to the mind when the body is least able to stand it. Mr. Jones also refers to the absence of anything but poor relief for non-manual workers, such as ships' officers, salesmen and clerical workers who when in work were earning more than £250 a year.

A section on education indicates the difficulties which many teachers in elementary schools in the area have to face as well as the points at which reorganization on the lines of the policy laid down in the Hadow report is most backward. The housing situation is summarized in a further section and particulars of rents and rates are analysed in a final table. The whole handbook, brief as it is, affords an admirable example of the presentation of facts in a manner designed to stimulate appropriate action.

The Highgate Literary and Scientific Institution Centenary Celebration

ONE of the marked features of the intellectual life of the early years of the nineteenth century was the founding of philosophical, literary or scientific institutions, or societies where lectures could be delivered, discussions held and where libraries could be formed and housed. Many of these institutions, especially those in small towns, have disappeared, or parts of their activities have been absorbed either in the local free library, or in the neighbouring technical college.

Some of the societies have survived and are doing most useful work: amongst these may be mentioned the Cambridge Philosophical Society, the Royal Glasgow Philosophical Society, the Manchester Literary and Philosophical Society, the Leeds Philosophical Society, and the Highgate Literary and Scientific Institution, which has just celebrated its centenary.

Exactly one hundred years ago, on January 16, 1839, a meeting was held at the Gate House Tavern, Highgate, to consider the formation of a society, or, in the quaint words of the invitation card, "for the purpose of forming an Institution designed to excite and cultivate an intelligent interest in the objects of literature and science". The first president was Mr. Harry Chester, who served in that capacity for eighteen years. The Society was evidently welcomed by the inhabitants of Highgate, because at the end of a month the president in his first presidential address was able to state that 110 members and associates had been elected, and that four hundred volumes had been placed in the library, of which three hundred were donations.

The founders were determined that the Institution should be democratic, as is shown by the opening remarks of the president: "This is a voluntary Association of many for the benefit of all and open

to all; it is no exclusive Association, to which admission depends on the likes and dislikes of individuals. Here all classes may meet without annoyance to any: and therefore with advantage to all."

In May 1840, the premises the Institution still occupies were rented from the trustees of the estate of Sir John Hawkins, who was an executor, and also a biographer, of Dr. Samuel Johnson. In 1932 it was found possible to purchase the freehold of the property, and in 1936 that of the immediately adjoining property, thus giving the opportunity for further future extensions.

The annual reports of the committee of management of the Institution give a brief story of its activities. In the seventh report (unfortunately, the first six reports are missing) a list of the periodicals in the reading room for the year 1846 is given. It is interesting to note that *Blackwood's*, *Chambers's Journal*, the *Edinburgh Review* and the *Quarterly Review* were mentioned; the remaining periodicals are no longer in existence.

The formation and maintenance of the library has always been regarded as one of the chief duties of the committee of management. The library now consists of more than 11,000 volumes, and includes a considerable number of books of reference. It must be confessed that the scientific side of the library has been allowed to lapse more than it should have done.

The giving of lectures by well-known experts and authorities has always formed an important activity of the Institution. It has been estimated that some 1,700 lectures on the greatest variety of subjects have been given during the past century. Looking back through the annual reports, the development of many of the sciences can be traced by the names of the lecturers and their subjects. "The Proposed Atlantic

Telegraph" (1857), "The Electric Light" (1881), "Polarized Light" (1881) by Mr. William Spottiswoode, then president of the Royal Society, "The Habits of Ants" (1884) by Sir John Lubbock, "Fireworks. Their Chemistry and Mechanics" (1886) by C. V. Boys, "An Evening with the Telescope" (1896) by Sir Robert Ball; and then down to the present time "Large Telescopes" (1937) by the Astronomer Royal, and "Links with the Past in the Plant World" (1938) by Sir Albert Seward. That the artistic and literary side of the Institution has not been neglected may be gathered from the fact that Prof. Henry Morley and Prof. S. R. Gardiner delivered courses of lectures on "Chaucer and the English Writers" and "On the History of England" respectively. Amongst modern writers who have spoken at the Institution may be

mentioned Mr. John Drinkwater, Mr. J. B. Priestley and Sir William Rothenstein.

To commemorate the centenary of the Institution, an appeal has been launched to enable some alterations and additions to be made to the old buildings. At the centenary dinner, held at the Criterion Restaurant on January 16, the president (Mr. R. S. Whipple), replying to the toast of "The Institution", which had been proposed by Sir Ian Fraser, mentioned that the sum of £1,327 had been promised—a good beginning, although much more is required. Sir Robert Waley Cohen proposed the health of the visitors, to which the Mayor of St. Pancras and Prof. Allan Ferguson replied. The latter dwelt on the usefulness of institutions such as that of Highgate as centres of intellectual activity.

Additional Evidence of Early Man in America

FURTHER particulars of the Borax Lake site, Lake County, California, on which relics of the Folsom and the earlier Mohave Lake cultures have been found, are made available in a preliminary report to the Carnegie Institution, Washington, by Mr. M. R. Harrington of the South Western Museum, Los Angeles, who was engaged in exploratory investigation there from July 1937 until June 1938.

The bed of Borax Lake is now dry, except for a little saline water at the north-west end. It is surrounded by hills, 300–400 ft. high; but at the south-east it is separated from the Clear Lake basin by a ridge 100 ft. high only. A number of small canyons drain into the lake bed. Their alluvial fans are insignificant, with one exception, on which is evidence of human occupation over a considerable period going back to a time even before the formation of the fan began.

On the surface, Folsom and Mohave points occurred with other elements of the two cultures, as well as a certain archaic type of stemmed projectile point, now named 'Borax Lake' from its relative abundance. With these were a few modern chipped obsidian points. Excavation revealed abundant artefacts at a depth of five and a half feet in dark-coloured soil, and occasional finds in the underlying yellow gravels, sands and clays to a depth of eight feet. No true Folsom or Mohave points were found below the surface, but 'Silver Lake' points of the Mohave complex, Borax Lake points and a 'willow-leaf' type occurred. A keeled type was abundant in the lower part of the deposit with large scrapers and combined chopper-scrapers. Smaller scrapers appeared practically throughout. Metates, hammer-stones and pestles were found, but no shell or bone implements.

It is suggested that occupation, possibly seasonal, began with the pluvial which followed the Pleistocene ice age, and was abandoned at its close, when desiccation set in.

At the same time exploration and partial excavation of caves in south central Oregon, carried out from 1934 onward by Dr. L. S. Cressman, professor of anthropology in the University of Oregon, would now appear likely to have an important bearing on the date of man's appearance on the American continent. These caves, situated in what is now an extension of the Great Basin of the United States,

were produced by the wave action of glacial lakes formed in dammed valleys during the Pleistocene period. On the recession of the ice and the onsetting of gradual desiccation the lakes disappeared, leaving the caves high and dry. One cave explored, for example, is two hundred feet above the valley floor. The caves were then occupied by man for some considerable time. Dr. Cressman has excavated occupational debris to a depth of nine feet or more.

In a preliminary report, also addressed to the Carnegie Institution, on excavations in 1937 at Catlow Valley and in three other localities, which were supported financially by the Institution, it is stated that numerous artefacts were discovered. These included basketry, sandals and black, undecorated potsherds. Faunal bones indicate a change of diet from mainly waterfowl and small rodents in the lower levels to large mammals, deer, bison and mountain sheep, in the upper.

Of two finds of human skeletal remains, one, consisting of a skull and other parts, was embedded about six inches deep in gravels at the north end of the cave and almost under the rear wall. This was about seven feet below the surface of the cave deposits. Absence of clear stratification in the cave invests this discovery with some ambiguity; but Dr. Cressman inclines to the view that the body was deposited in the gravels by wave action, when it was partially decomposed, but still covered with flesh, thus accounting for the unscratched condition of the bones and the circumstances of deposit. This could have happened only when the lake had begun to fall, but storm waters still invaded the cave, that is, not more than 15,000 years ago. It is, therefore, in Dr. Cressman's view, "entirely likely that we have here a representative of early man in the New World".

In two cave sites, one at Paisley and one at Fort Rock, a layer of pumice overlay the earliest evidence of human occupation. The earlier of these, that at Paisley, is assigned to an age of about 10,000 years.

In view of the abundance of fresh water and game in this early period, Dr. Cressman concludes not only that numerous traces of early man will be found in this area, but also that it may have served as the line of advance to Central America of the Asiatic immigrants.

Science News a Century Ago

Birth of Microphotography

IN his paper to the Royal Society on January 31, 1839, entitled "Some Account of the Art of Photogenic Drawing or the Process by which Natural objects may be made to delineate themselves without the aid of the Artist's pencil", Fox Talbot devoted a section to the application of the art to the microscope. "Contemplating the beautiful picture which the solar microscope produces," he wrote, "the thought struck me whether it might not be possible to cause that image to impress itself upon the paper, and thus to let Nature substitute her own inimitable pencil for the imperfect, tedious and almost hopeless attempt of copying a subject so intricate. My first attempt had no success . . . I therefore began a series of experiments in order to ascertain the influence of various modes of preparation . . . the result of these experiments was the discovery of a mode of preparation greatly superior in sensitivity to what I had originally employed. . . . When a sheet of this, which I call 'Sensitive Paper' is placed in a dark chamber, and the magnified image of some object thrown on it by the solar microscope, after the lapse of perhaps a quarter of an hour the picture is found to be completed. . . . On examining one of these pictures, which I made about three years and a half ago, I find by actual measurement of the picture and the object that the latter is magnified seventeen times in linear diameter and in surface consequently 289 times."

The Rhinoceros in the Paris Basin

IN its column of miscellanea, the *Athenaeum* of February 2, 1839, said: "On digging the foundations of the new buildings at the Hôtel de Ville in Paris, the workmen, at a depth of seventeen feet, in an alluvial yellow sand, mixed with pebbles, found the right humerus of a rhinoceros, named by M. Cuvier *R. Tichorhinus*. Rhinoceros bones have not been before met with in the Paris basin, although the bones of elephants have occurred. The humerus now alluded to is only four lines less than that of the Cape Rhinoceros, in the museum of the Jardin du Roi; it is sixteen lines less in length than the single-horned rhinoceros of India, but its circumference exceeds each by one inch. M. Cuvier's opinion thus appears to be confirmed as to the relative size of the two-horned fossil rhinoceros which he thought was of shorter and thicker proportions than the recent animals."

Preservation of Bodies for Dissection

THE *Lancet* of February 2, 1838, contains the following information: "M. Gannal has recently published a pamphlet on the embalming of bodies and the preservation of specimens of natural history and morbid anatomy. After numerous trials with the salts of alumina and various other substances M. Gannal has elected the sulphate of alumina as being at once the most efficacious and the cheapest material that can be employed. Two pounds of the sulphate of alumina dissolved in a quart of water are sufficient to preserve a dead body in a state of freshness for at least two months. If the weather be very hot it will be necessary to employ the fluid in a greater degree of concentration. The solution of alumina is simply injected into the vessels of the subject, and the cost of preservation does not exceed tenpence for each body."

Societies and Academies

Paris

Academy of Sciences (*C.R.*, 208, 22-56, Jan. 3, 1939).

A. CHEVALIER: Species, varieties and hybrids of cotton, especially the cotton of Asiatic origin cultivated in tropical Africa. These Asiatic cottons are not of commercial importance, having been displaced by American cottons.

F. ENRIQUEZ: The characteristic property of irregular algebraic surfaces.

F. ROGER: Critical varieties of systems of functions of many variables and the critical families in the calculus of variations.

H. MILLOUX: A new inequality in the theory of meromorphic functions.

P. VAILLANT: Passage of current through copper iodide. A cell consisting of 'iodized' copper foils has a conductance of some tenths of mhos, which varies between wide limits with intensity and duration of current and the temperature.

A. RABINERSON and M. PHILIPPOV: Emission of ultra-violet rays in the course of coagulation [of hydrophobic sols such as $\text{Fe}(\text{OH})_3$ and V_2O_5 and of hydrophilic sols such as sodium oleate].

P. CASTEL: Preparation of ortho-arsenic acids of thorium.

C. PRÉVOST: Contribution to the study of the Raman wave numbers of the ethylenic bond.

O. K. HOVO: An α - γ -biethylenic alcohol.

P. GAUHERT: Mobile rings produced in anisotropic drops of the nematic phase by the addition of a substance possessing [optical] rotatory power. The method provides a means of detecting optical rotatory power and its sign; 0.1 mgm. or less of the substance is required.

H. GARRETT: Measurements of radioactivity and temperature in the region of Lyngmarksbreen (northern Greenland).

J.-L. VIDAL: Role of transpiration and of carbon dioxide in the etiology of calcium chlorosis. Although lack of soluble iron may be the fundamental cause of chlorosis, carbon dioxide in the soil and intense transpiration are other factors.

E. MILNE: Influence of altitude on the biology of the potato. Altitude and also the use of artificial cold increase the vitality and productivity.

E.-F. THÉBOINE and MILLE T. DEVRIENT: Degree of oxidation of the waste products of protein catabolism as a function of their importance and of their origin.

MME. S. BELLUO, J. CHAUSSIN, L. LESCOEUR and MME. T. RANSON: Action of Vichy water treatments on the urinary elimination of the normal man; modifications produced in the metabolism of phosphates.

Brussels

Royal Academy (*Bull. Classe Sci.*, 24, No. 10, 1938).

L. GODBAUX: (1) Algebraic surfaces the canonical system of which is composed of at least one involution having only a finite number of unit points. (2) Involutions of genera one belonging to an algebraic surface.

J. E. VERSCHEFFELT: (1) The application of the principles of thermomechanics to the conduction of heat. (2) The application of the principles of thermomechanics to fluids in movement.

E. DE WILDEMAN: Movements of certain organs of higher plants (2).

H. FREDERIOQ: The mechanism of the 'secondary refractory period' of the cardio-inhibitory apparatus of the tortoise.

S. GOLAB: Some points of the geometry of ensembles.

P. CAPRON and M. DE HUMPTINNE: Concentration of the carbon isotope of atomic weight 13. By a battery of Hertz pumps a sample of methane was obtained containing 50 per cent of carbon 13.

G. BALASSE: Continuous spectrum of atomic hydrogen.

P. DENT: Mitraspexime, a new alkaloid from *Mitragyna speciosa* Korthals.

Budapest

Hungarian Academy of Sciences, December 12.

A. BUZÁGH: Structure of adsorbed layers and adhesion in liquids.

G. RADOS: Further data on the theory of unitary substitutions.

J. MARKE, O. WELLMANN and L. URBÁNYI: Changes in the composition of the blood of a young pig, induced by food containing different kinds of minerals.

N. MAUTHNER: (1) Synthesis of a new glucogallic acid. (2) Synthesis of 6-oxy-8-methoxycoumarin.

L. BOGSCHE: Contribution to the knowledge of *Ervillea pusilla* and *Ervillea micropusilla* races.

A. ERDÉLYI: Eigen-values of the Sturm-Liouville boundary problems.

I. LIPKA: Nets of conic sections.

Cracow

Polish Academy of Sciences (C.R., December 1938).

K. DZIEWOŃSKI, Z. ALBIN and P. TRZĘSIŃSKI: Study of pyrene.

J. TOKARSKI: Petrography of tufa elements of the sub-Carpathian salt-bearing regions.

MŁCZ. J. DYAKOWSKA: The interglacial formation of Ściejowiec in the neighbourhood of Cracow.

H. SZARSKI: Results of removal of the thymus in anuran batrachians. Frogs and toads live after this operation for more than ten months without food; the gonads develop normally.

Dublin

Royal Dublin Society, December 13.

V. C. BARRY: Constitution of laminarin: isolation of 2:4:6-trimethylglucopyranose. Attempts made to extract laminarin sulphate from *Laminaria* fronds with dilute oxalic acid gave laminarin which contained very little combined sulphate. Laminarin was converted to a triacetate which on methylation was converted quantitatively to trimethylaminarin. Hydrolysis of trimethylaminarin gave a crystalline trimethylglucose which was identified as 2:4:6-trimethylglucopyranose. Laminarin, therefore, is linked from the aldehydic carbon of one glucose unit to the third carbon of the next unit. Examination of its properties suggests that laminarin consists of a chain of β -glucopyranose units bent into a spiral form.

J. S. BARLIE: A note on the waxy secretion of some glaucous cedar leaves. Two cedars of the same variety, *Cedrus atlantica* var. *glauca*, were compared. One grown in a city atmosphere was very stunted and weakly, being but 1.63 m. high. The other tree, $2\frac{1}{4}$ miles out of town, was well developed and healthy, about 7 m. high. Each tree was more than twenty years old. It was suggested that the stunting of one tree was due to the blocking of the stomata of the leaves by soot; and examination of sections of the leaves by transmitted light indicated that the stomata were occupied with an opaque material, which also covered the surface of the leaves. This substance, however, was seen to be pure white. It gives the whole tree its characteristic silver colour, and was shown to be a wax. It is apparently a normal secretion, for it was found on the healthy as well as the stunted tree.

Tokyo

Imperial Academy (Proc., 14, No. 8, 325-357, November 1938).

KENTARO YANO: The new theory of Einstein and Bergmann.

KOSAKU YOSIDA and SHIZUO KAKUTANI: Application of mean ergodic theorem to the problems of Markoff's process.

ATUO KOMATSU: Surfaces of cell spaces.

TSUBUSALUO TAKASU: A conformal geometric generalization of geodesic lines (2).

HIDEO MATSUYAMA: Thermal analysis of the second order reaction.

SEI'ITI KAWAI and NOBORU SUGIYAMA: Researches on egonol. Syntheses of the two egonol degradation products—dihydro-coniferyl alcohol and styranolic aldehyde.

HIROKATSU YAHN and TOKIO SHIKAMA: A new Jurassic mammalian from South Manchuria.

Vienna

Academy of Sciences, November 10.

A. KAILAN and O. ALBERT: Velocity of catalysed hydrogenation. The velocity of hydrogenation of aliphatic acids in the presence of a nickel catalyst is determined. Acids with an even number of carbon atoms have a higher velocity of hydrogenation than the neighbouring acids with odd numbers of carbon atoms.

F. WESSLEY and S. WANG: Occurrence of adonitol. The pentahydric alcohol adonitol has been found in the Chinese drug chai-hou (the root of *Duplourum falcatum*). The only other known natural source of this compound is *Adonis vernalis*.

R. WIENER: Radium content of Algae. Both sea- and fresh-water Algae are found to be rich in radium, the content of *Zygnema*, for example, being as great as that of the granites richest in radium. Fresh-water Algae have 10-100 times the radium content of sea-water Algae.

R. PITTIONI and E. PREUSCHEN: Excavations in 1937 and 1938 in the pre-historic mining region of Kelchthal at Kitzbühel.

November 17.

K. GRAFF: Colorimetric measurement of stars down to the $6\frac{1}{2}$ magnitude visible in Europe.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Monday, January 30

BIRKENHEAD COLLEGE CHEMICAL SOCIETY, at 6.—Prof. S. Sugden, F.R.S.: "Neutrons and Chemistry".*

Tuesday, January 31

LONDON SCHOOL OF ECONOMICS, at 5.—Dr. L. Dudley Stamp: "The Fertility of the Land in Britain".*

COURTAULD INSTITUTE OF ART, at 5.30.—Dr. Herbert Chaitley: "Ancient Chinese Astronomy" (succeeding lectures on February 7, 14, 21 and 28).*

Thursday, February 2

INSTITUTE OF ELECTRICAL ENGINEERS, at 5.30.—L. W. Hayes and B. N. MacLarty: "The Empire Service Broadcasting Station at Daventry".

Friday, February 3

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—E. J. Wayland: "Soil Erosion in Uganda".

ROYAL INSTITUTION, at 9.—Sir Charles Bracey: "Bigger London or Better London".

Saturday, February 4

GILBERT WHITE FELLOWSHIP (in the Hall of the Art-workers Guild, 6 Queen Square, W.C.1), at 3.—Dr. J. Ramsbottom: "Toadstools and Their Ways".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

UNIVERSITY READER IN BIOCHEMISTRY at Guy's Hospital Medical School—The Academic Registrar, University of London, Senate House, W.C.1 (February 1).

LECTURER IN PHYSICS AND CHEMISTRY AND LECTURER IN ENGINEERING SUBJECTS in the West Hartlepool Technical College—The Chief Education Officer, Education Office, Park Road, West Hartlepool (February 3).

BIOCHEMIST in the Department of Animal Husbandry of the Royal Veterinary College—The Bursar (February 4).

ASSISTANT WOMAN LECTURER IN NATURAL HISTORY in the Froebel Educational Institute Training College for Teachers, Grove House, Roehampton Lane, London, S.W.15—The Principal (February 5).

ASSISTANT (grade III) in the Geological Survey and Museum, Exhibition Road, South Kensington, S.W.7—The Director (February 7).

HEAD OF THE CHEMISTRY DEPARTMENT in the Rutherford Technical College—The Director of Education, City Education Office, Northumberland Road, Newcastle-upon-Tyne (February 11).

LECTURER IN CHEMISTRY in the West Ham Municipal College, Romford Road, Stratford, E.15—The Principal (February 14).

PROFESSOR OF MEDICINE in the University of Otago—The High Commissioner for New Zealand, 415 Strand, London, W.C.2 (March 25).

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1813 (3450): Variations of Shear Stress in Thin-walled Tubes under Torque. By D. Williams and J. Taylor. Pp. 7. 1s. 2d. net. No. 1831 (3109): Simple Formulae for the Fundamental Normal Frequencies of Cantilevers. By Dr. P. B. Walker. Pp. 20. 3s. net. No. 1833 (3556): Critical Reynolds Numbers of Spheres in the Compressed Air Tunnel. By A. Fage and D. H. Williams. Pp. 8. 1s. 2d. net. No. 1833 (3534): Notes on Longitudinal Stability at Low Speeds. By R. H. Francis and Dr. G. B. Pringle. Pp. 6. 1s. net. No. 1837 (3537): A Comparison of Aileron Control on Tapered Wings with Straight Leading Edge and Straight Trailing Edge. By H. B. Irving and A. S. Batson. Pp. 8. 1s. 2d. net. No. 1839 (3497): A Simplified Theory of Wing Flutter. By Dr. A. G. Pugsley. Pp. 10. 1s. 6d. net. (London: H.M. Stationery Office.) [2313]

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Freedom of the Universities

WITH what now seems almost prophetic insight, the report of the University Grants Committee in 1936 referred to the special responsibility of the universities of Great Britain, in view of the suppression in the universities of several European and other countries of all independent thought and critical discussion of the principles of government or of the meaning of life, if the Greek tradition of candid and intrepid thinking about the fundamental issues of life is to be preserved for mankind. That responsibility has grown the heavier in the last three years. The area in which freedom of thought and learning is proscribed has grown larger year by year, and further waves of refugees have added to the burden of the Society for the Protection of Science and Learning, and converted what was possibly at first regarded as a temporary into an apparently permanent or perennial task.

There are welcome signs that their responsibility is nobly recognized by the universities of Great Britain. In one practical form it is seen in the support which has been forthcoming from them for the work of the Society for the Protection of Science and Learning. A series of meetings has been arranged for the first week in February in the majority of British academic centres, in which many leading men of science have promised to take part, including Sir William Bragg, Sir Henry Dale, Sir Richard Gregory, Prof. Winifred Cullis, Prof. F. A. E. Crew and others. The Royal Society, in collaboration with the British Academy, is giving a special reception to the academic exiles and those who have been working in their interests on February 7, and on February 10 the evening discourse at the Royal Institution is to be given by Prof. Max Born, one of

the many distinguished men of science who have found refuge in Great Britain.

This practical assistance is of importance not only on the grounds of humanity but also in the interests of learning itself, by enabling those who in the past have made important contributions to knowledge to resume their studies or investigations. Besides this, however, there is a rapidly growing volume of evidence that members of the universities of Great Britain, whether engaged in teaching or administration, are fully alive to the importance of preserving their full freedom of teaching and investigation. In a striking address to the Conference of Education Associations on "The Function of the University", Lord Macmillan asserted that the first essential of a university must be its spirit of intellectual freedom. A university must be the servant of truth, and have no other bondage whether of race, State or creed.

Lord Macmillan put freedom in the very forefront of the life of the university, as it is known in Great Britain. It is the essence of knowledge that it should give freedom to those who pursue it. To seek to impede the free interchange of thought and ideals is the supreme crime. The noblest task which the universities can perform is not only to maintain among ourselves the constant and free pursuit of truth, but also to use every endeavour to spread its light throughout the world, so that it penetrates even to those countries where the universities are subservient to the State.

No less striking were the speeches at the recent degree ceremony when the Duke of Devonshire was installed as Chancellor of the University of Leeds. In welcoming the Chancellor, Mr. B. Moust Jones referred to him as one who, by tradition and conviction, accepted both the universality of

knowledge and the trust imposed upon universities to safeguard the liberty of thought and to defend the free spirit of man. In returning thanks for his election, the Chancellor responded on the same note. Of all the forces working for good in the world, for better understanding between peoples, for liberalism and tolerance in the highest sense of the words, for the spreading of true knowledge, the universities and all that they stand for are, he said, perhaps the most important. They are playing a greater part than ever in the life of the nation and their influence is felt among an increasing proportion of the population. Moreover, without minimizing the importance of the practical and utilitarian work at the universities, or their contribution to technical and commercial progress, a university must be a servant of truth.

In delivering an address at the close of the ceremony, on behalf of the honorary graduates, Lord Baldwin spoke vigorously on the same theme. There are two things, he said, for which a university stands pre-eminently: standards, and truth. The more democratic we become, the more important it is to maintain our standards in literature, in art, in science, in work of all kind. Nothing should for one moment be accepted as first-rate which is in fact second-rate. The second thing is truth, which is particularly important to-day. It is not yet in danger in Great Britain and he hoped it never would be. We never want to see the day when truth is sought merely with the object of proving a case, or history written with that object. Universities must stand and be recognized as seekers for truth with no ulterior motive.

It is a strange commentary on the distance we have travelled in the last ten years that the chancellor of a university should find it pertinent to speak thus emphatically on what a few years ago would have seemed a platitudinous theme, and to find his words so warmly welcomed. Lord Baldwin, moreover, proceeded to point out dangers which in Great Britain might affect, even if indirectly, the maintenance of such standards and the service of truth.

For universities to uphold their trust to-day, as ever, they must be absolutely free and independent, governing themselves and regulating themselves, and never becoming subservient. Among the dangers which may threaten their independence Lord Baldwin referred first to that attending the influence of wealth. In Great Britain it is scarcely a source of danger, for when people give money

to universities, it is not given with the idea of interference, but for use. It is for the universities themselves to decide in what way the gifts shall be expended. While this is generally true, in his recent book "The Social Function of Science" Prof. J. D. Bernal refers to ways in which the freedom of a university may be restrained by conditions attached to grants, and indicates that cases of the withdrawal of donations on political grounds are known to many scientific workers. If universities are to make their full contribution to the life of the community, while their members must be careful not to lend the weight of their names or influence to the support of statements on matters of which they have no special knowledge, it would be disastrous if any such restraint prevented individual members of a university from accepting their responsibilities for playing a part in the life of the community, whether as citizens or as the leaders for which their training and ability fit them. An atmosphere of right thinking and right action is demanded as well as freedom, and this is the more important as the emphasis on the social quality of the university is increased.

The greatest danger, however, which threatens the independence of the universities is one from which Great Britain is fortunately so far free—that of State interference. This we have seen in Europe in our own time, though had we not seen it we could scarcely have believed it. Universities depend more and more on State grants and public money, and this dependence is likely to increase rather than to decrease. The burden of equipment and re-equipment for efficient research is one factor likely to increase the need for State assistance. The more democratic that entry to our universities becomes, and the more widely their importance in training leaders is recognized, the stronger their claims upon the State for assistance. Many of the admirable recommendations, for example, of the recent Conference of the National Union of Students on student health depend largely on State assistance if effect is to be given to them. In spite of this, as Lord Baldwin asserted, the universities must resist to the death, if it ever came, any attempt of a Government department, or of a Government of any shade of opinion, to make gifts conditional on what is taught. In view of what has happened in other countries in recent years, we must be doubly vigilant in safeguarding our own liberties and our own freedom. It is a false optimism to eschew such vigilance because there is no immediate threat, especially in the face

of what is happening elsewhere in the world to-day. Circumstances can easily be visualized in which the threat might become imminent even in Great Britain. Nor is the threat confined to the totalitarian regimes. Even in the western hemisphere, religious dogma has already sought to restrain the teaching of particular scientific theories in the post-War period.

In Great Britain, as has already been pointed out, one or two attempts have been made, if not from the Government side, to impose restraints by withholding donations or subscriptions. When university needs are growing and financial stringency threatens, it is the more important that universities should stand together in resisting such pressure and in exposing the instigators. Such danger as exists is in fact largely indirect. It arises in part from the unfortunate extent to which teaching and research are linked under our present system. Conditions which may quite legitimately be laid down in regard to the donation of a large sum for research are quite intolerable if applied to teaching. None the less, because teaching and research are so interlocked, quite unintentionally endowment of research in this way may affect the prestige or extent of freedom of teaching in a particular subject.

Particularly is this true in the social sciences. On the universities above all lies the responsibility for developing a world conscience and a world culture if mankind is to be turned aside from the hideous road to economic self-sufficiency and war.

Moral unity can only be achieved through mutual understanding, respect and approbation, and we need more than ever to bring into relief the true aim and purpose of human society. Social science in this sense can bring into being a vital relation between the university and the non-academic world, but it can only do so as long as it possesses, unchecked and unhampered, its full liberty of criticism and investigation, free from any suggestion of prejudice or bias.

Many will recall Lord Baldwin's insistence on this same responsibility for preserving freedom and all it involves in the elimination of prejudice and of bias by the maintenance of scrupulous honesty of thought and fairness of criticism, in his welcome to the delegates to the Congress of the Universities of the Empire held at Cambridge three years ago. Scientific workers may be equally grateful for his latest reminder of their obligations and duties in this matter. Contact with many of the refugee scientific workers whom the Society for the Protection of Science and Learning has been assisting should render their own experience available for the vital task of foreseeing the threats to our great heritage of freedom and integrity of thought, and taken in due time, wise measures may be devised to minimize the danger, if not to avert it entirely. Certain it is that freedom is best served to-day by vigilance and foresight and constructive action, rather than by procrastination which may leave us merely with the option of resisting unto death.

French Administration in Africa

African Majesty:

a Record of Refuge at the Court of the King of Bangangté in the French Cameroons. By F. Clement C. Egerton. Pp. xx + 348 + 123 plates. (London: George Routledge and Sons, Ltd., 1938.) 18s net.

MR. EGERTON'S choice of a change of scene to escape certain features of civilized life was little more than fortuitous; but in the event it proved well judged for his purpose. For some months he lived in the headquarters of a native king of the French Mandated Territory of the Cameroons, and came into intimate contact with a cultural outlook and organization of life which he found novel, but in its cultural environment, essentially reasonable, allowance being made for

certain adjustments necessitated by the regulations of the mandatory power.

The author has had the advantage of training under Prof. Malinowski. It is, therefore, scarcely necessary to say that life as he viewed it at the *chefferie* of Bangangté was seen as a whole. The history of this kingship, unlike others enshrined in shorter memories in this part of Africa, is known for some ten generations. The country has been in the possession of the people, immigrants, for not more than a hundred years. In consequence, it is possible to trace to a well-defined origin certain peculiar characters in the social organization, such as, for example, the institution of the chief's henchmen, and the delegation of the chiefly authority to local sub-chieftains. The whole essence of the kingship seems to have resided in

organization for war; but under European control the office would appear to be stripped of its meaning. Yet the present king, probably a forceful personality under a deceptive exterior, in some manner which Mr. Egerton was not able to fathom, has retained his sacrosanctity, even for radically-minded individuals, who did not refrain from criticism, and even regarded any member of the blood-royal as something of a rogue.

Informative as is the author's account of a society largely pagan, his remarks on their character and on French methods of administration, both in relation to future development, are even more illuminating. They are those of a well-balanced and careful observer. His attitude towards the French administration, so far as it goes, is wholly favourable; and while he regrets change in the native, he accepts the fact as inevitable. He maintains, however, that the changes which European control has introduced, in what is intended to be the spirit of the mandate, are advantageous to the white man rather than to the

native. This perhaps is to take a short view. Custom at present, he notes, is preserved under the influence of the members of the community who are more than thirty years of age; but desire for the power, which obviously is inherent in the white man, attracts the native and leads to imitation, which appears to fasten on the less desirable features in white character and culture. The needs of the people of the Cameroons, as the author sees them—he attempts no judgment on Africa as a whole—is for the reinforcement of custom under a strong personal administration, which will ensure, through the co-operation of the chiefs, its compulsory observance. Further, the future of the African, he holds, demands a policy which should not be at the mercy of an uninstructed democracy, or made subservient to European political relations.

Mr. Egerton writes lightly and easily; but no reader of his book should allow himself to be misled into thinking that what he has to say is not deserving of most careful and mature consideration.

The Practice of Plant Propagation

Propagation of Plants:

a Complete Guide for Professional and Amateur Growers of Plants by Seeds, Layers, Grafting and Budding; with Chapters on Nursery and Greenhouse Management. By Prof. M. G. Kains and L. M. McQuesten. Pp. x+555. (New York: Orange Judd Publishing Co. Inc., 1938.) 3.50 dollars.

IN the forefront of programmes of agricultural and horticultural research of the last twenty years have been placed agronomic studies of economic plants; thus extending applied botanical investigations into the yield, in quantity and quality, of these plants. The technique employed in the maintenance and multiplication of such plants has of necessity also been subject to closer scrutiny, although but infrequently forming the major item of the programme at any one station or institution. It is not surprising that a standard text-book written twenty years ago required thorough revision in the light of such newly acquired knowledge. The present authors claim in their preface to have carried out such a revision, and a brief survey of the contents of the volume under review generally substantiates their claim.

The earlier chapters deal with topics related to the establishment in field and garden of many short-lived plants; these include germination studies and methods of seed testing. The Seeds

Act of 1920 and the regulations laid down in 1922 govern the tests made in Great Britain of agricultural seeds and vegetables; whilst seed establishments of high repute test their flower seeds also. Whilst there are differences between the American and British legislation concerned, the technique of seed testing in the two countries is in many respects similar, so that the subject-matter of these chapters is of value to seed analysts and other British readers. Fortunately all the "fifty worst weeds" of the United States (listed as table 15) have not become established in Great Britain.

Recent studies made at the Boyce Thompson Research Institute by Dr. Crocker and his staff have demonstrated the importance of storage conditions in relation to subsequent germination; the value of stratification, ensuring adequate moisture and fluctuating cool temperatures, has been scientifically established. In Great Britain it has been proved with rosaceous seeds that such methods compare very favourably with others, including prolonged colder storage. The table showing the effective temperatures and periods of stratification with many seeds is a valuable feature of the work. In discussing the influence of light upon seed germination, the authors have presented rather a brief list of light-sensitive seed, omitting reference to *Lythrum* and *Primula* species known to be highly sensitive. The germination of orchid seeds receives scant treatment; mycorrhizal fungi

are not mentioned. Mention is made of the fungi causing the 'damping off' of seedlings, and formalin is recommended as a control measure. The widespread use in Great Britain of Cheshunt mixture (prepared from copper sulphate and ammonium carbonate) is evidently not an American practice, but it is one that can be most strongly recommended to American nurserymen and amateur gardeners. The proved value of additional phosphates mixed in the compost after soil sterilization has been clearly demonstrated by Lawrence at the John Innes Institution; other practical points concerning the injurious effect arising from the mixing of chalk or lime with humic matter before sterilization have also been established, but no reference to this work was found in this text.

All manner of vegetative methods of propagation are serially brought under review, and there can be little doubt that the many illustrations in this section will assist students, and more especially those who cannot regularly carry out the operations so clearly described. From the Dutch growers and their research stations information regarding hyacinth propagation has been freely drawn upon; the methods of the late Dr. Griffiths and his associates used in the propagation of lilies from bulbils and scales are briefly described. More recent research comes under review in the chapters dealing with the propagation by stem cuttings. The use of several synthetic growth substances in accelerating and facilitating root development is dealt with, and in this section the authors have

reviewed the work of Dr. Zimmerman and his associates in the United States, and that of investigators in Great Britain.

In the section dealing with the control of pests, a useful practical point concerning eelworm infection of herbaceous phlox might be added to a later edition; from root cuttings non-infected plants are readily raised, as is a Wisley practice, whilst stem cuttings remain infected.

When reading of the propagation of fruit trees, and methods of grafting and the after treatment of grafted trees, and particularly (Chapter xiv) when considering fruit tree stocks and the influence of stock on scion and the reverse processes, the value of the book would have been enhanced for British readers had the authors considered in further detail East Malling work upon the classification of apple stocks and the influence the various types exert; reference is, however, made to certain effects of root-stocks on the blossoming of seedling apples. The authors deal with citrus stocks, and other trees not grown to any large extent in Great Britain.

The modern tendency towards mechanization is seen in the illustrations and descriptions of machinery used in nursery management. The American Quarantine Act and the regulations appertaining to this Act come under review. The book concludes with a series of fifty "practicums" or schedules for practical work. The selected bibliography refers to 150 titles of recent publications.

M. A. H. TINKER.

Soil Conservation

Conservation of the Soil

By Prof. A. F. Gustafson. (McGraw-Hill Publications in the Agricultural and Botanical Sciences.) Pp. xvii+312. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 18s.

Crop Management and Soil Conservation

By Joseph F. Cox and Dr. Lyman E. Jackson. (Wiley Farm Series.) Pp. xvii+610. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937.) 13s. 6d. net.

SOIL conservation is as old as, and might indeed be regarded as synonymous with, agriculture. Ancient China, India and Persia knew about it, but during the last century, while great advances have been made in the art of soil exploitation to satisfy the needs of rapidly expanding populations, little attention has been paid to soil conservation, with the result that soil fertility has declined

catastrophically and soil erosion has become almost universal. The consequences have been particularly disastrous in the United States, where the imperative necessity of putting back into the soil what pioneer farming took from it is now realized. At the present time, American agriculture is undergoing a fundamental and timely revolution, from which an art, as old as China and as new as the United States, will in due course emerge.

Prof. Gustafson gives a very clear account of the main principles of soil conservation. Little that the ancients did not know and practise has emerged during the renaissance of conservative agriculture, but ancient customs have been greatly modified to suit modern large-scale farming carried out with powerful instruments of destruction. Forests and prairies which under exploitative agriculture were regarded as inefficient forms of land utilization have earned renewed respect as far more efficient soil

conservers and flood controllers than any structure built by man. The evolution of the broad-based from the bench terrace as an efficient instrument for retaining water and soil, while not interfering with mechanized agriculture, is the most original feature of the new soil conservation. Listing, silt-pitting, strip-cropping, rotations are all modifications of ancient practices designed to curb the destructiveness of mechanized cultivation. Conservation of forest land consists essentially in managing the forest on a sustained-yield basis—a practice which comes naturally enough to the real forester but is something of an unwelcome innovation to the lumber baron. In short, the art of soil conservation is to treat the soil kindly, and its practice involves moderation in the use of already existing scientific equipment rather than the application of more science.

Science, however, can take a hand in flood control in badly eroded catchment areas where a highly specialized engineering technique is demanded; but even there it is now recognized that the engineer performs the surgeon's task of keeping the battered patient alive until Nature can complete a lasting cure with trees and grasses. An interesting application of meteorological data is the use of rainfall-intensity frequency charts in determining the design of flood-protection constructions.

"Crop Management and Soil Conservation" is a college text-book of conservation agriculture. The first part emphasizes the need for caution on the same lines as Gustafson describes, the second part tells the student how to farm for a living and possibly also for a profit. It is a straightforward guide to sound American farming. G. V. J.

More Chemical Encyclopædia

Thorpe's Dictionary of Applied Chemistry
By Prof. Jocelyn Field Thorpe and Dr. M. A. Whiteley. Fourth edition. Vol. 2: B1—Chemical Analysis. Pp. xxiii+712. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1938.) 63s. net.

THE second volume of Thorpe's "Dictionary" has made its appearance with commendable punctuality. In a foreword, the editors state that they have done their utmost to reduce the space occupied by organic formulæ, although they maintain, quite rightly, that a modern article on organic chemistry must be illustrated by elaborate formulæ. How much more, however, should an article on an industrial process be illustrated by elaborate drawings of plant? Yet these are mainly conspicuous by their scarcity. The new special drawings promised in the foreword appear to be about eleven in number and, of these, eight are small and purely diagrammatic. A cement kiln is allotted far less space than the six formulæ for cedrene and its derivatives, and many of the photographs give no useful information. The outstanding exception is the article on bromine, with ten good drawings reproduced from the Supplement.

The unfortunate choice of the same type for formulæ and the headings of the articles frequently makes it difficult to find a subject, particularly as no spacing is allowed between the end of one article and the beginning of the next, and confusion in reading is caused by the somewhat unusual practice of continuing the subject matter

of the first column in the second whenever a table intervenes which reaches across the page.

The greatest defect of the work is perhaps the lack of any kind of index, without which much useful material is bound to escape unnoticed. A brief list of the more important items which do not appear alphabetically under their own headings would take less time to compile than the thirteen-page list of abbreviations of the titles of journals and could be carried on from volume to volume.

The longer articles, largely written by men engaged in industry, are for the most part excellent, although, as is perhaps inevitable, there tends to be a lack of correlation between the number of pages devoted to a subject and its importance—for example, 14½ pages to rice and 2½ to wheat. In a few cases, there is a scarcity of references later than 1930, and an article on chemical affinity, in which 'activity' is scarcely mentioned and 'free energy' not at all, is unusual in 1938. Among much good matter, it is perhaps invidious to select individual contributions, but mention must be made of those on bromine, synthetic camphor, carboic acid, carbon dioxide, carbon disulphide, casein, celluloid, celluloid plastics (photographic film) and cellulose. All these abound with details which are not readily to be found elsewhere and inspire a feeling of reality.

The shorter items are, as in earlier volumes, clear and concise summaries, with references which form a useful starting point for further investigation. It is not quite clear why some of the halides and sulphides of carbon should have been grouped with phosgene under the heading "Compounds of

Carbon", while carbon tetrachloride and carbon disulphide are treated separately and the technically important dichlorodifluoromethane is omitted altogether. The avoidance of such grouping would materially assist the reader.

The article, "Chemical Analysis", deserves special mention. It is no mean feat to give a fairly detailed account of most of the branches of this subject in the space of 170 pages, but yet it is impossible to resist the feeling that the effort is largely wasted. The first fourteen pages are a paraphrase of the corresponding portion in the 1912 Dictionary, and seem to have been included owing to their historical interest. It does not appear possible otherwise to explain the poorly drawn and inaccurate illustrations, or the advice to fill a steam oven with toluene and to avoid the use of coal gas when making dry tests for sulphur. Electrically heated ovens and the many modern aids to analysis are barely mentioned.

The remainder of the article contains information to be found in most text-books on analysis, but frequently not in sufficient detail to enable an analysis to be conducted without further reference. Many of the interesting new reactions described in the Supplement have been omitted. One of the difficulties confronting the modern analyst is to decide which of several procedures to adopt, but in this respect no assistance is forthcoming. A recommendation by the authors of one particular method would have been more valuable than details of several.

From the reader's point of view, it would have

been advantageous to have limited the scope of the article to general and novel methods, leaving further details to be presented under the headings of individual elements. Aluminium, for example, is to be found under "Cobalt Nitrate Reactions", "Special Reactions", "Drop Reactions", "Beryllium", "Aluminium" (with instructions to heat alumina to 1,200° in a sintered glass crucible), "Volumetric Analysis" and "Colorimetric Analysis", in striking contrast to the convenient and admirable summary given under "Aluminium" and noticed in a previous review. The search for an analytical method is not facilitated by the absence of sub-titles at the head of the pages or by the arrangement of the elements in chemical groups for the first hundred pages in contrast to the alphabetical method adopted for the rest. The former is perhaps more scientific, but it is more difficult for the reader who may not have the Periodic Table at his finger tips and may wonder why "uric acid" should be placed next to "silicon".

Only ten pages are devoted to physical methods. The writer on "dielectric constant" (presumably, as an analytical method) has been unable to refrain from a digression into dipole moments, and it is a pity that space could not be found for a table of *raies ultimes* in the excellent account of the analytical applications of spectroscopy.

It cannot be denied that this is an interesting and valuable book. Whether it is worth while for those who already possess the last edition and supplements to purchase the volume is a matter for individual decision.

H. E. W.

Structural Evolution of Southern California

Structural Evolution of Southern California

By R. D. Reed and J. S. Hollister. Pp. xx+157. (Tulsa, Okla.: American Association of Petroleum Geologists; London: Thomas Murby and Co., 1936.) 2 dollars; 9s.

THE problem of structure of the Coast Ranges of California is by no means new. In fact, ever since the middle of the last century, when the first geological expedition went to California, it has been a subject of interest. Since the discovery of oil in Southern California, this interest in structural complexities has naturally been considerably enhanced. As a result, the State Mining Bureau and the United States Geological Survey have sponsored a great deal of survey work in this territory. Nearly the whole of Southern California has been mapped in detail, and widely differing theories on structure have been advanced

from time to time, many of which have been published.

R. D. Reed and J. S. Hollister, in the book under notice (in a sense a sequel to "Geology of California" wherein only casual reference was made to structural evolution), have made use of all published bulletins, papers, maps, charts, etc., available to them. No claim is made that all the opinions expressed are original. Their work has rather been the collection, correlation and sifting of all data, and an expression of views they have come to believe as a result of this spade-work.

On the problem of essential structure, the authors are impressed with the belief that post-Jurassic structural evolution has been dominated by distribution of fundamental basement types. Distribution of these types indicates that Southern California was divided in Lower Mesozoic times into six major palaeogeographical provinces;

accordingly, names have been adopted or invented for these provinces. The important "Franciscan" deposits appear to have accumulated in typical geosynclines and therefore their underlying "provinces" are designated geosynclines. Contiguous "positive" provinces are given names ending in "ia" as being comparable with hypothetical ancient lands such as "Appalachia" and "Cascadia".

The conclusion is reached that a local orogenic time-law holds good for provinces similar to one another in basement character; "... so far as the post-Franciscan history of Southern California is concerned, tectonically comparable areas seem to have been affected at all times by orogenic and epeirogenic forces". Were other regions of similar size and complexity to Southern California classified by the same geologist into tectonic belts, and a sequence of tectonic events for each belt and for the region as a whole worked out, this local orogenic time-law might be more extensively

generalized. Decision on this point, however, must necessarily be delayed for some time to come, owing to the volume of work involved.

The above is only one of many interesting suggestions put forward as a stimulus to further investigation of this fascinating problem. Actually Southern California is too small an area to throw much light on major structural problems concerning comparable world-wide tectonic movements, but the results achieved by systematic assembling of data necessary for rational theorizing on Coast Range structure must prove of great interest to those concerned with major geotectonic problems.

The authors are to be congratulated on a text which lifts mere compilation of data to a high plane of scientific interpretation and constructive philosophy. A modest ending, suggesting that every reader may be "inspired to invent better theories for himself and will readily succeed", only serves to sustain the reader's confidence in the soundness of the authors' thesis.

Cellulose

(1) An Introduction to the Chemistry of Cellulose

By J. T. Marsh and Dr. F. C. Wood. Pp. xv + 432 + 18 plates. (London: Chapman and Hall, Ltd., 1938.) 21s. net.

(2) Die Chemie der Cellulose:

unter besonderer Berücksichtigung der Spinnfaser- und Zellstoff-Industrien. Von Prof. Dr. Carl G. Schwalbe. Zweite völlig umgearbeitete Auflage. Hälfte 1, Abteilung 1: Die Chemie der Hölzer. Pp. viii + 451. (Berlin: Gebrüder Borntraeger, 1938.) 24 gold marks.

CELLULOSE, the structural basis of the vegetable world and the raw material of the cotton textile industry, has long been the subject of scientific investigation. Within comparatively recent years its chemical constitution, in particular the length of the chain molecule, has been approximately determined, though the view is gaining ground that the properties of normal cellulose only reflect the average characteristics of the ultimate units of cellulose of which it is composed.

The industries which concern cellulose are so numerous and in many respects so different the one from the other that those engaged in them have a variety of problems to study. Nevertheless a good general knowledge of the behaviour of cellulose is the first requisite, and the progress of the last few years, both on the scientific side and

in regard to practical application, has enabled a considerable number of facts to be established, including physical data, which will facilitate further attack on the riddle presented by this most remarkable of all natural materials.

(1) This book is sponsored by Sir Kenneth Lee, who affirms that the close correlation of science to the textile industry has already had a profound effect on its development. The authors claim it to be a relatively simple book which may act as a guide to chemists engaged in the cellulose industries. The scope is best judged from the chapter headings—general properties, dispersed cellulose, modified cellulose, cellulose derivatives, constitution and structure. Being intended for experts, it is scarcely readable in the ordinary sense; but is full of informative detail. It cannot fail to be useful, more particularly since the literature of the subject is widely scattered, often in journals which are not everywhere available.

(2) Dr. Schwalbe wrote an important book on cellulose in 1911 which was very rapidly taken up. Various reasons have delayed the production of a second edition until he has retired from active work. A comprehensive text-book of the whole subject in the old German style is now planned in four volumes of which this, the first, deals with wood alone. For those primarily interested it will no doubt be found exhaustive, though, to judge from the references, very little British work has been considered.

Geology of the Tampico Region, Mexico

By John M. Muir. Pp. xix+280+16 plates. (Tulsa, Okla.: American Association of Petroleum Geologists; London: Thomas Murby and Co., 1936.) 19s. 6d.

KNOWLEDGE of the geology of the Tampico region of Mexico has been gradually amassed over a period of years by geologists and others interested in the development of its oil resources. In 1928, an attempt was begun to collect and correlate information from various fields and this work proceeded intermittently until 1934, when it was decided by the Executive Committee of the American Association of Petroleum Geologists that the results should be published in a separate volume. When it is realized that hitherto no attempt had been made to assemble and present in book form existing knowledge of the geology of that region, it will not be difficult to assess the value of this work, particularly to future workers in the oilfields.

The first half of the book is concerned with stratigraphy and paleogeography of the region. Rocks outcropping in the Tampico Embayment range in age from Middle Cretaceous to Miocene, while beyond its northern and southern limits Paleozoic and Jurassic rocks are found. Descriptions of all the formations encountered are given in considerable detail. The latter half of the book is devoted to an account of structural features of the northern oilfields situated on the southern prolongation of the Sierra Tamaulipas anticline and the Southern Oilfields which extend from about 48 to 90 miles south of Tampico. Main occurrences of oil are described and attention directed to particular characteristics of individual pools caused not only by structural differences but also in most cases by slight facies-changes in the sediments. Throughout the major period of exploitation the southern fields were considered economically to be of far greater importance than the northern fields, but since 1933 this assessment has been reversed. In the appendixes valuable data are given on oilfield temperatures, well pressures, their stripping, shooting and acid treatment. Finally, there is an excellent bibliography of Mexican oilfield geology which, together with the text of the book, forms a useful record of the advancement of geological knowledge in this region during recent years.

The History of the Telephone in the United Kingdom
By F. G. C. Baldwin. Cheaper edition. Pp. xxvi+728+75 plates. (London: Chapman and Hall, Ltd., 1938.) 15s. net.

THE reprint of this history is the same as the first edition of 1925, but it may usefully be recalled that the author brings together representative material relevant to the development of the telephone service in Great Britain from the invention of the telephone more than sixty years ago until 1912, when the main body of the telephone system was brought under the unified control of the State, with details of machine-switching and long-distance telephony up to 1922, which preceded the inauguration of unified control of international telephony by a consultative committee. The author, sponsored by

Mr. Frank Gill, chief engineer of the National Telephone Company between 1902 and 1913, modestly claims that he has prevented historical material from straying, but he has certainly anticipated what he expects a later writer to do, critically to describe the problems of exploitation of an invention in many respects still similar in essentials to its original form, and draw lessons from a balanced view of the past.

Telephony in Great Britain was from the first parochially conceived, harshly restricted by legislation, and hidebound by patents; can we or can we not blame the powers that were for not realising that telephony was to become a powerful public service and treating it accordingly? A parallel history could be written around the supply and distribution of electric power, which is yet to be straightened out. The present rapid increase, as compared with other countries, in both the use of telephony and the consumption of electric power, can be traced to our backwardness following early restriction. That history can teach lessons to authorities is illustrated by the fact that the present radio-relay services are to be taken out of the hands of private companies in the next year or so, before their development gets out of control. L. E. O. H.

Adventures with Living Things:

a General Biology. By Elsiebeth Kroeber and Walter H. Wolff. Pp. xiii+798. (Boston, New York and Chicago: D. C. Heath and Co.; London: George G. Harrap and Co., Ltd., 1938.) 1.96 dollars.

THE teaching of biology is still in the experimental stage in Great Britain; and, as shown by the large number of good American texts on the subject, there is much to be learned from the methods adopted in other countries, especially the United States. The book under review is a case in point. For in it, a wide, though general, survey of the plant and animal kingdoms is made, the 'type system' is disregarded, and there is no suspicion of dividing the subject into the two sections, botany and zoology. Most authoritative surveys and reports on the teaching of biology, including the recently issued report of the Spens Committee, are agreed that the best approach to the subject is through natural history: and this is the method adopted in this book. The authors have shown breadth of vision, and their text is supported by nearly five hundred excellent illustrations, mostly photographs—which are desirable in the early stages of teaching.

Part 1 approaches the subject through natural history, and is a descriptive account of living things. Part 2 is the functional approach, and deals with the way organisms live and reproduce. Part 3 considers the great generalizations of biology, such as unity in organisms, heredity, evolution and human betterment through biology.

The scientific attitude is inculcated and the scientific method adopted throughout by periodic insertions of practical work, problems for class discussion, supplementary activities for the biological novice and bibliography.

The book can be recommended as a guide to the teaching of biology in Great Britain.

Forest Protection

By Prof. Ralph O. Hawley. Pp. ix+262. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937.) 13s. 6d. net.

THIS book consists of part of the material originally included in the author's "Practice of Silviculture" considerably extended. To some extent, the outline follows European standard works. A notable departure, which in connexion with the United States is readily comprehensible, is that something near one half (117 out of 247 pages) of the book (Chapters viii-xiii) is devoted to forest fires, their suppression, control and so forth.

In the minds of some American authors, there would appear to be doubt as to the borderlands separating different branches of forestry science. It is, of course, obvious that to a varying degree they must run the one into the other. It is therefore all the more necessary that the writers of text-books should reach as clear an understanding as possible in this matter.

Surely since the work in question is entitled "Forest Protection" it was unnecessary for the author to write in his preface "This book is not intended to be an engineering or administrative manual for any of the phases of forest protection". The trained forester will understand the meaning underlying these words, but in the case of a book for the student of forestry they appear out of place.

The book is not illustrated. It is to be hoped that in a subsequent edition the author will supply this want since illustrations are almost essential for the student.

A Text Book of the Differential Calculus

By S. Mitra and G. K. Dutt. Pp. xiv+302. (Cambridge: W. Heffer and Sons, Ltd., 1937.) 10s. net.

THIS book has been written to supply the special needs of teachers and students in Indian universities. The authors have aimed at making the subject clear to the ordinary reader equipped only with an elementary knowledge of algebra and trigonometry. The foundation is well laid in the early chapters, which are devoted to a full and lucid discussion of variables, bounds, limits, continuity and infinitesimals. This part may provide rather stiff reading for beginners; but the time spent on it will, as the authors point out, "lead to a much better comprehension of the essential principles of the calculus". There follows a rigorous development of the standard results connected with the differentiation of functions of a single variable, leading to a consideration of the chief properties of infinite series and their convergence, maxima and minima, implicit functions and changes of variables. The latter part of the course is devoted mainly to the applications of the principles of the differential calculus to geometry, and, in the selection of the examples, a careful consideration has been given to the needs of students not only of pure mathematics, but also of engineering and the natural sciences.

The text throughout is rigorous, lucid and up to

date and is well illustrated both by clearly drawn diagrams and skilfully chosen exercises.

Exposés de Physique atomique expérimentale

6: Spectrographie de Masse; les Isotopes et leurs Masses. Par Louis Cartan. (Actualités scientifiques et industrielles, 560.) Pp. 91. (Paris: Hermann et Cie., 1937.) 20 francs.

THE author's own researches in the field covered by this volume enable him to discuss with both brevity and thoroughness the technique and results of the new spectrometry and to show their bearing on such questions as the energy and stability of the nucleus. The first part treats of the masses and the methods and instruments used in measuring them, from that of Aston of 1927 to the double-focusing ones of the present day. The second deals with isotopes, including those of artificial radioactive substances, their detection and measurement, and the third with the principal numerical relations, such as that of the mass to the charge of the nucleus, and the even and odd law, which have been discovered among the 260 isotopes at present known. The volume is well supplied with plates, figures, numerical tables of results, and a bibliography brought well down into 1937.

Physics for Technical Students in Colleges and Universities

By Prof. William Ballantyne Anderson. Third edition. Pp. xi+807. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 24s.

THIS is the third edition of the author's book and shows the result of long teaching experience in American colleges. The entire manuscript of the new edition has been carefully revised by the author and his engineering colleagues; and many new diagrams and problems have been introduced. The superiority of the metric system is recognized, but the British engineering system, in which the 'slug' is the unit of mass, is frequently used and is recommended to students. It may be pointed out that Henry Cavendish, who weighed the earth, was a younger son of Lord Charles Cavendish, and is not correctly described as 'Lord Cavendish'. The chapters on rotary motion and on uniform circular motion deserve special commendation, and the whole book should serve its purpose admirably.

Handbuch der biologischen Arbeitsmethoden

Herausgegeben von Prof. Dr. Emil Abderhalden. Lieferung 467. Abt. 5: Methoden zum Studium der Funktionen der einzelnen Organe des tierischen Organismus, Teil 10, Heft 7. Allgemeine und vergleichende Physiologie. Pp. 1235-1474. (Berlin und Wien: Urban und Schwarzenberg, 1938.) 13 gold marks.

THIS section contains articles on light-sources for physiological purposes and on methods of measuring and recording electrical changes by M. Wreschner, on the mechanical disintegration of tissues by M. Behrens and on chromatographic analysis by A. Winterstein.

The Swanscombe Skull*

IN view of the importance of the discovery in 1935 and 1936 by Mr. Alvan T. Marston of two bones of a human skull, associated with implements of Acheulean type, in Pleistocene gravels of the Barnfield pit, near Swanscombe, Kent (see NATURE of October 19, 1935, p. 637, and August 1, 1936, p. 200), a research committee was appointed by the Royal Anthropological Institute in 1937 to examine and report on the discovery in all its aspects. Further excavation was carried out on behalf of the Committee by Dr. M. Aylwin Cotton of the Institute of Archaeology, the cost being borne by a grant of £50 made by the Council of the Royal Society. Publication of the report has been assisted by the Trustees of the British Museum.

The findings of the Committee are based upon reports by specialist members of the Committee, which appear as chapters, ten in number, in the report, and following a general description of the site, deal respectively with geology, palaeontology, archaeology, including an account of the further excavations contributed by Dr. Cotton, correlation of the deposits, the general features of the bones, their form, and the endocranial of the brain.

The Barnfield pit, which is situated about half a mile to the north-west of Swanscombe, between Dartford and Gravesend, has long been famous as a rich source of the implements of palaeolithic man and of the remains of Pleistocene mammals; but no human skeletal remains had been found previously. This is also the first occasion on which human remains have been found definitely in association with an Acheulean industry not only in Britain, but in Europe generally.

The deposits belong to the Boyn Hill or 100-ft. terrace of the Thames. A uniform stratification makes it possible to recognize local sub-divisions, in sequence from above downward, of upper gravel and hill wash, upper loam, middle gravel and sands, lower loam, and lower gravel. The deposits lie in a channel, running from west to east, cut in the chalk and Thanet Sands. A subsidiary channel, or possibly scour, containing false-bedded gravel, has cut down through the lower middle gravels through the lower loam to the lower gravel. The two cranial fragments were discovered in an obliquely bedded gravel in this subsidiary channel. This seam is the lowest member in a series of eight similar seams between

the lower middle gravel and the upper middle gravel series. The bones are unquestionably indigenous to the series.

The fossil mammalian remains, of which the examination by Mr. M. A. C. Hinton is not yet complete, include, according to a tentative identification, *Elephas antiquus*, *Rhinoceros hemitoechus*, *Bos primigenius*, *Dama clactoniana*—a species at present known only from Britain—and *Equus caballus*—a fauna predominantly of a woodland type, and of an interglacial facies.

A report on the stone industries by Mr. C. F. C. Hawkes, with the co-operation of Dr. K. P. Oakley and Mr. S. Hazzledine Warren, enters into a detailed analysis of the content of each stratum. This analysis is of importance not only as fixing definitely the place in the cultural series of the implements associated with the human remains, but also for its examination of the attribution suggested by Mr. Marston of the industries of the lower and lower middle gravels to the Challean, or Abbevillian industry, as it is now termed.

The cultural succession, as determined by the report, definitely rules out the Abbevillian attribution, assigning the industry of the lower gravels to Clactonian II, but somewhat prior to Clactonian II of the type site. The lower loam is sterile, such implements as it contains showing evidence of exposure, and evidently having sunk through. The industry is still Clactonian, though of a somewhat more advanced type than that of the lower gravels. The industry of the lower middle gravels is characterized by the number of hand-axes. It was formerly (1912) denominated "Chelles or a transition to St. Acheul"; but it is here assigned to Early Middle Acheulean, the Acheulean III of Breuil; while the large number of flakes may be classed as flake-products of the same Acheulean industry. A small proportion utilized still represent the Clactonian tradition.

Mr. Marston here also assigned certain of the hand-axes to the Abbevillian on the ground of the crudity of their workmanship; but it is pointed out that crudity is not necessarily an indication of relative age, and that the industry must be taken as a whole, when its essential unity appears as entirely of the Early Middle Acheulean.

The industry associated with the skull fragments is regarded as belonging to exactly the same culture as that from the lower gravels. Above the oblique seams of gravel, in which the seam containing the skull fragments is the lowest, the channel is filled by a stratum of gravelly silt, over

* Report on the Swanscombe Skull prepared by the Swanscombe Committee of the Royal Anthropological Institute. Reprinted from the *Journal of the Royal Anthropological Institute*, 68, 1, 1938. Pp. 17-96 + 6 plates.

which the upper middle gravel series continues in the form of horizontally bedded yellow sands, covering the channel and the lower middle gravel surface flanking it. These deposits are not rich in implements, and nothing suggesting an advance in human material culture has been recovered from them. The yellow sands are uniformly sterile and the skull layer is thus well insulated against conflation with any subsequent cultural development. This is reinforced by the upper loam which again is sterile; and only from the top surface have any further implements been obtained. Such flakes and hand-axes as are yielded by the upper loam show that at this stage the culture prevalent at Swanscombe was still Acheulean. Some advance is suggested by 'sub-cordate' or 'sub-ovate' types; but they have never yet been found *in situ* in the Barnfield pit. A sign of real innovation are the primitive 'tortoise' cores associated with hand-axes in Rickson's pit, in which the earliest stage of the Levallois industry has been recognized. The whole evidence from the overlying strata confirms the inviolable association of the skull with a pure Early Middle Acheulean industry, which already, on the evidence of the artefacts alone, had been assessed by Breuil as Acheulean III.

Dr. K. P. Oakley discusses the correlation of the deposits. The gravels of the 100 ft. terrace must be diagnosed as interglacial and as younger than the Lower Chalky Boulder Clay. This is

supported by the fauna and the glacial erratics. From the geological and archaeological evidence no doubt can arise that the middle gravels are older than the main Combe Rock stage. If the industries correspond with Middle Acheulean III, in the Somme Valley Middle Acheulean is assigned to the Mindel-Riss interglacial, and it would seem that the middle gravels at Swanscombe must also be regarded as belonging to that period.

The anatomical and anthropological characters of the skull have been examined by Prof. W. E. Le Gros Clark and Dr. G. M. Morant. The fragments found are the occipital and left parietal. Both are nearly complete and articulate perfectly. The individual to whom the bones belonged was probably female and died in her early twenties. In two respects only do they show any significant difference from a modern skull of *Homo sapiens*, namely, in the unusual breadth of the occipital bone and in the thickness of the bone. The endocranial cast shows no feature which serves to differentiate it from the endocranial cast of modern human skulls. The series of measurements fall well within the range of the modern human female skull. The estimated cephalic index is in the neighbourhood of 78 and the cranial capacity 1,325 c.c., which would be unexceptionable in a modern female skull. The missing parts of the skull, however, might have been so formed as to provide clear evidence of differentiation from modern man.

McDougall's Experiments on the Inheritance of Acquired Habits

IN a series of papers extending over a period from 1926 until 1938, Prof. William McDougall brought together evidence which led him to suppose that the hypothesis of Lamarck concerning the inheritability of acquired characteristics is substantially correct.

In designing his experiments, McDougall kept in mind two principles which previous investigators have overlooked. These are, first, that "the adaptation investigated should be achieved by the intelligent purposive efforts of the organism concerned", and, second, that it should be of such a nature that slight degrees of adaptation should be measurable, for it has already been shown by Lamarck's opponents that acquired characteristics are not transmitted as "perfected wholes of structure or function". Hence, if Lamarckian transmission is to be found at all, it should be looked for as some "slight increase of facility in the acquisition of the modification acquired by the parent". Many generations would

probably be necessary, therefore, before any very marked changes appeared.

White rats were chosen as subjects for this experiment since it was possible to obtain an initially pure strain (Wistar), and since the breeding habits of rats allow a large number of generations to be studied in a reasonable length of time. A preliminary experiment showed deterioration in performance with successive generations, due, apparently, to an increasing fear of electric shock. The final form of the experiment, therefore, was designed to develop such a phobia. To this end, an apparatus was constructed consisting of three parallel alleys, the central one serving as an entrance and the outside ones as exits to a platform. The apparatus was filled with water, and the motivation was escape from the water to a dry platform. Of the two exit alleys, one, the shocked pathway, was brightly illuminated while the other, the free pathway, was kept dim. The task confronting the animals, therefore, was to escape from the water

through the dim alley, the 'error' of choosing the bright being punished by an electric shock of tetanizing strength. The strength of the shock was varied from animal to animal to obtain this behavioural effect with all of them, and tetanization lasted for three seconds. To avoid position habits, the 'correct' alley was alternated from left to right of the central. This alternation technique, however, allows no control of any alternation habits adopted by the rats. Rats were placed in the apparatus in batches of about six at a time and were given six trials daily. The primary measure of any Lamarckian inheritance was the total number of errors made in reaching a criterion of mastery of twelve successive errorless trials, though note was also taken of any pre-training preference for the dim path.

McDougall's conclusions rest, in the main, on the results obtained with three groups of rats, an experimental group (or Tank group), a control group, and an experimental group obtained by adverse selection from the control stock. The Tank rats were originally obtained from Wistar stock, and subsequent generations were obtained by mating trained members of this stock according to a random selection. The only conscious selection of breeding stock was in the rejection of obvious runts. The control stock does not show the same continuity and inbreeding. McDougall's early intention was to use half the original Wistar stock as controls and breed from members trained in some task other than that of the experimental group. This stock, however, seems to have been abandoned, and subsequent controls were obtained direct from the Wistar Institute, or, in some cases, from other laboratories. The adversely selected experimental group represents an attempt to balance any unconscious favourable selection in the Tank rats by breeding from the worst animals in each generation.

The results with the Tank rats show a progressive improvement from generation to generation, until by the thirty-fourth, the average total number of errors per rat had decreased from an estimated 120 for the first generation (McDougall's records are incomplete before the fourteenth), to 36 for the thirty-fourth. This improvement in error scores seems to be correlated with an increase in timidity, cautiousness or hesitancy. 'Normal' learning shows an initial period of rapid, chance reactions, followed by a pre-solution period of hesitancy with oscillations from one exit to the other. This hesitancy developed earlier in the training period with successive generations of Tank trained rats, and is regarded as the probable cause of the decrease in errors. The adversely selected stock similarly show a very marked improvement, the total average error decreasing from 215 to 43

in fourteen generations. However, the control groups also show a decrease in errors. Groups obtained from Wistar stock in 1926, 1927, 1930 and 1932 show a decrease from 149 to 102. Admittedly, this decrease is by no means as large as those of the experimental groups, but neither the number of generations tested nor the environmental conditions of the groups are at all comparable. McDougall interprets the improvement in the control groups, which had had little contact with his laboratory and whose only relation with the experimental groups was that they too were Wistar rats, as indicating a probable improvement in the entire Wistar stock, for reasons which he is unable to suggest. The possibility that there was an improvement in his experimental technique should also be taken into account.

McDougall's experiments have been repeated by Crew and Agar, neither of whom have obtained any evidence of Lamarckian inheritance. Both these experimenters have attempted to duplicate McDougall's apparatus, but have changed the procedures somewhat to obtain what they consider to be more trustworthy results. Thus, Agar standardized the strength and duration of the shock, and abandoned McDougall's group method of experimenting in favour of the more usual individual trials. Crew, on the other hand, retained the group method and used McDougall's tetanizing criterion of the strength of shock, but introduced marked changes in training, giving his animals a hundred trials before the introduction of shock instead of McDougall's six. All these changes, however, though likely to produce marked changes in the rate of learning of any given group of rats, should be relatively unimportant in producing different rates of learning in successive generations, provided the same technique is rigidly adhered to throughout any given experiment.

Explanations of McDougall's results as due to variations in the strength of shock used imply a gradually increasing strength with successive generations. Since there is no evidence either that such a gradual increase did take place, or that the rate of learning is affected by such small variations as would be necessary with each generation to keep within the limits of variation admitted by McDougall, such explanations cannot be regarded as satisfactory.

Other criticisms have, in the main, accepted McDougall's technique as sufficiently consistent throughout the experiment, but have endeavoured to explain his results in terms of factors other than that of the inheritance of acquired characteristics. One obvious criticism, advanced by Sonnborn and Agar and examined by Crew, is that McDougall unwittingly selected the brightest animals in his experimental group for breeding. That this is

possible in apparently random selection is known to everyone who has worked with animals for any period. However, Crew was satisfied that in his case there was no such favourable selection and thinks it unlikely, therefore, that there would be in McDougall's experiment, and, furthermore, McDougall specifically controlled for such selection in his group of adversely selected animals. The fact that these animals also gave evidence of increased facility with successive generations makes it relatively unimportant whether or not there was favourable selection in his Tank rats.

Both Agar and Crew have criticized McDougall for failing to maintain adequate control groups in his experiment. Agar points out that over a long period of intensive inbreeding there may be progressive changes in the general constitution of the animals, and that such changes might facilitate the performance of McDougall's task. Since all these experimenters agree that less vigorous animals learn more quickly on this task, this criticism may be valid. McDougall states in answer to it, that he observed no such progressive change, but the only really satisfactory control would be the maintenance of a group from the same original stock, subjected to the same laboratory conditions, and inbred in a similar manner.

Crew criticizes McDougall for not having maintained adequate pedigree charts, so that he is unable to say which of his original stock are represented in his later generations. Crew's analysis of his pedigree and record charts led him to postulate the existence of 'quick' and 'slow' rats, 'quickness' being a Mendelian dominant and 'slowness' a recessive. On these grounds, he explains the improvement in the average number of errors per rat in McDougall's experiment as showing merely an increasing number of 'quicks' per generation. As he further states that a 'quick' may make a poor score owing to the action of numerous chance factors, adverse selection may result in a heterogeneous group of 'slows' and 'latent quicks'. If now unconsciously favourable selection is exerted, the 'latent quicks' may be chosen for breeding, and hence a decrease in average errors could be expected. While it may be that rats do differ in some general factor, especially in some such factor as 'photo-phobia', Crew's explanation of the results of McDougall's adversely selected group seems somewhat improbable, particularly as 'latent quicks' keep appearing for fourteen generations.

None of these experimenters seem to have considered the work of Tryon in breeding 'bright' and 'dull' strains as measured by maze performance, or Krechevsky's analysis of these strains. Tryon has bred rats selectively according to their ability on the California automatic maze, and, in

a very carefully controlled experiment, has shown clearly that the offspring of 'bright' parents contain more 'brights' than 'dulls', and the offspring of 'dulls' more 'dulls' than 'brights'. The interesting point here in connexion with Lamarckian inheritance, however, is that both strains, 'dulls' as well as 'brights', became progressively better at learning this maze. Tryon inclines to the belief that increased vigour was responsible for the improved performance, but admits the possibility of Lamarckian inheritance.

Krechevsky has analysed the performance of these strains on various problems, and has concluded that they do not differ in any general factor; that is, 'brights' are not 'brights' on all problems, but rather that the difference is one of specific abilities. 'Brights' are good at maze problems because they utilize 'spatial hypotheses' almost entirely, that is, their reactions are governed by spatial cues, while the 'dulls' use primarily visual hypotheses. This penalizes them on a maze, but might assist them in any brightness discrimination test. On McDougall's test, one would assume that Tryon's 'dulls' would be Crew's 'quicks', because they would be 'photo-phobic' and would react on a basis of the differential illumination of the two paths, while the 'brights' would more readily adopt spatial hypotheses such as position or alternation habits.

The position regarding Lamarckian inheritance of acquired habits, on the basis of these experiments with rats, seems to be as obscure as ever. McDougall and Tryon have obtained evidence of an increased facility on a specific task with successive, trained generations; Crew and Agar, under conditions resembling McDougall's, have obtained no such evidence. The reasons for this discrepancy are not clear from the published accounts. It may well be that faults in the experimental techniques are responsible, and that this particular technique will not give trustworthy results concerning inheritance.

McDougall's task is open to criticism on two lines: (1) that an avoidance habit is not really suitable for an inheritance problem, since avoidance reactions are closely knit with such innate factors as fear, timidity, etc., the inheritance of which may certainly not be Lamarckian; and (2) that it provides a very untrustworthy measure of learning ability. All the experimenters who have used it comment on the large element chance plays in producing behaviour which meets the criterion of learning adopted. Crew, in fact, states that thirty-nine of his animals never received a single shock, and, therefore, obviously cannot have 'learned' the differentiation. Others may satisfy the criterion merely by adopting an alternation habit which happens to coincide with the alternation

of the 'correct' alley. If they get 'out of step' they may then make 100 per cent errors. That such an occurrence is possible betrays a poor experimental technique, and raises serious doubts as to the validity of any results obtained with it. Furthermore, the practice of allowing animals to escape by the 'wrong' alley, differentiating it as an error merely by the presence of shock, is poor from the point of view of speed of learning, and trustworthiness of results. Apart from the chance factor as to when and how often the animal encounters both conditions of escape-shock and escape-no-shock, a violent shock can produce marked neurotic symptoms, which may result in purely random activity, or may, in some cases, result in a stereotyping of the error. Crew, in fact, gives a vivid description of violent, emotional and purely random activity lasting for as long as a hundred trials resulting merely from one violent shock.

Without enumerating more of such experimental artefacts here, it is obvious that trustworthy

comparisons between successive generations would be a very hazardous task where chance factors can have so marked an effect on the rate of learning. Future research would do well to use a more trustworthy task, and to control not only the constitutional factors so rightly emphasized by Crew and Agar, but also that type of factor shown by Kroechevsky to be responsible for the differentiation between Tryon's strains. G. C. DREW.

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Obituary Notices

Dr. Calvin B. Bridges

THE untimely death of Dr. Calvin B. Bridges, of the California Institute of Technology, on December 27, a fortnight before the fiftieth anniversary of his birthday, will be deeply mourned by the many who appreciated his work and his personality.

One of the foremost in the iconoclastic work of creating the modern science of genetics, in the place of what passed as the 'classical' points of view in that field, Bridges was notable also as one who approached the wider problems of life in a spirit as rationalistic and as unfettered by traditional dogmas as that in which he dealt with his own speciality, and although he held no teaching positions, his influence in the suffusion of this attitude was considerable.

Bridges was brought up in a small town in the wilds of Northern Lake Champlain, in a family of very moderate means, of pre-revolutionary American stock (including even an American Indian strain). At Columbia College he naturally gravitated into scientific lines and, although he was hampered by the need of earning money while studying, both for the support of himself and, very soon, of a family, his initiative and ability won him in 1910, while yet an undergraduate, a position as personal assistant to Prof. T. H. Morgan in the work which the latter was just beginning on *Drosophila melanogaster*. Bridges' chief task here was to look for and test mutations, and practically his entire career has been an expansion of this work, in which he quickly became the leader. Almost immediately the work proved to be the beginning of a new trail. It became

Bridges' passion to follow out this new trail logically everywhere it led, and to work and rework it until it became a broad highroad with many branches, opening up hitherto unsuspected territories. Often the results thus arrived at were in conflict with older beliefs, based on less exact evidence, and in ruthlessly brushing aside the latter he naturally aroused the opposition of those who could not abandon the older modes of thought.

Bridges carried out the same kind of process in regard to the more general problems of the time and in his own personal living, thereby suffering considerable misunderstanding and antagonism on the part of others, which hampered him in the pursuit of his profession. But he always remained true to his own concepts and ideals and did not dissimulate. His open designation of himself as "atheist" in "Who's Who in America" and his opposition to the invasion of the Soviet Union by the Allies shortly after the Great War illustrate his uncompromisingness where his theoretical convictions were concerned, and his lack of faith in prevailing doctrines and institutions. In place of the latter, however, he substituted an ardent belief in the success of future human co-operation, in matters social and economic, and in the radical application of physical and biological science, including genetics, to human affairs.

Through the remarkably energetic and methodical character of his scientific work, including such an apparently trivial but effectively revolutionary change as the introduction of the binocular microscope for the examination of *Drosophila* material, he succeeded in

finding considerably more spontaneous mutations than all other *Drosophila* workers together. He made it his duty to determine the place, in the genetic scheme, of all the changes which he found, and continually to refine upon the conceptual system which they constituted and which, as his work helped to prove, represented the actual material plan of the germ plasma. It was in the course of this systematic testing that he happened, one after another, upon that series of unusual cases which proved to be, not mutations in individual genes, like the rest, but abnormalities of whole chromosomes, of chromosome parts, and of entire sets of chromosomes, and which served as the starting point of most of our modern knowledge of 'chromosome mutations'.

The first of these great contributions of Bridges to genetics was his discovery of non-disjunction, first of the sex chromosomes (1913, 1916) and later of the fourth (1921), together with his working out of its mechanism and of its cytology. It was the striking visual demonstration of the chromosome theory of heredity thus provided which first convinced Bateson, and along with him many other sceptics, of the truth of this theory as a whole. But at least equally important, in its actual pushing forward of our genetic knowledge (as distinguished from the confirmation of things for which cogent evidence really existed already), was his discovery and working out of cases of deficiency (1915, published 1917, *et seq.*) of a part of a chromosome, and of the first translocation (1918, published 1919, *et seq.*). His discovery of triploids (1921), with its proof of the then disputed idea that sex determination depends upon the relative doses of interacting genes, opened up new chapters in our understanding not only of sex determination but also of the manner in which genes in general exert their effects. While in the interpretation and in the planning of the attack on all these cases he enlisted the forces of the whole group of *Drosophila* workers, his initial discovery of the cases, his recognition of the fact that their peculiarities were such as to make them worthy of special studies, and his exemplary prosecution and presentation of these studies themselves, were direct results of that combination of assiduity and intelligence, of method, of painstaking attention to detail, and of following up all clues to their logical conclusions, which always characterized Bridges' manner of working.

In recent years, applying this same meticulousness to the cytological investigation of the giant (multiple) chromosomes of the salivary glands, the possibilities of which had been revealed by Painter (1933 *et seq.*), Bridges, working with renewed vitality on this new branch of the old trail, succeeded in developing amazingly upon the technique and the exactitude of the results; he invented (independently of Koltzoff) the 'polytene' explanation of these chromosomes, and made the important discovery that the remains of 'duplications' produced in past evolution by a process of chromosome breakage and reattachment of parts, similar to that occurring in observed translocations, could still be detected by direct observation in the chromosomes normal to the species. This, and the gathering together and systematization of the multi-

tudinous extant material on *Drosophila* mutations and technique, in the 'Drosophila Information Service', constituted the invaluable work upon which he was still engaged at the time of his death.

Bridges suffered more than most men of science from the hardships attendant upon the following out of new trails of thought and action both in his scientific work and in general. But, though in a sense single-minded, he preserved his early freshness of attitude, boyish enthusiasm, sunniness of character and friendliness. He did not let scientific rivalry interfere with his personal friendships, and threw himself into them whole-heartedly and without suspicion. Combined with calculation, he preserved a charming naiveté. He was most patient and kind in helping less advanced workers. He was engrossed in his work to a point of absent-mindedness which became a byword to others. His personality was such that it is likely to pass into legend. But his work will undoubtedly form a solid indestructible part of the basic structure of all future biological science.

H. J. MULLER.

Mr. M. A. Phillips

MR. MONTAGU AUSTIN PHILLIPS, the well-known lecturer on natural history subjects, died on January 11, aged fifty-nine years. He had been for many years associated with the British Museum (Natural History) where he acted as a deputy guide-lecturer. Originally he assisted the late Mr. J. H. Leonard, the first official guide-lecturer to be appointed at the Museum, and after Mr. Leonard's death in 1931 he carried on the whole of the guide work until the appointment of the second official guide-lecturer, Miss Mona Edwards, in October 1932. From that time onwards, Mr. Phillips acted as an auxiliary lecturer at the Museum, and was so engaged up to the close of last year, when ill-health caused him to abandon his work. In addition to lecturing in the Museum he had for many years been a well-known lecturer at schools, societies and field-clubs and travelled extensively in connexion with this work. In his lectures, Mr. Phillips had a certain charm of manner which made even the dullest of subjects attractive to his audience, whether it was a large audience at a 'sit-down' lecture or a small group of people in the Museum Galleries.

Mr. Phillips was educated at King's College, London, and was a fellow of most of the senior scientific societies, including the Linnean, Zoological, Geological, Geographical and Royal Entomological Societies; he was in addition a member of the British Ornithologists' Union and was associated also with the Royal College of Organists, being an enthusiastic musician.

GUY DOLLMAN.

Dr. C. J. Gahan, keeper of the Department of Entomology in the British Museum (Natural History) during 1913-27, on January 21, aged seventy-seven years.

Prof. A. Sauveur, professor of metallurgy in Harvard University during 1906-35, aged seventy-six years.

News and Views

Co-operation Between the Nations

ON Friday, January 27, there was broadcast in the news bulletin in German sent out by the B.B.C., and again in the news bulletin in English later in the evening, an appeal, signed by eighteen leading men in science, literature, the arts, and medicine in Great Britain, to "men of good will who value the fruits of civilization" to join together to prevent the catastrophe of war. "A spirit of uneasiness broods over the world", the appeal began, and the peoples everywhere, while they know that warfare between modern States can bring no final good, see the armaments of the nations ever growing. It is time for men to break down the artificial barriers of hatred by which they are in danger of being divided, and "to speak across the frontiers to those who feel as they do". The appeal concluded: "We appeal above all to leaders and people in the great German Reich to use those great gifts by which they have for centuries enriched our common heritage in all fields of human knowledge and activity and to join with us in a supreme effort to lay the spectre of war and enmity between nations, and in a spirit of free and willing co-operation, by which alone can their needs and ours be satisfied, to build with us a better future so that we may not only preserve civilization but hand it down to our children enhanced by our experience".

THE signatories of this dignified appeal were: Lord Willingdon, Lord Derby, Lord Dawson of Penn, Lord Horder, Lord Macmillan, Lord Stamp, Mr. Montagu Norman, the Right Hon. H. A. L. Fisher, Prof. G. M. Trevelyan, Lord Eustace Percy, Sir Michael Sadler, Dr. Vaughan Williams, Sir William Bragg, Sir Arthur Eddington, Sir Edwin Cutyens, Sir Kenneth Clark, Mr. John Massfield, and Lord Burghley. While the real effect of the appeal, through the medium of the broadcast word, will never be assessed, it cannot be doubted that it will contribute to the promotion of that international good will which all right-thinking men must desire.

National Service in Great Britain

THE guide to National Service which has now been issued briefly describes the various civilian services, such as air raid precautions, police, fire services, nursing and first aid, for which volunteers are required, and indicates those for which part-time training in peace time is or is not required. Details are also given of the various branches of the armed forces for which recruits are required and how to join. A Central Bureau is being established by the Ministry of Labour for men and women with professional, scientific and technical qualifications who would be prepared to undertake specialised work in

the event of an emergency. The provisional Schedule of Reserved Occupations includes such classes of scientific workers as bacteriologists (25), chemists (21), engineers (25), physicists (25), from the age indicated, and in his introduction to the guide, Sir John Anderson expresses the hope that workers in such reserved occupations will fit themselves for part-time duties such as air raid precautions at their places of work. The guide and the schedule make it clear that the Government is fully alive to the importance of having available a record of men and women with scientific and technical knowledge. It is to be hoped that, should an emergency arise, the Government will see to it that proper use is made of their services.

The late Mr. S. H. Ray

THE remarkable record of the late Sidney H. Ray as a student of the languages of the Pacific, which Dr. A. C. Haddon reviews in his obituary notice (see *NATURE* of January 28, p. 149) is an outstanding achievement of scholarship in adverse circumstances, which has few, if any, parallels in either field investigation or academic study. Not only was Ray compelled to make the work for which he was peculiarly fitted by genius and temperament the secondary consideration of his scanty leisure, but also he laboured in an unmapped field, in which the difficulties would have taxed the energies and powers of concentration even of a student freed from all other preoccupations. The tragedy of Ray's career, however, lay not so much in the conditions in which his studies were pursued, as in the fact, as he himself would have been the first to contend, that through lack of more adequate leisure so much of the unique linguistic knowledge he had acquired, and still more his reasoned conclusions and inferences from that knowledge, have been lost to science and the world. Many years ago, both the Bible Society and Ray's employers, the London County Council, expressed amazed admiration at his vast erudition, but even though the former was afterwards able to make use of his assistance, both bodies expressed regret that they could not offer him the opportunity needed for the development of his powers. When a unique capacity for the advancement of knowledge such as that possessed by S. H. Ray is brought to light, it is surely the duty of the community to see to it that it is not wasted, as undoubtedly it was to a great degree in this instance.

Petrus Camper (1722-1789)

THE Faculty of Medicine of the University of Groningen, in collaboration with the *Netherlands Journal of Medicine* and the Netherlands Society for the History of Mathematical and Natural Sciences,

will commemorate in April next the one hundred and fiftieth anniversary of the death of Petrus Camper, physician, anatomist, obstetrician and artist. The name of Camper is perhaps now most frequently recalled in connexion with his contributions to the foundation of craniology as a scientific study. He was the first to make use of the facial angle—an invention apparently of the artist Dürer—as a factor in racial discrimination. The occasion is not without special interest to science in Great Britain, as it was during Camper's visit to London in 1748, through his association with Pringle, Mead and Pitscottie, and his familiarity with the collections of Sir Hans Sloane, Collinson and others that his interest in natural history was stimulated, if not actually aroused. Camper was born on May 11, 1722, at Leyden, where he was educated and took his degree in philosophy and medicine in 1746. He afterwards held professorial chairs at Franeker (1750), Amsterdam (1755) and Groningen (1768), being appointed councillor of State in 1787, two years before his death in 1789. He was among the most distinguished men of science of international standing of his day. Not only was he a fellow of the Royal Society of London, but also he shared with Boerhaave the then unique honour for a foreigner of membership of the Paris Academy of Sciences. His works, of which a collected edition was published in Paris in 1803, covered a wide field, ranging from the physical education of children to detailed studies in anatomy, physiology and natural history. Among his anthropological treatises were studies of the origin and colour of negroes, and on the variation of the facial angle in different races.

Preservation of Wildfowl

An amendment put forward by the promoters of the Wild Birds (Duck and Geese) Protection Bill has secured the withdrawal of the opposition, on behalf of shore-shooters, which has been holding up the Bill in the House of Commons, and it is to be hoped that it will now have a successful and rapid passage. The amendment provides separate close-times for wild duck and geese above and below high-tide mark; further, the date of the period of prohibition of import of wildfowl will commence on February 1. This last is an extremely important feature of the Bill, for it stops the demand for duck caught in decoys on the Continent during the breeding season. The Bill, which is promoted by the International Committee for Bird Preservation (British Section) and has the full support of the Government, is part of a big international scheme to preserve the stock of wildfowl in Europe. The accumulation of adverse effects of modern civilization is having a most serious effect on wild duck and geese. Cold storage, facilities of transport, draining of land, development of arctic areas and over-commercialization by means of decoys are but a few of the factors which are depriving wildfowl of their nesting and resting grounds and causing their destruction on a vast scale. The shooting season is also admittedly too long in many countries. Sweden has already taken drastic steps by prohibiting all shooting in several

of its largest provinces, Denmark and Germany have greatly restricted their shooting seasons and other European countries are alive to the necessity of action to safeguard the general stock of wildfowl before it is too late. The state of affairs in America, where wildfowl have been reduced to a perilously low number, is only too gloomy an example.

Engineering and Social Science

In a recent address to the Manchester and District Association of the Institution of Civil Engineers on the work of the civil engineer in relation to social and international problems, Mr. R. D. Brown urged that engineers are no better qualified for statesmanship or politics than the medical man, the lawyer, the psychologist, the physicist or the parson. Engineering science has nothing to do with solving the social economic and political problems of mankind, and the scientific and the political minds and methods of working have nothing in common. While engineers should be mindful of their duties as citizens, they can only engage in politics if they are prepared to give up engineering altogether and devote their time and energy to a new way of life. Mr. Brown is sceptical of the value of the proposed Council of Engineers, and recommends rather that any man of science, whether an engineer or not, who desires to help in this matter to get into touch with the committee of the newly formed Division for the Study of the Social and International Relations of Science of the British Association. The committee will require all the help it can obtain, whether from engineers, chemists, biologists, publicity experts or others. Mr. Brown referred to the importance of thinking about such problems of divesting the mind of all prejudice, superstition and humbug, and of laying aside all preconceived political, social or racial notions. He considered the committee's work might prove to be the most important investigation ever undertaken by the British Association.

Steel Manufacture in South Wales

THE project of a new steel works and rolling mill at Ebbw Vale in Monmouthshire designed on the latest lines and including a hot strip rolling mill for continuous production has aroused considerable interest. The size of the undertaking may be estimated from the fact that the plant cost about ten million pounds, and is designed to give an output of 600,000 tons per annum of tin plate and sheet steel of the highest quality. The raw materials, coal and lime stone, are in the immediate vicinity and transport facilities are good. The electrical part of the equipment is very complete. The works have an installed capacity of 250,000 kw. and will consume approximately 200 million units per annum. The Victorian generating station of the former Ebbw Vale Company has been largely reconstructed, but to provide the greatly increased demand of the new plant a grid supply at 132 kv. is brought from the Upper Boonville power station, a distance of eighteen miles. The supply of iron ore for the works is obtained from Northamptonshire, and ample coal is obtainable

from the neighbouring collieries. The coke oven plant is designed to deal with 1,370 tons of coal a day, a complete by-product recovery plant being provided. The two blast furnaces have been entirely reconstructed, the output of each being increased to 3,500 tons of pig iron. The molten iron from the blast furnaces is taken direct to the steel works, but any surplus not required at the moment is diverted to a pig-casting shop. The molten metal is first poured into a 1,400-ton mixer, where it is kept in a molten state until it is required to charge the furnaces. The molten steel is discharged from the furnaces at floor level and is cast into ten-ton ingots.

River Control in Great Britain

A BROADCASTER issued by Political and Economic Planning (PEP) deals with the difficulties which regionalism presents to the efficient operation of specialized and technical services, as exemplified in the control of rivers. Already the Ministry of Health, the Ministry of Agriculture and Fisheries, the Ministry of Transport, the Electricity Commissioners, the Board of Trade, the Mines Department, the Home Office and the Development Commissioners are concerned with different aspects of water supply and the control of rivers in Great Britain. The Land Drainage Act of 1930 was a consolidating and amending measure based on the recommendations of a Royal Commission and created some forty-nine catchment areas which cover the greater part of England and Wales, but the process of constituting and reorganizing drainage boards within catchment areas is not yet complete. Navigable rivers are controlled mainly by 51 public bodies, and waterways are owned by the railways and 31 other companies.

In the even more important matter of water supply, there are at present 782 local authorities and 50 joint authorities supplying, besides 236 companies and 1,053 private proprietors. To secure further rationalization and conservation of water supplies, nine regional advisory committees have been created, and a sub-committee of the Advisory Water Committee recently recommended that other committees should be created in the Greater Metropolitan Area, South Wales and the North-East. The possibility of damage to mains and reservoirs during air raids makes working agreements even more essential. The control of sewage presents yet another problem calling for co-ordination, while there are nearly fifty fishery boards concerned to prevent pollution of rivers, which may come into conflict with the navigation authorities. Moreover, town and country planning schemes are required to prevent ribbon development along river banks and undue pressure to develop sites. It is suggested that the Thames Conservancy Board, which is both a conservancy and catchment authority and has power over pollution and fisheries, is a model of what is required. How far it would be possible to entrust the general supervision of all water interests to one central department is a matter for discussion.

British Museum (Natural History): Recent Acquisitions

THE Trustees have purchased for the Department of Mineralogy uncut crystals of topaz, sapphire, and a set of seven rough crystals of ruby from Mogok, while cut stones are represented by a good example of deep lilac-coloured kunzite and a remarkable clear yellow cassiterite, cut from a stone from Uganda. A small diamond of considerable interest in the history of diamond-mining has been presented by Sir Ernest Oppenheimer. It is the first diamond taken from the first of the Kimberley diamond mines—the Jagersfontein—and was found by William Wreford Paddon. Dr. Stanley Smith, University of Bristol, has presented a specimen of natural coke showing columnar structure, from a quarry near Cockfield, County Durham. The coke was formed where a coal seam had been burnt out by a basalt dyke. Miss Beatrice O. Corfe has presented to the Department of Botany more than three hundred paintings of British flowers. The Department already possesses a number of Miss Corfe's paintings which were purchased some years ago. The paintings are artistic and at the same time botanically sound, and a number of them suitably adapted have been reproduced in the Museum series of botanical picture postcards. As a result of a short expedition to St. Lucia undertaken for the Museum by Mr. Harold E. Box, more than three hundred flowering plants and ferns were obtained chiefly from the higher altitudes of the mountains in the interior of the island. Unfortunately, Mr. Box's visit coincided with the almost unprecedented rainfall of November last, and twenty out of twenty-eight days had to be spent in camp or indoors.

Fisheries Research in Hong Kong

At the recent meeting of the British Association in Cambridge, the president of Section D (Zoology), in a highly important address, directed attention to the fact that the British Empire as a whole is regrettably deficient in fisheries research and administration. This is especially true of British territories in the Far East. In consequence, highly skilled and intensely industrious Japanese fishermen have in recent years been exploiting practically all the great fishing grounds of the Pacific region and landing large quantities of fish at most of the principal fish-markets—both British and foreign—along the coasts of China, India, Philippines, Malaya and Dutch East Indies. It is highly gratifying, therefore, to note that the University of Hong Kong recently has published a small handbook (*"Common Marine Food Fishes at Hong Kong"*). By G. A. C. Harklote and S. Y. Lin. Pp. 75. Hong Kong: G. A. C. Harklote, The University. n.d. n.p.) written in both English and Chinese, describing forty of the commonest food fishes landed at Hong Kong fish-markets. Each fish has been given its scientific name, Chinese name or names, and an English name—in some instances specially coined for this book. This is followed by a brief but useful description accompanied by a black-and-white illustration, with notes on distribution, seasonal abundance, price and food value. At the end of the book are set out twelve Chinese and seventeen European recipes for the cooking of fish dishes.

As a preliminary contribution to our knowledge of the food fishes of Hong Kong this book is most valuable. It is greatly to be hoped, however, that it merely heralds the inauguration of a much more far-reaching and systematic study of the marine resources of the Hong Kong region, to be undertaken by or under the auspices of the University; or, better still, by a specially built and properly equipped fisheries research laboratory.

The Lighting of the Western World Fair

THE illumination of the San Francisco Panama-Pacific Exposition of 1915 set a high standard in exhibition lighting which was for long unsurpassed. According to an article on the Golden Gate Exposition, which appeared in the *Electrician* of January 20, it will be far surpassed by this new exhibition on Treasure Island in San Francisco Bay which will be opened on February 15. The gem-like appearance of the various buildings is mainly due to the use of an inexpensive insulating material called 'vermiculite'—an alteration of mica expanded by electric heat to fifteen to twenty times its original size. Applied to wet stucco, vermiculite imports an antique finish which scintillates with light. The sea wall and roadway lighting of Treasure Island is designed to be in keeping with the main project, and it is considered that it will establish a new milestone in the history of illumination. Projectors concealed in troughs floodlight the walls in white. Cylindrical golden amber lanterns are spaced on approximately sixty-foot centres along the entire facade for roadway illumination and to break up the flatness of the long lighted wall. Spectacular lighting has been arranged for the Courts of Pacifica and of the Seven Seas. The sculptured relief work consisting of submarine scenes is painted with paints that fluoresce under the ultra-violet light provided by concealed projectors from below. Nearly three hundred ultra-violet mercury floodlights, each of 100 watts capacity, are being used for fluorescence effects on outdoor murals. More than two hundred underwater floodlights are being installed, and altogether the outdoor lighting equipment comprises more than 10,000 units. The interiors of exhibition buildings are uniformly lighted by day and night; they have no windows. At the high points of the main buildings a concentrated type of reflector is employed while at lower points reflectors with layer spread are used. The total illumination of the 400 acre exposition site is estimated to require 40 million kilowatt hours during the 288 days the fair will be open.

Standard Television Terms

Now that television broadcasting has become a public service in Great Britain, it is very desirable that, so far as possible, standardised terms and definitions should be used in connexion with the technique of this subject. The British Standards Institution has already made some progress in the matter in so far as the "Glossary of Terms used in Electrical Engineering" (No. 205-1936) contains two sub-sections dealing with terms used in connexion with television and with cathode ray tubes re-

spectively. More recently, the Radio Manufacturers' Association has given consideration to the desirability of television equipment manufacturers and television engineers using a common form of nomenclature. It has been decided that, so far as possible, the technical terms given in the above Glossary should be used by manufacturers in their literature and in any instruction classes which they may operate. In addition, the Association has compiled a list of titles which are recommended for use in working the controls of television receivers. Fourteen titles are listed and described, and in so far as the modern receiver may have upwards of six hand controls directly accessible to the user, this would seem to be a very sound recommendation. It is understood that the R.M.A. has communicated the above recommendations to technical institutes providing radio engineering courses, with the view of securing their co-operation towards the desired objective.

Marine Engineering Collection

H.M. STATIONERY OFFICE has recently published a new descriptive catalogue (price 2s. 6d. net) of the Marine Engineering Collection in the Science Museum. Nowhere else is to be seen anything like so large and representative a collection of marine engineering models, drawings, photographs, etc., as that at the Science Museum; and a close study of this catalogue and the companion volume on history and development, will repay anyone with an interest in the subject. Nearly 400 exhibits are described clearly and accurately, and there are 15 plates. Among the illustrations are photographs of the engine built by David Napier in 1811 for Henry Bell's *Comet* and of one set of the main steam turbines of the *Queen Mary*. Both these vessels were built and engined on the Clyde, but some of the most beautiful models in the collection are those of engines built on the banks of the Thames when the names of Penn, Seaward, Maudslay and Field were as widely known as those of the marine engineers of the Clyde and the Tyne are to-day. In connexion with this it is perhaps permissible again to recall the debt of marine engineers to Bennett Woodcroft, who by securing the early engine built by Symington, and that of the *Comet*, laid the foundation of the fine series of exhibits described in this catalogue of marine engines.

First-Aid Services and Air Raid Precautions

FOLLOWING the recent transfer from the Home Office to the Ministry of Health of responsibility for approving the air raid precautions schemes of local authorities in respect of first-aid posts and ambulance services, the Minister of Health has forwarded to all local authorities responsible for such schemes and to every voluntary hospital an explanatory communication (Circular 1764. H.M. Stationery Office. 1d. net). There should be at least one medical man, and if possible a trained nurse, in addition to the volunteer personnel, in attendance at every aid post. An aid post should be attached, or be very close, to all hospitals which are to be used for the initial reception of casualties, and some of the smaller hospitals,

clinics, health centres, etc., might be transformed into aid posts. In some areas, it is suggested, the fixed posts should be supplemented by mobile units, which could give medical aid on the spot. Ambulances that may be required, the organization of ambulance services, and their personnel, are described, as well as the use and training of women for ambulance driving. Finally, the Minister urges all responsible authorities to press on with their schemes and proposals without delay, and desires that an interim report be furnished by every authority involved.

The Placing of Children in Families

THE Advisory Committee of the League of Nations has issued a report upon this subject ("The Placing of Children in Families". Geneva, 1938. Vol. 1, price 3s.; Vol. 2, price 5s. Messrs. Allen and Unwin, 40 Museum Street, W.C.1). To begin with, the Child Welfare Committee of the League planned a survey on the placing of children in families as part of its general inquiry into the treatment of neglected and delinquent minors, but it was afterwards decided to treat independently the whole problem of placing in families as a method of child care. The first volume of this report presents the principles accepted as underlying provisions for child care, the characteristic features of the different systems employed in various countries, and the organization of social services to direct 'placing'. Vol. 2 describes the various systems of placing children in families that are now employed in different parts of the world.

Buildings for the Academy of Sciences of the U.S.S.R.

A LARGE plaster-of-Paris model of the main new buildings of the Academy of Sciences of the U.S.S.R. is now on view at the Academy's premises in Bolshaya Kuluzhakaya Ulitsa in Moscow. The buildings were designed by A. V. Shohusev. The site for the buildings most favoured is on the Frunze Embankment of the Moscow River. The new buildings of the Academy, according to the plans, consist of five blocks with a volume of 880,000 cubic metres. In the centre of the architectural ensemble is the main block for the presidium of the Academy. The hall is large enough to seat 2,000 persons. There are also four smaller auditoriums. Near the main hall are rooms for the demonstration of films and for broadcasting; also a post and telegraphic office and an information bureau. A block has been set aside for the library and storage premises for fifteen million volumes. On either side of the block for the presidium are buildings to accommodate two museums, one of which will be the Natural History Museum.

The Food and Drugs Act, 1938

THE Minister of Health has issued a circular to local authorities and public analysts on the new Food and Drugs Act passed last July, which comes into force next October (Circular 1755. H.M. Stationery Office. 2d. net). This Act represents a great simplification of existing food and drugs law, some of which dates back to the sixteenth century, and opportunity has been taken to introduce, into the general law, provisions which have up to now been included only in Local Acts. Among new provisions

which will become enforceable are the registration by local authorities of premises used for the sale or manufacture of ice cream and the preparation or manufacture of sausages or preserved food. Ice cream vendors must have their names and addresses on stalls, carts and barrows, and this requirement may be extended to all or any foods by the local authority. Slaughterhouses and knacker's yards will all in future be licensed for limited periods only, and new requirements are laid down as regards rooms, yards, etc., in which food is sold or prepared for sale.

Earth Tremor in the Lipari Islands

A STRONG earth tremor with epicentre near latitude $38^{\circ} 40' N.$, longitude $15^{\circ} 7' E.$ occurred during the night of January 27 and lasted several seconds according to human experience. The shock damaged several buildings, but no casualties are reported. The depth of focus is uncertain, but is unlikely to have been at the surface, as the shock was experienced and caused some apprehension in Messina. Messina has been troubled by earthquakes on several previous occasions, including February 25, 1509, June 8, 1599, March 28 and April 9, 1780, February 5–March 28, 1783 (six altogether), December 28, 1908, September 8, 1905, and October 23, 1907. The one on December 28, 1908, at 5 h. 21 m. was probably the most severe, nearly destroying Messina and Reggio, and causing the deaths of 77,283 people. On that occasion there were two epicentres in the Straits of Messina, the northerly one being the most important. The shock lasted 30 sec., caused sea-waves 38 ft. high at San Alessio, and subsidences of 22.9 in. two miles south of Reggio and 28 in. within two miles of Messina harbour.

The Chilean Earthquake

CHILE is one of the great seismically active regions in the world and part of the circum-Pacific ring of instability. During the night of January 24, an earthquake which lasted according to human experience for three minutes, shook an area greater than 40,000 square miles embracing Talca and Concepcion, and caused the deaths of approximately 15,000 people. It was the most severe for twelve years in Chile and the most destructive of human life since Quetta (India) in 1935. The three towns of Chillan, Pailalque and Parral are reported completely destroyed; Concepcion, Talcahuano, San Rosendo and Los Angeles are severely damaged, and Talca, Angol, Lota and Curico damaged. At Talca the prison collapsed, fires broke out at the port of Talcahuano, the cathedral tower at Vaparaíso swayed dangerously, and half Concepcion is reported in ruins. From the available macroseismic evidence the epicentre appears to be near lat. $37^{\circ} S.$ and somewhat to the east of long. $73^{\circ} W.$ The shock appears to have had a normal focal depth and to have caused some surface faulting, and the railway line is reported damaged in several places, including one point about 12 miles south of Talca. Two trains are reported derailed.

CONCEPCION has had an unfortunate history seismically, having been severely damaged on no fewer than six occasions: February 9, 1570, March 15, 1657, July 8, 1730, March 25, 1751, February 20,

1835, and July 23, 1898. The last was the least severe, but the five others were all accompanied by sea waves. On February 20, 1835, Concepcion was utterly ruined. The sea waves were 28 ft. and more in height, causing damage even as far north as Fernandez (420 miles). On this occasion the coast was raised by 4-5 ft., though it afterwards subsided by half that amount. The epicentre on the present occasion is probably farther inland than on former occasions, as most damage appears to have been done to the east of Concepcion and no sea waves are mentioned. The most active epicentre for moderate shocks recently appears to have been lat. $38^{\circ}0'$ S., long. $73^{\circ}5'$ W., which is a little to the south-west of the one suggested in the present instance, though more precise information concerning this latter must await the records of seismograms at observatories throughout the world.

Announcements

PROF. ARTHUR CONWAY, professor of mathematical physics in University College, Dublin, has been appointed by the Pope a member of the Pontifical Academy of Sciences to occupy the seat left vacant by the late Lord Rutherford.

PROF. P. G. H. BOSWELL, who has just retired from the chair of geology in the Imperial College of Science and Technology, has been appointed emeritus professor of the College.

THE annual award of the Pittsburgh Section of the American Chemical Society has been made to Dr. George H. Clapp. The award, an aluminium plaque suitably inscribed, is made in recognition of outstanding service to chemistry in the Pittsburgh district. Dr. Clapp, who recently celebrated his eightieth birthday, directed, with Captain Hunt, the firm of Hunt and Clapp, which afterwards acquired the Pittsburgh Testing Laboratory. With Captain Hunt, Dr. Clapp was instrumental in bringing to Pittsburgh Charles M. Hall and in organizing the Pittsburgh Reduction Co., which is now the Aluminium Co. of America. Dr. Clapp's hobby is conchology.

SIR FRANK SMITH, who has just retired from the post of secretary of the Department of Scientific and Industrial Research (NATURE, Jan. 14, p. 56), has taken up an appointment with the Anglo-Iranian Oil Co., Ltd., to advise on the company's research and development work.

AN appeal will be broadcast from all national stations of the B.B.C. at 8.45 p.m. on Sunday, February 5, on behalf of UFAW (Universities Federation for Animal Welfare). This body differs from many having kindred objects in that its membership is drawn from the universities and includes a number of distinguished men of science, particularly biologists. The appeal will take the form of a dialogue between "Fougasse", the art editor of *Punch*, and the Hon. Harold Nicolson, M.P.

THE sixth International Congress of the Technique and Chemistry of Agricultural Industries will be held in Budapest on July 10-20.

ELECTION to Beit Fellowships for scientific research will take place on or about July 7. Not more than

three fellowships will be awarded. Applications must be received on or before April 6. Forms of applications and further information can be obtained from the Rector, Imperial College, South Kensington, London, S.W.

A SCANDINAVIAN Summer School in Norway and Sweden is being arranged by the Association for Education in Citizenship, to be held during August 5-22. The party will stay in colleges at Bommersvik, near Stockholm, and at Syverud, near Oslo. Lectures in English on the political, economic and educational developments taking place in their respective countries will be given by Norwegian and Swedish experts. Further information can be obtained from the secretary at the Association's offices, 10 Victoria Street, S.W.1.

THE annual joint meeting of the Institute of Radio Engineers and the International Scientific Radio Union (American Section) will be held in Washington, D.C., on April 28-29. Meetings of other scientific societies will be held in Washington during the same week including the National Academy of Sciences, American Physical Society and American Geophysical Union. Papers on the more fundamental and scientific aspects of radio will be presented. The programme will be published in the April issue of the *Proceedings of the Institute of Radio Engineers*. Further information can be obtained from S. S. Kirby, National Bureau of Standards, Washington, D.C.

THE annual malaria control course for laymen will be held at the London School of Hygiene and Tropical Medicine commencing on June 26. The course will be under the direction of Sir Malcolm Watson and the staff of the Ross Institute of Tropical Hygiene. The course lasts five days. It includes instruction on mosquitoes and their habits, drainage and other measures for the prevention of malaria. It is illustrated by lantern slides, films, demonstrations of the living insect in the various stages of its history, and a practical demonstration on Hampstead Heath. Application to attend the course, which is free, should be sent in as early as possible to the Organizing Secretary, Ross Institute of Tropical Hygiene, Keppel Street, Gower Street, London, W.C.1.

THE thirty-first annual general meeting of the Institute of Metals will be held in London on March 8-9. In addition to the usual list of papers to be read and discussed on the first day of the meeting, there will be two general discussions extending over the whole of the second day of the meeting. At the morning session the subject of debate will be "The Effect of Work on the Mechanical Properties of Non-Ferrous Metals", and in the afternoon the discussion topic will be "Industrial Application of Spectrography in the Non-Ferrous Metallurgical Industry". On March 8, the second annual award of the Institute of Metals Medal will be made, the recipient being Sir Harold Carpenter. The medal, which is of platinum, is the gift to the Council of the Institute, which decides its award, of the Mond Nickel Co., Ltd. The first award of the medal was made last year to Sir William Bragg.

Letters to the Editor

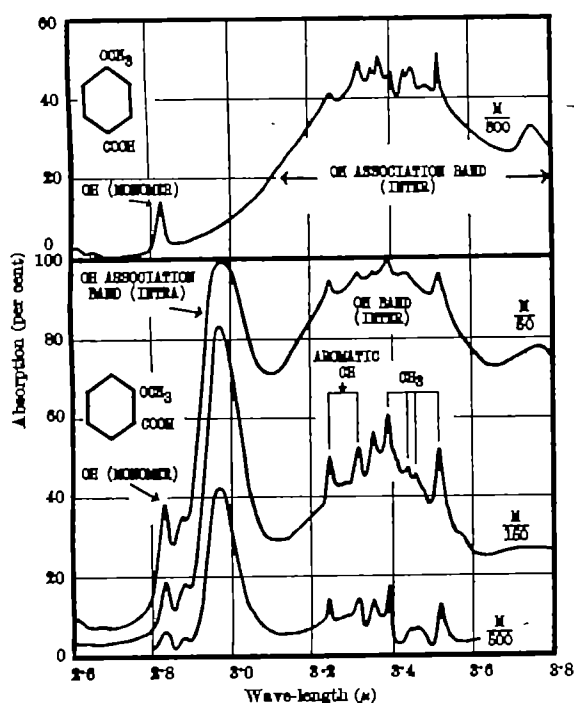
The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 207.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

A New OH Band in a Carboxylic Acid

RECENT investigations of infra-red spectra in the region of 3μ by Davies and Sutherland¹, and Buswell, Rodebush and Roy², have shown that the COOH group of carboxylic acids has an absorption



ABSORPTION OF *o*- AND *p*-METHOXYBENZOIC ACIDS IN CARBON TETRACHLORIDE. CELL LENGTH 1 CM. TEMP. 20°C.

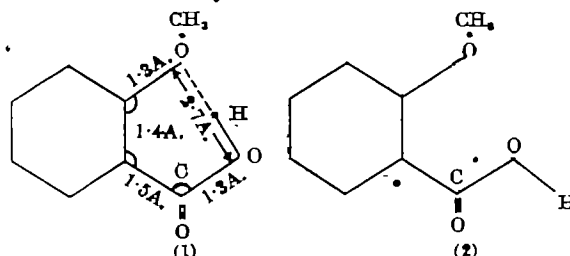
band close to that given by the OH group in alcohols and phenols³ ($\sim 2.8\mu$) as well as a large region of absorption at longer wave-lengths. There is, however, an important distinction between the acids and other compounds. While alcoholic and phenolic bodies are generally unassociated in carbon tetrachloride at concentrations of 0.01 mol./l. and lower (compounds such as salicylic aldehyde are exceptions and are completely associated intramolecularly), the acids are much more strongly associated and intense absorption in the association region is found at concentrations so low as 0.002 mol./l. at ordinary temperatures.

It has not yet been shown whether the acid complexes split up completely at still lower concentrations, although the infra-red investigations of Rodebush *et al.*², and polarization measurements⁴ would indicate its probability. A breaking up of the complexes is fairly easily achieved by working at higher temperatures. The double COOH ring of associated

acids has been well established by electron diffraction measurements of Pauling and Brookway⁵, and offers a ready explanation of a number of physical properties of carboxylic acids. Thus terephthalic acid, diphenyl-4:4'-dicarboxylic acid, and many other dibasic acids have high melting points and are sparingly soluble in most organic solvents. Clearly if the molecules are associated at both COOH groups, the substance will exist in chains of considerable stability and will not easily dissolve or melt. Diphenic acid (2:2'-dicarboxylic acid) is quite soluble, on the other hand, and here the contiguity of the two COOH groups makes association into large complexes unlikely.

In carboxylic acids, the OH band is displaced somewhat from the position found in other hydroxylic bodies (2.75μ in primary alcohols, 2.77μ in phenol, and $\sim 2.83\mu$ in acids) and at ordinary temperatures the band obtained is very small, while the association band is more intense than with the other hydroxylic bodies and extends over a greater wave-length range, about 3.0 to 4.2μ (cf. Rodebush *et al.*²). The simple doublet structure attributed to this band by these workers in our view requires further investigation, and no one, so far as we know, has yet advanced an explanation of the great width and intensity of the band.

In the accompanying figure we give curves for *o*-methoxybenzoic acid at concentrations of 1/50, 1/150 and 1/500 mol./l., and for *p*-methoxybenzoic acid at 1/500 mol./l. (almost the limit of solubility), both in carbon tetrachloride. It will be observed that the *para*-compound gives the usual carboxylic acid curve, with an OH band at 2.824μ and an association band at 3.4μ . The sharp peaks superimposed on the association band are readily identified as being due to OH vibrations of the benzene ring and of the OCH_3 group. The *ortho*-compound, in addition to an OH band at 2.833μ and the usual association band, has a new band of considerable intensity at 2.974μ , totally distinct from those usually found in acids. It is well recognized that *ortho*-compounds exhibit abnormal behaviour in absorption (cf. Wulf *et al.*⁶, and Pauling⁷) and *o*-methoxybenzoic acid is an example of this. The phenomenon seems to indicate the existence in solution of two monomeric forms of *o*-methoxybenzoic acid:



Form (2) will behave like the *p*-acid, while in Form (1) interaction between the oxygen of the methoxy group and the OH of the COOH group will prevent normal association of two COOH groups, and so a strong monomeric OH band should be observed, although with a frequency somewhat slower than that of the unaffected OH. Giving the C—O and O—O bonds the lengths shown in (1) and making the angles indicated all equal to 122° , it is found that the O—O distance is close to 2.7 Å., the value accepted for hydrogen bonding. The hydrogen atom need not be exactly in line with the oxygen atoms as shown, although little strain of the normal COH angle would be required for this to be the case.

It will be noted that the association band is smaller in the *ortho*- than in the *para*-compound at a given concentration, and this supports the idea that the new band has formed at the expense of the association band. As is to be expected on this view, the *ortho*-compound is more soluble in carbon tetrachloride than is the *para*-compound (ratio $\sim 10:1$); the latter also has much the higher melting point. The new band bears a strong resemblance to the bands at $\sim 2.9\mu$ found by Errera and Sack³ for ethyl alcohol and phenol in dioxan, where opportunity exists for a somewhat similar interaction.

The *m*-acid gives an absorption spectrum almost indistinguishable from the *p*-acid.

J. J. FOX.

A. E. MARTIN.

Government Laboratory,
London, W.C.2.

Dec. 20.

¹ Davies and Sutherland, *NATURE*, 141, 372 (1938).

² Burwell, Bodebush and Roy, *J. Amer. Chem. Soc.*, 60, 2239 (1938).

³ Fox and Martin, *Proc. Roy. Soc., A*, 168, 419 (1937).

⁴ Le Fèvre and Vine, *J. Chem. Soc.*, 1795 (1938).

⁵ Pauling and Brookway, *Proc. Nat. Acad. Sci.*, 20, 336 (1934).

⁶ Wulf and Liddel, *J. Amer. Chem. Soc.*, 57, 1464 (1935).

⁷ Pauling, *J. Amer. Chem. Soc.*, 58, 94 (1936).

⁸ Errera and Sack, *Trans. Farad. Soc.*, 34, 723 (1938).

Interpretation of Beta-Disintegration Data

FERMI's original theory of β -decay¹ made a definite prediction as to the energy distribution of the electrons emitted from a β -active element. It was found² that the experimental distribution curves did not agree in shape with this prediction in the sense that the number of electrons of low energy (relative to the upper limit of the spectrum) was considerably greater in the experimental than in the theoretical curves. A modified theory was then proposed by Konopinski and Uhlenbeck (K.U.)³ which introduced in the distribution curve another factor proportional to the square of the momentum of the emitted neutrino. This theory appeared to agree with the facts.

Further experimental evidence, however, revealed a number of facts which did not fit in well with the modified theory: (1) The shape of the observed energy spectra did not fit the K.U. law near the upper limit, but seemed there to follow the original law of Fermi, although the latter did not fit with any other part of the curve⁴; if one determined the position of the upper limit by extrapolation from the K.U. law, one obtained values that were difficult to reconcile either with the observed spectrum or with the other data on the energy balance⁵. (2) The Sargent curves (decay constant against disintegration energy) seemed to agree better with the Fermi theory⁶. (3) The probability of capturing a *K*-

electron, as compared to that of emitting a positron, was found to be much smaller than the K.U. theory would predict, but in reasonable agreement with the Fermi theory⁷. (4) An attempt to develop the K.U. theory into a mathematically consistent scheme showed that it was, at any rate, far more complicated than that of Fermi, and no proof has as yet been given that it can be consistently carried further than to the first order of approximation⁸.

We therefore investigated the view that the original theory of Fermi correctly represents the elementary law; but that the observed spectra, in so far as they belong to 'allowed' transitions, do not represent the effect of a single nuclear transformation, but rather a superposition of different spectra belonging to transitions to different levels of the final nucleus. It is then clear that the resulting energy distribution will contain rather more electrons of low energies, compared to the upper limit of the spectrum, than a single Fermi curve. If the nucleus is left in an excited state, it must eventually lose its energy by radiation, and the crucial test for the suggested point of view is the presence of γ -rays of suitable energy and intensity from all those radioactive bodies which have 'allowed' transitions and the energy spectra of which are known to be different from the simple Fermi curve. The γ -rays might in some cases be absent because the excited state of the nucleus might be a metastable isomer; but this could not be true for all such elements. The restriction to allowed transitions is necessary because in 'forbidden' transitions the shape, even of a single curve, is affected by more complicated factors⁹.

Interpreting from this point of view the electron spectra of ^{10}B , ^{10}F , ^{17}F , ^{12}N , ^{16}O , as given by Fowler, Delsasso and Lauritsen¹⁰, we have estimated the energy and intensity of the γ -radiation to be expected. The results are given in the following table.

Active element	Product nucleus	Energy of γ -ray in Mv.	Number of γ -quanta per disintegration
^{10}B	^{10}Be	5	0.5
^{10}F	^{10}Ne	2	0.7
^{12}N	^{12}C	0.27	0.8
^{16}O	^{16}N	0.5	0.4
^{17}F	^{17}O	0.9	0.6

No great accuracy is claimed for these results since the curve-fitting is very sensitive to the high-energy ends of the electron spectra, which are not very accurately known, and also because we have assumed that only one excited level is involved, whereas there might be more.

The presence of a γ -ray accompanying the disintegration of ^{12}N was indeed reported by Richardson¹¹, who gave its energy as 0.3 Mv. A γ -radiation from ^{17}F was reported by Burcham and Smith¹², and measurements of the energy of this radiation, which are being made by Bower¹³, indicate a value of about 2.2 Mv. Although γ -radiations of the predicted energies from the other elements of our table have not been reported, it is interesting to notice that an energy level in ^{16}O at 0.83 Mv. is known to exist, since it is excited in a number of other nuclear reactions^{14,15}, and similarly an excited state of ^{12}C at 4.3 Mv. is known¹⁶. We are indebted to Mr. P. I. Dee for this discussion of the experimental data.

Finally, we would like to point out that, although one cannot consider the above evidence as convincing confirmation of the point of view we suggest, it is certainly incompatible with the K.U. theory, since

the existence of γ -rays shows that the observed curves must be superpositions of at least two simple spectra, whereas their shapes are not such as could be represented as sums of two K.U. curves with end-points differing by the energy of the γ -rays.

H. A. BETHE.

Physics Department,
Cornell University.

Emmanuel College, Cambridge.

F. HOYLE.

University, Birmingham.
Dec. 24.

R. P. FENNER.

¹ Fermi, E., *Phys. Rev.*, **53**, 161 (1934).

² Kurie, F. N. D., Richardson, J. R., and Paxton, H. O., *Phys. Rev.*, **48**, 368 (1935).

³ Konopinski, H. J., and Uhlenbeck, G. E., *Phys. Rev.*, **43**, 7 (1935).

⁴ Richardson, H. O. W., *Proc. Roy. Soc., A*, **161**, 456 (1937).

⁵ Cockcroft, J. D., *Proc. Roy. Soc., A*, **161**, 540 (1937).

⁶ Walker, H. (in the Press).

⁷ Fermi, E., *Helv. Phys. Acta*, **10**, 123 (1937).

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⁹ Fowler, W. A., Doleman, L. A., and Lauritsen, C. O., *Phys. Rev.*, **40**, 549 (1936).

¹⁰ Richardson, J. R., *Phys. Rev.*, **53**, 610 (1938).

¹¹ Burroughs, W. M., and Smith, O. L., *Proc. Roy. Soc., A*, **166**, 176 (1938).

¹² Private communication.

¹³ Cockcroft, J. D., and Lewis, W. B., *Proc. Roy. Soc., A*, **164**, 261 (1936).

A New Form of the Baryteron Equation and Some Related Questions

It is known that the 2-component *spinors* introduced by Van der Waerden must be completed to 4-component quantities if linear transformation of their components by the complete Lorentz group including reflections is required. These quantities, often called 'Dirac wave-functions', will be called here 'four-spinors' or '*undors*' of the first rank*. Defining the reflection in the right way¹, it is possible to join to every four-spinor ψ another four-spinor² ψ^c , the components of which are linear combinations of those of ψ . This ψ^c is called the *charge-conjugated*³ of ψ . For if ψ is a solution of the Dirac equation for a positive particle,

$$m\psi = \beta(\epsilon - (\alpha\pi))\psi,$$

$$c\epsilon = \hbar(\partial/\partial t) - e\phi, \quad \pi = -\hbar\nabla - (e/c)\vec{A},$$

then ψ^c is a solution of the Dirac equation for a negative particle:

$$m\psi^c = \beta(\epsilon L - (\alpha\pi L))\psi^c,$$

$$c\epsilon L = \hbar(\partial/\partial t) + e\phi, \quad \pi L = -\hbar\nabla + (e/c)\vec{A};$$

vice versa ($\psi^c L = \psi$). Four-spinors, which are equal to their own charge-conjugated, we may call *neutrinos*. These quantities, which are equivalent to a two-spinor together with its complex conjugated, are not only useful in the so-called neutrino theory of light, but also Majorana's theory of *neutrons*⁴ may be summarized by stating that the quantized four-spinor of a neutral particle is a neutrino.

An *undor-calculus* analogous to tensor-calculus and Van der Waerden's spinor-calculus can be developed. An undor of the second rank $\Psi_{k,k'} (k, k' = 1, 2, 3, 4)$, that is, a quantity transforming like the product of two four-spinors, may be regarded then as consisting of a scalar, a pseudo-scalar and a pseudo-4-vector (the antisymmetrical part of $\Psi_{k,k'}$) and a regular

* Unds = Wave.

4-vector with an antisymmetrical tensor (its symmetrical part). So Kemmer's baryteron* field⁵ can be represented⁶ by one single symmetrical undor ($\Psi_{k,k'} = \Psi_{k',k}$). Denoting by ψ_p and ψ_n the wave-functions of protons and neutrons and by α, β and α', β' the Dirac matrices operating on k and k' , the baryteron equation^{7,8} is given in the following simple form:

$$2m_{\text{op}}\psi + 2if_{\text{op}}(\psi_{nk}\psi_{pk} + \psi_{nk'}\psi_{pk'}) = \beta(\epsilon - (\alpha\pi))\psi + \beta'(\epsilon - (\alpha'\pi))\psi. \quad (1)$$

The operator f_{op} , which operates on the arguments k and k' , becomes a constant c -number (f) only if the two constants f and g , occurring in Kemmer's equations⁵, would happen to be equal. As experiment seems to indicate⁹ that these constants do not differ very much, this formal argument for the advantage of equality of f and g seems to be interesting.

The electric charge-density and electric current are given by⁶

$$\rho = (e/8\hbar) \cdot \Psi^*(\beta + \beta')\Psi,$$

$$\vec{j} = (e/8\hbar) \cdot \Psi^*(\beta\alpha' + \beta'\alpha)\Psi.$$

The wave-function of *free* baryterons can be interpreted to some extent as the Dirac wave-function in the hole-theory of electrons. In both cases the same kinds of difficulty arise.

As for the complications occurring in baryteron theory^{5,6}, as well as in the quantum theory of the Maxwellian field^{10,11}, which are caused by the fact that some of the canonical equations of the field do not contain time derivatives, it is possible to develop a theory of quantization of mixed fields of Fermi-Dirac particles and Einstein-Bose quanta, in which the question of dealing with such complications is answered in a rather general way.

Details will be published elsewhere.

F. J. BELINFANTE.

Instituut voor Theoretische Natuurkunde,
Leiden.
Dec. 22.

* Baryteron = heavier.

¹ Racah, *Nuov. Cim.*, **14**, 832 (1937).

² Pauli, *Ann. Inst. H. Poincaré*, **6**, 130 (1936).

³ Kramers, *Proc. Roy. Acad. Amsterdam*, **48**, 814 (1937).

⁴ Majorana, *Nuov. Cim.*, **14**, 171 (1937).

⁵ Kemmer, *Proc. Roy. Soc., A*, **106**, 127 (1938).

⁶ Compare De Broglie, "Actual. Scient. Indust.", No. 181 (1934) and No. 411 (1936).

⁷ Yukawa, *Proc. Phys. Math. Soc. Japan*, **20**, 819 and 730 (1933).

⁸ Bhabha, *Proc. Roy. Soc., A*, **106**, 501 (1938).

⁹ Frohlich, Hettler and Kemmer, *Proc. Roy. Soc., A*, **106**, 154 (1938).

¹⁰ Heisenberg and Pauli, *Z. Phys.*, **59**, 1 (1932).

¹¹ Rosenfeld, *Ann. Inst. H. Poincaré*, **2**, 25 (1933).

Exploration of the Sun's Disk and its Astrophysical Results

IN NATURE recently (Dec. 10, p. 1035), I took the opportunity, in connexion with the recent researches on practical relativity by H. E. Ives and G. R. Stilwell, to place on record that on principles scarcely anywhere denied now, a radiating atom, or system of atoms, falling free into the sun or describing a free orbit close around it should not experience any internal influence on the periods of its radiation, the

relativist factor due to the velocity produced being exactly balanced by another scalar direct effect of the field of gravitation itself: so that there would be left in evidence only the inevitable kinematic (Doppler) effect arising from mutual approach of the radiator and the terrestrial observer which, however, would soon rise to preponderance with increasing velocity.

I had forgotten at the time an array of important evidence bearing on this subject, in which I took close interest a year or two ago. I had been permitted by Mr. J. Evershed to learn in advance the results of his exploration of the variations of radiation periods on the solar disk, as it proceeded with greatly improved methods in his underground spectroscopic observatory in the Surrey hills, in continuation of researches in India by which he established an international fame for the solar observatory at Kodaikanal, above Madras. As he has now published preliminary results, in the *Observatory*, I can make use of this personal knowledge. Briefly, it was concluded that the observations could be fairly represented by an effect of the general type of pure relativity, such as might be due to the gravitating field of the sun but of about twice the Einstein predicted amount, combined, however, with a vector (Doppler) effect such as would arise from a *slow radial fall* of the absorbing system of atoms into the sun, about equal at its maximum, which is at the centre of the disk, to the Einstein factor, and, of course, vanishing at the limb, thus strongly favouring the important and natural result that only the systems of cooler atoms falling back into the sun (here at about 2 km. per sec.) produce the Fraunhofer absorptions.

(The familiar Evershed drift at sunspots, of the same order as the above, is tangential inward above and outward below, adjusted perhaps to compensate a much greater radial fall into the spot of the cooler absorbing gases such as would be required to damp off the continuous radiation of the photosphere below.)

If the outer layer of radiating atoms were subject to free fall into the sun, there would thus in fact be vanishing effect on periods, in accord with the general relations of relativity for isolated systems, as recognized and known definitely in England and America now for forty years. It follows that the forces of mutual atomic collision which float up the radiating atoms in the sun's atmosphere must provide a compensating factor that annuls, largely at any rate, what would be the result of free fall; for otherwise the total result for undisturbed falling atoms could not be null, as perhaps nobody would appear now to deny.

Another important result is to be signaled here. Astronomers are now accustomed to believe, on this type of spectroscopic evidence, that the dark companion of the star Sirius has a density, of value perhaps bordering on the fantastic, being about eight thousand times that of iron—though indeed this only involves that the atoms are twenty times closer packed in linear order. If the gravitational spectroscopic displacement is not solely of the Einstein type and is moreover mixed up, as here indicated, with effects due to other restraints and forces, there appears to be ample room, amid new atomic discoveries and ideas, for reconsideration of this decision as to abnormal material densities in stars.

JOSEPH LARMOR.

Holywood,
N. Ireland.
Jan. 1.

Frequency Interpretation in Inverse Probability

DR. JEFFREYS implies in his letter in *NATURE* of September 17 (p. 535) that a prior probability cannot have a frequency interpretation. That there are several usages of the word probability is well recognized—it is a frequency, a mathematical result, a state of mind, or a degree of rational belief, depending on the circumstances. Jeffreys' point of view must be insisted on only when the conditions under which an experiment is performed are not subject to repeated sampling. However preponderant these circumstances may be in practice, it is important that consideration be given to problems in which the frequency interpretation does apply to the prior probabilities, since the frequency interpretation is the only one that is operationally verifiable.

A problem for illustration is this. A box has had 10 balls transferred to it by a blindfolded man from an auxiliary container holding equal numbers of black and white balls, the contents of the auxiliary container being kept constant and thoroughly mixed by an assistant. Then an experiment is carried out on the box; the blindfolded man draws a ball from the box and returns it, the assistant noting the colour of the ball and shaking the box before the next draw. The blindfolded man makes five such draws from the box (each with replacement); four of them show black and one white. What are the probabilities of the various possible contents of the box? (Reworded from an example given in Fry's "Probability", Van Nostrand, 1928, p. 123.)

The stirring and blindfolding, we shall presume, create randomness and cause the point binomial to be applicable in the frequency sense, both with regard to the 10 balls put into the box and the 'experiment' of drawing 5 balls with the replacement from the box. The equal numbers in the auxiliary container have only the effect of making $p = q = \frac{1}{2}$ in the binomial expansion of $(q + p)^n$, and any other proportions would do as well. We have at once from the binomial expansion the term $\binom{n}{r} q^{n-r} p^r$ for the

prior probability that r white balls found their way into the box in the first place ($n = 10$; $r = 0, 1, 2, \dots, 10$; $p = q = \frac{1}{2}$). Now if there are r white balls in the box, the probability that five draws, with replacement, will show 4 black and 1 white is $\binom{5}{1} \left(\frac{r}{10}\right) \left(\frac{10-r}{10}\right)^4$, whereupon the simultaneous probability that r of the 10 balls in the box are white, and that the 'experiment' should show 4 black and 1 white, is the product of these two expressions, namely,

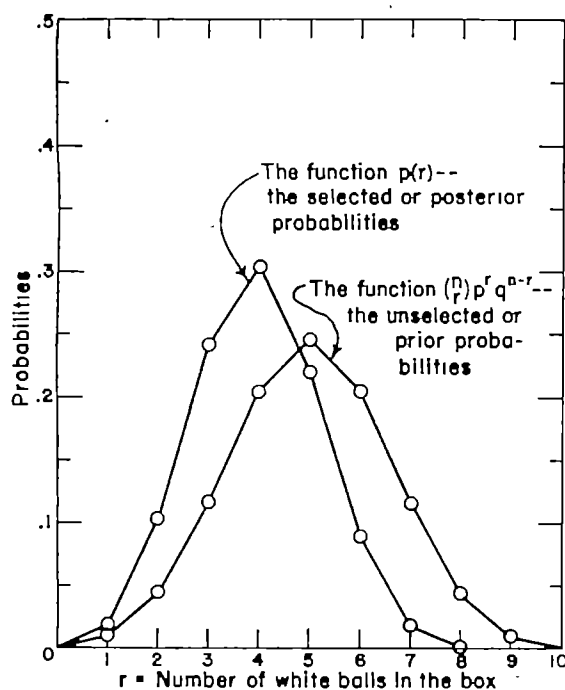
$$\binom{10}{r} \left(\frac{1}{2}\right)^{10-r} \left(\frac{1}{2}\right)^r \binom{5}{1} \left(\frac{r}{10}\right) \left(\frac{10-r}{10}\right)^4.$$

If we now 'normalize' this product we shall have, after cancelling common factors,

$$p(r) = \frac{\binom{10}{r} \left(\frac{r}{10}\right) \left(\frac{10-r}{10}\right)^4}{\sum_{r=0}^{10} \binom{10}{r} \left(\frac{r}{10}\right) \left(\frac{10-r}{10}\right)^4}$$

for the 'posterior probability' of there being r white balls in the box. Plotted against r , the two functions $\binom{n}{r} q^{n-r} p^r$ and $p(r)$ give the two sets of points shown in the accompanying figure (for clarity the points in each set have been joined by a broken line).

The frequency interpretation of the prior probability $\binom{n}{r} q^{n-r} p^r$ is as follows: at a single filling of the box there are either, for example, 3 white balls in the box or there are not; that is, the probability of there being 3 white balls in the box is either 0 or 1, no intermediate value being admitted. There is no talk of the probability of there being r white balls in the box, in the frequency sense, unless the box is filled *many times* from the auxiliary container under conditions that produce random results in the box content. If this is presumed, then after a large number of fillings, a record of the box content would show $\binom{n}{r} q^{n-r} p^r$ for the relative frequencies of r white balls getting into the box ($r = 0, 1, 2, 3 \dots 10$); we can assert this because the drawings are 'at random',



which I take to mean nothing more nor less than the validity of the frequency interpretation of the binomial expansion. The term $\binom{n}{r} q^{n-r} p^r$ is ordinarily called the 'prior probability' of r white balls, but a better name might be *unselected* probability, and it is so labelled in the figure: it is unselected because *all fillings have been counted* in the record, that is, no selection from the record has been made.

Now for the frequency interpretation of $p(r)$, let us suppose that at each filling of the box, before it was emptied and filled again, the 'experiment' of drawing 5 balls was performed and the results noted. Then for each occasion upon which 10 balls were put into the box in the prescribed manner, we have a notation in our record showing, first, the number of white balls in the box (0, 1, 2 . . . 10), and secondly, the result of the experiment (0 white and 5 black, 1 white and 4 black . . . 5 white and 0 black); and there are supposedly some huge number of these notations. If we now strike from this record all the notations *except* those for which the immediate experiment yielded 4 black and 1 white, we shall find that the relative frequencies (probabilities)

of r white balls in the box, in *this selected class*, is $p(r)$. The denominator of $p(r)$ is a mathematical device for accomplishing this selection. $P(r)$ is called the 'posterior probability' of r white balls in the box, but a better name would be the *selected* probability, and so it is labelled in the figure. Thus we see a frequency interpretation for both the prior and posterior probabilities, and we see also from the frequency point of view the distinction between them—in the former the probability of r white balls is computed without selection, and in the latter, with selection.

From the figure, it is evident that the box content that yields 4 black and 1 white most frequently in the 'experiments' is 6 black and 4 white. At the same time it is interesting to note that this particular box content will yield 3 black and 2 white in five draws more frequently than it will yield 4 black and 1 white, and that the optimum box content for 4 black and 1 white is 8 black and 2 white.

W. EDWARDS DEMING.

Department of Agriculture,
Washington, D.C. Nov. 18.

An Electro-Chemical Theory of Salt Absorption and Respiration

THE surface layer of wheat roots which are put in distilled water behaves like a membrane charged with hydrogen ions in a concentration of about $10^{-3} N$. ($pH = \alpha. 3$)¹. If a neutral salt is added to the water, the metallic cations are adsorbed in exchange for part of the hydrogen ions. As a consequence, the actual pH of the protoplasmic membrane increases; in a $10^{-3} N$ solution of potassium chloride it is about $pH = 6$. If the solution has $pH = 7$ a potential difference of about 58 mv. occurs. The protoplasmic membrane is then negative relatively to the solution. This negative charge is the normal state of the absorption cells of the root tissue.

Owing to the negative charge of the protoplasmic membrane, cations pass without difficulty into the protoplasm, whereas the uptake of anions requires energy supply. Oxidation processes seem to supply this energy.

Oxidation implies a decrease of the negative charge of the oxidized substance. According to Le Chatelier's principle, oxidation processes will be promoted in the surface of the protoplasm of root cells. Respiration is the oxidation of carbohydrates by free oxygen effected in special redox systems of the living cell. If such a respiration system is put into action by the potential difference between the protoplasmic membrane and the medium, it will act electro-chemically as if electrons (anions) were thrown out into the solution. In exchange for these amounts of negative electricity that traverse the outer cell boundary, anions will move in the opposite direction from the medium into the cell.

This theory of 'anion respiration' is supported by a large number of observations made in my laboratory during the course of the last six years. A few of them are described here.

The respiration intensity of roots which are surrounded by distilled water always attains very high values². Potential measurements¹ show a correspondingly high negative potential of the root surface. It attains values of -150 to -200 mv. In this case, the anion respiration will of course be 'idling', because there are no anions to absorb from the distilled water, except very small amounts of OH^- and HCO_3^- .

The relation $\frac{\text{respiration}}{\text{anion absorption}}$ shows high values when the salt concentration in the medium is low, and decreases with increasing concentration. The potential difference between the root and the medium decreases also with increasing salt concentration. In one series the relation $\frac{K \text{ absorb.}}{NO_3 \text{ absorb.}}$ attained the values 0.77 in a 0.001 N. KNO_3 solution and 0.43 in a 0.01 N. solution. The initial potential difference was ca. -70 mv. in the diluted and ca. -25 mv. in the more concentrated solution. More energy is needed to absorb anions in the former case.

Extensive experiments² indicate a sort of quantitative relation between the amount of anions absorbed by the root and the respiration intensity during the same period. The following equation was formulated:

$$R_t = R_f + kA,$$

where R_f is a fundamental or 'minimum' respiration that occurs independently of the mechanism of anion absorption; kA is the anion respiration, which is a multiple k of the anion absorption A ; R_t is the total respiration measured in the experiments. The existence of a 'fundamental respiration' is proved by the fact that its intensity is unaffected by agents, for example, potassium cyanide, which check the anion absorption. The anion respiration is an oxidation mechanism which is regulated by the negative electrical charge of the protoplasmic membrane and it supplies apparently the energy for the absorption of anions against the potential gradient.

The above equation represents only the outlines of the process, for other factors also influence the surface potential of the protoplasm. Thus the coefficient k is a constant only if other factors, for example, the kind of cations in the solution, are constant too. From what has been said about salts and surface potential of the protoplasm, it is evident that the exchange power of the cations partly determines this potential. Bivalent ions have a larger exchange power than monovalent ones, and therefore, in equimolar concentration, depress the potential difference more. On the other hand, ions of high exchange power are less mobile in the protoplasmic colloids; their retention in the solution increases again the negative potential in the protoplasmic membrane. It requires more energy, of course, to absorb anions from a solution if cations are held back than if they are absorbed in similar amounts too. Consequently absorption experiments

show that the relation $\frac{\text{anion respiration}}{\text{anion absorption}} = k$ gives higher values for salts of bivalent cations, for example, Ca^{++} , than for potassium salts. For the same reason, k is higher in a barium salt than in a calcium salt (Ba^{++} is less mobile than Ca^{++}). If the mechanism of the anion respiration is regulated by the negative charge in the protoplasmic membrane, and if this charge, as measurements show, is a product of the relation $\frac{cH \text{ of protoplasmic membrane}}{cH \text{ of the medium}}$, the cH value of the

medium and all factors which determine this will be included in the complex of conditions which determine the value of the coefficient k in the above equation. Apart from the relative absorption velocity of cations and anions just mentioned, one end-product of the respiration, HCO_3^- ions, is an important regulator of the pH of the medium. The aeration of the medium

will consequently be an important factor, apart from the fact that the oxygen supply which controls the respiration also depends upon the aeration. The somewhat curious situation will then occur that a very effective aeration is a drawback for intensive anion uptake, because the carbon dioxide left in the solution helps the protoplasm to overcome the resistance to anion absorption.

The theory of anion respiration of which we have here given an outline refers to cells with a pronouncedly acid protoplasmic membrane. Such a membrane seems to be characteristic of plant roots. Other kinds of cells might behave differently. I recall in this connexion the interesting observations on the skin of frogs³. If the charge of the root cells is changed to positive by holding them in a ca. 10^{-2} N. solution of a strong acid, they die within a few minutes. Also in very concentrated salt solutions ($> 10^{-1}$ N. KCl) the charge of the membrane will be changed into positive; but the cells then live longer. Such media are by no means normal. On the other hand, one can easily conceive that cells of a normally positive charge relatively to the medium might exist. Such cells will be able to absorb anions without any extra energy supply, but the absorption of cations needs energy supply. This is a speculation so far, because our experience of the interference of reduction processes in ion absorption is very limited. From the point of view of electro-chemistry, reduction processes diminish the positive charge. Attention is here directed to the interesting results of Arens in the polarity of leaf cells during photosynthesis⁴. Potential gradients in protoplasmic boundaries are probably of fundamental importance both in the metabolism and in the translocation of substances within the organism, as well as in the absorption and excretion of ions. From this point of view the investigations in the ion absorption of plant roots may have a wider application.

H. LUNDGÄRDH.

Institute for Plant Physiology,

Uppsala,

Uppsala, Dec. 15.

¹ Lundgårdh, H., *Biochem. Z.*, **308**, 5 (1938).

² Lundgårdh, H., *Biochem. Z.*, **308**, 104 (1937).

³ Lundgårdh, H., and Burström, *Biochem. Z.*, **301**, 235 (1933); **377**, 233 (1934).

⁴ Krogh, A., *NATURE*, **140**, 755 (1937).

⁵ Arens, K., *Jahrb. Wiss. Botanik*, **53**, 561 (1936).

Reduction of Carbon Dioxide with Molecular Hydrogen in Green Algae

A VIGOROUSLY growing pure culture of the alga *Scenedesmus* sp. D.3 is suspended in a hundredth molar (1/100 M.) solution of potassium bicarbonate and kept for six hours in the dark in an atmosphere of hydrogen containing 2 per cent carbon dioxide. Shortly before the last traces of oxygen in the vessel have disappeared by way of respiration, the cells begin to absorb hydrogen. The amount of hydrogen absorbed in this reaction varies with the condition of the algae. After this absorption has stopped, practically no further gas exchange is observed. If the light is now turned on, no evolution of oxygen can be detected but the algae begin to absorb hydrogen instead. The process has a measurable induction period, but thereafter it proceeds at a steady rate. This phenomenon is strikingly similar to the reduction of carbon dioxide with molecular hydrogen brought about by purple bacteria. That this absorption of hydrogen by the green algae is connected with the

reduction of carbon dioxide can be shown by the same method which enables one to establish the ratio H_2/CO_2 in purple bacteria¹. The algae are suspended in a slightly acid phosphate buffer, treated with hydrogen in the dark, and then illuminated until all carbon dioxide stored or produced by fermentation has been used up in photosynthesis. Addition of a known amount of carbonate at this point is followed by a rapid uptake of hydrogen, the quantity of which exceeds the ratio $2H_2$ for $1CO_2$ found in purple bacteria. In *Scenedesmus* this ratio often reaches a value of about 3.

The reaction between molecular hydrogen and carbonic acid in green plants is affected in a peculiar manner by the light intensity. Up to a certain threshold the rate of hydrogen absorption is proportional to the light intensity and at constant intensity, when both reactants are present in excess, the reaction proceeds at a constant rate. If, however, the light exceeds a certain limit of intensity, the absorption of hydrogen stops and after a few minutes normal photosynthesis is in full activity with the production of oxygen.

This effect of light of too high intensity cannot be reversed merely by subsequent reduction of that intensity; a slow dark reaction is necessary to re-establish the bacterial type of light metabolism in green plants.

In the absence of light, 'hydrogen-treated' algae are able to catalyse the 'oxyhydrogen' reaction, provided the tension of oxygen is held below a certain limiting value. Oxygen at a higher pressure inhibits the oxidation of hydrogen completely; once it has been inhibited, the reaction cannot be immediately restored by lowering the oxygen pressure. For reactivation an incubation period under anaerobic conditions is necessary. The inhibiting effect of oxygen on the 'oxyhydrogen' reaction in *Scenedesmus* is very similar to the phenomenon in *Acetobacter peroxidans*².

These two observations in *Scenedesmus* supplement each other inasmuch as the reduction of carbon dioxide with hydrogen can be explained by the oxyhydrogen reaction, the catalytic system of the latter reaction being apparently able to use the molecular oxygen produced in photosynthesis at low light intensities. The reaction rates, however, suggest an alternative explanation. Under the conditions of the experiments the oxyhydrogen reaction in green plants may be catalysed by the same enzyme system which normally liberates oxygen in photosynthesis. When completely reduced, the enzyme would not react as a catalase but as an oxidase and a peroxidase. This action of the catalyst would be practically the same in green plants and in purple bacteria. The alternative explanation therefore brings photosynthesis by purple bacteria into accord with that in green plants. Added support to this hypothesis is found in the papers of Keilin and Hartree³ and of Stern⁴ on hydrogen peroxide catalase, from which it appears that catalase will occasionally act as a peroxidase.

H. GAFFRON.

Kaiser Wilhelm Institut für Biologie,
Berlin-Dahlem.

Hopkins Marine Station,
Pacific Grove, California. Nov. 9.

¹ Gaffron, H., *Biochem. Z.*, **275**, 301 (1935).

² Wieland, H., and Pictor, H., *Liebig's Ann.*, **588**, 116 (1934).

³ Keilin, D., and Hartree, E. F., *Proc. Roy. Soc.*, B, **119**, 141 (1935).

⁴ Stern, K. G., *J. Biol. Chem.*, **114**, 473 (1935).

Further Evidence for the Lamarckian Theory of the Cause of Evolution

THE death of Prof. William McDougall marks the end of an epoch in the history of biology. Prof. McDougall attained world-wide fame as a brilliant experimental psychologist, but his equally important work on the heritability of acquired habit has been, I think, for the most part overlooked. He experimented on rats, and he showed that when rats were forced by unpleasant experience to acquire a habit, they produced offspring which acquired the habit more readily than did their parents until, at the end of nine years, they acquired the habit at the first contact with the unpleasant experience.

The late Miss Dorothy Sladden (whose work has periodically been noted in NATURE) also, like McDougall, was engaged in experiments on the heritability of acquired habit, though she knew nothing of McDougall's work. When she died her work, like that of McDougall, was complete, but the final and conclusive part of it was embodied in jottings in note-books and columns of figures. My former colleague, Mr. H. M. Hewer, has edited these notes and published his results, which were noted in NATURE¹.

As Miss Sladden's experiments were of a much simpler type than those of McDougall, a very brief account of them may be given here. She used the stick-insect *Coroniscus morosus*, a native of South India, which in Great Britain normally feeds on privet. This insect was subjected to periods of semi-starvation, each lasting two days, when it was offered ivy for food which it detested. At the end of each period it was revived by a leaf of privet. Each of these ordeals was called a 'presentation'. The overwhelming majority of the insects would not accept ivy until the fifth presentation, and some even held out until the tenth presentation. These insects are parthenogenetic and when their eggs were collected and bred from, it was found that they accepted ivy at an earlier presentation than did their parents until at the end of five years they took ivy at the first opportunity. Thus Miss Sladden and Prof. McDougall between them have adduced evidence in support of the hypothesis that the acquired habits of one generation are passed on to the next.

Of this I may give two examples. The Didsbury Institute informs me that the effort to transplant sea-land cotton from islets off the coast of Carolina to other parts of the world has resulted in failure. In a few years the transported cotton reverts to the native stock. On the other hand, Marquis wheat, which has doubled the Canadian wheat crop owing to its ability to survive 'summer frosts', has been proved to be a northern Russian race which has gradually adapted itself to the rigours of a subarctic climate. 'Mutants' only persist when cultivated under the exact conditions of soil in which they made their appearance; further, they become progressively weaker and liable to disease.

The alternative hypothesis as to the origin of species has been that these originated from the sports familiar to us in the garden and farmyard which are the source of some of our most valuable domesticated animals and plants. But there are two difficulties about this hypothesis: first, Mohr, whom the late Dr. Bateson called the first geneticist in Europe, has shown that all sports are physiologically weaklings and could never survive in the open; and secondly, that when such sports are returned to the wild in a

place where their natural enemies are absent, in forty-fifty years they revert to the condition of the wild ancestor. Further, though it might be supposed that the study of these sports is of prime importance to the farmer, experience shows that this is not so. Thus the work of these two experimenters has raised Lamarckism from the rank of an hypothesis to the status of a proved fact; for the first time evolution has been experimentally demonstrated in the laboratory.

E. W. MACBRIDE.

West Bank,
Nr. Alton,
Hants.

NATURE, 142, 801 (1938).

The Dead Language of Science

PROF. F. E. FRITSCH¹ complains of the many new terms encumbering a recent German text. We must all sympathize with his view. But is there not a worse evil in our midst, one to which long use has inured us? I mean the constant reiteration of dead terms, of decayed verbiage. Prof. Fritsch disinters a sample, the word 'spireme', and discusses its use. This word originally (in 1882, according to Wilson) referred to the threads seen in the prophase of a nuclear division, mitosis or meiosis. In England and America it was connected with *Oenothera* in 1907, and became known as the 'continuous spireme' of meiosis. This connexion ended after a period of some confusion in 1932, when the spireme suddenly passed away. By 1934 it had disappeared from Sharp's "Introduction to Cytology". It is no doubt from the *Oenothera* connexion that Prof. Fritsch recollects the word and in a meaning to which it was never restricted elsewhere. In Germany its last technical use is found in 1934 (Geitler, "Grundriss der Cytologie"). There also it has since disappeared (Geitler, 1938, "Chromosomenbau").

By technical use, I mean use by those who are handling the material or studying the process every day. There are many words, dead words, found in text-books for elementary students which are never used in technical practice. This fact is obvious as soon as it is pointed out. Take the word 'karyokinesis'. It is never used either in speech or writing by those who study nuclear division, and was effectively superseded by 'mitosis' more than fifty years ago. Yet almost every English text-book mentioning cytology tells its readers that nuclear division is known as karyokinesis or mitosis; and every student commits to memory this unnecessary fiction—usually, it must be admitted, along with a correspondingly erroneous account of the process. Other sciences could tell the same tale.

There are many words in text-book currency which fall into this phlogiston group. Words like 'heterotypic mitosis', 'nuclear reticulum', 'telosynapsis' and 'xenia' are the dead or dying remains of past misunderstandings—merely useless lumber. There are many others not yet dead, however, which have no proper place in text-books. Words as cacophonous as 'obdiploetemony', as obscure as 'arrhenotoky', as superfluous as 'phragmoplast' must give the specialist pause.

It is to be feared that men of science in all countries will often, in inventing new terms, create hideous, meaningless and unnecessary words. It is also to be feared that compilers of text-books will often be afraid of appearing ignorant if they neglect to record

these verbal discoveries. But it is the business of these writers to sort out the words which will convey the information necessary for doing certain work. Words that do not fulfil this use should always be rejected from the text and segregated in a glossary for the inspection of the learned, not for the confusion of the learner.

C. D. DARLINGTON.

John Innes Horticultural Institution,
Merton Park, London, S.W.19.

Jan. 18.

¹ NATURE, 142, 47 (1939).

The Prehensile Paw of the Giant Panda

IN NATURE of January 28, p. 157, Prof. Wood Jones, in his description of the prehensile digit in the fore paw of the giant panda, stated that the radial sesamoid bone has a special muscular arrangement making it movable so as to act as a true thumb it "usurps the place of the true thumb and simulate all its movements".

This remark must have been based, I think, upon an examination of the paw with the skin removed because in the skeleton of the foot, as has been known for years, the lengthened sesamoid bone in question looks, in a measure, so like an additional digit on the inner side of the foot that anyone might be excused for suspecting that it projects like a thumb and is capable of considerable lateral movement, giving it a prehensile function. It has scarcely any such function. It is enveloped in the skin of the foot, like the metacarpal bones, and is quite invisible the only indication of it, as is also well known, being the enlarged, cushion-like extension of the plantar pad which covers its apex. The use of this pad was unsuspected until the living animals were observed in the Zoological Gardens. On the dead specimen, found it capable of only slight movement; but it acts as an accessory to the prehensile power of the first and, to a lesser degree, of the second digit. When these are normally flexed in a vertical plane their terminal pads come into contact with the elevated portion of the plantar pad and constitute a grasping organ. The mechanism is exactly comparable to that produced by bringing the tips of the first and second fingers on to the ball of the thumb in the human hand.

R. I. POOCK.

British Museum (Natural History),
S.W. 7.

Turtles in the English Channel

IN his interesting letter on the occurrence of turtles in British waters, Mr. H. W. Parker¹ has suggested that their presence in the English Channel may be an indication of the drift of warm surface water up-Channel. There is another possible explanation. Evidence has not been lacking during recent years that there has been an extension of the distribution of many warm water animals to the far north (see, for example, Stephen²). Recently also the unusual capture of a flying fish, *Cypselurus heterurus*, in Oslo Harbour in 1937 has been recorded by A. Wollbeaek (see Brunn³); this is the first record of a flying fish at Oslo since 1848.

While there is no indication that the water temperature in the Channel region is any higher than normal there can be no doubt that warm water has been penetrating farther towards Arctic regions. This will

flow an extension of the northern boundary of certain animals, and it is perhaps natural to suppose that, allowing this extension, the centres of distribution may also have shifted more to the north. Such an extension might thus bring turtles into a region in which westerly winds would tend to drift them up the English Channel, without necessarily a passage of any considerable body of water in the same direction.

F. S. RUSSELL.

Marine Biological Association,
Plymouth.
Jan. 21.

Parker, H. W., *NATURE*, 143, 181 (Jan. 21, 1939).

Stephen, A. C., *J. Animal Ecol.*, 7, 125 (1938).

Bruun, A. Fr., *Nytt Mag. Naturv.*, Oslo, 78, 205 (1938).

Formation of Native Lead under Laboratory Conditions

THE conditions which may have governed the formation of native metals in non-igneous rocks are not always readily reproducible in the laboratory owing to the difficulty of performing experiments

requiring many years for completion. An observation made during the reconstruction of the Plymouth Laboratory may be regarded as an experiment of fifty years duration.

The slate back, sides and bottom of the aquarium tanks in the main laboratory, built in 1888 and dismantled recently, were cemented with a lute composed of white lead with some red lead and linseed oil. During fifty years, pockets and seepage channels have formed into which sea-water, rich in organic matter, has crept. The oxides and carbonates of lead have been reduced, in some places to black lead sulphide. More remarkable has been the further reduction, in other pockets, giving rise to inclusions of metallic lead answering to the usual analytical tests. When first exposed these had rough but bright metallic surfaces, similar in appearance, both to the unaided eye and under the microscope, to commercial lead which had been etched with dilute acetic acid.

L. H. N. COOPER.

D. P. WILSON.

Marine Biological Laboratory,
Plymouth.
Jan. 10.

Points from Forgoing Letters

INFRA-RED absorption in the region of 3μ of *o*- and *m*-methoxybenzoic acids in carbon tetrachloride has been investigated by Dr. J. J. Fox and Dr. A. E. Martin. These compounds show a small band attributable to OH vibrations in the monomer, and a broad band at 3.4μ due to OH vibrations in the dimer. In addition, the *ortho*-compound has an intense band at 2.974μ ascribed to intramolecular association of the OH group.

Prof. H. A. Bethe, F. Hoyle and Prof. R. Peierls state that the experimental evidence on β -disintegrations, except for the shape of the energy spectrum, supports Fermi's original theory rather than its modification by Konopinski and Uhlenbeck, and that one can account for the shape of the spectrum by postulating the emission, in some disintegrations, of γ -rays of suitable energy and intensity. The existence of such γ -rays is in some cases confirmed, in others not ruled out, by the experimental evidence.

In the same way as vectors are generalized to tensors, Dirac wave-functions may be generalized to 'undors' and a consistent under-calculus may be developed, according to F. J. Belinfante, who presents the equation for heavy quanta (baryterons) in a concise form closely analogous to the Dirac equation for the electron.

Referring to the variations observed by J. Evershed in the radiation periods on the solar disk, Sir Josepharmor states that they support the view that the forces of mutual atomic collision which float up the radiating atoms in the sun's atmosphere must provide a compensating factor that annuls any influence on the period of radiation which would otherwise be reduced by the free fall. If the gravitational spectroscopic displacement is not solely of the Einsteinian type but is influenced by other forces, as indicated, it may be necessary to reconsider the enormous densities which have been calculated for certain stars such as the dark companion of Sirius.

Dr. W. Edwards Deming takes the view that there are circumstances in which prior probabilities have a frequency interpretation, and describes an experiment in which the frequency interpretations of the prior and posterior probabilities are contrasted: the former, he states, are probabilities associated with the circumstances in which all the experiments are performed, and might be termed *unselected*. The posterior probabilities also refer to the circumstances of the experiment but not to all experiments; they refer to the selected class, namely, those that had a particular result, all others being excluded, and might be designated as *selected* rather than posterior.

Prof. H. Lundegårdh develops an electrochemical theory of salt absorption according to which cations pass without difficulty into the protoplasm owing to the negative charge of the protoplasmic plant membrane, whereas the uptake of anions requires a supply of energy, which is provided by oxidation processes. The author remarks that this applies to the plant cells so far investigated and that other cells may behave differently.

Dr. H. Gaffron states that by prolonged anaerobic treatment in an atmosphere of hydrogen green algae acquire the capacity to reduce carbon dioxide with hydrogen when illuminated. No oxygen is developed. This new light reaction may go on for a long time at low light intensities but stops immediately at higher intensities, the absorption of hydrogen then changing into the normal production of oxygen.

The work of Prof. W. McDougall and Miss Dorothy Sladden is quoted by Prof. E. W. MacBride as affording conclusive evidence that acquired habits of one generation may be passed on to the next. Prof. MacBride reiterates his view that this is the main mechanism of evolutionary change, and maintains that 'mutants' are physiologically weaklings which tend to return to the ancestral type.

Research Items

Archaeological Excavations at Eastburn, Yorkshire

IN the making of a new aerodrome at Eastburn on the Yorkshire Wolds, near Driffield, skeletons were found which on examination proved to be of iron age type; but no pottery or metal was found with them to determine their age. Later, in the course of constructing a hangar, some fifty iron age graves were exposed. The site and the relics recovered have been described by Mr. Thomas Sheppard (*Hull Museum Publications*, 197; 1938). Each tumulus was very clearly indicated in the white chalk gravel by a circle representing a slight trench on the outside of the mound, and a dark, usually squarish, place in the centre of the circle, three to four feet across, which contained a skeleton or occasionally two skeletons. The bones were so decomposed that in three instances only was it possible to remove sufficient of the skull for examination. No pottery or iron was associated with the burials, excepting a single iron brooch or fibula of the involuted type. This type is considered by Sir Arthur Evans to date from 300 B.C. A fragment of a similar brooch was brought to the excavator. It had a knob of red glass still attached by a metal stem, of which the head is apparently copper. A typical iron age pot larger than those from the Danea graves was also found. A year later further discoveries were made, including a female skeleton in remarkably good condition. Three earthenware vessels were also found, of which one, a small vessel with a slightly curved depression between lip and shoulder, is the only one of its kind found in that condition in East Yorkshire. The largest of the three is an example of coiled technique. This vessel and another each contained the humerus of a pig. Among the iron objects found were a leaf-shaped spearhead and a remarkable iron sword 28 inches in length. Its handle had been mounted with horn and there were traces of a wooden scabbard. On the arm of a female skeleton was a bronze bracelet of great beauty with two decorated bands of cable-like design. Roman and Anglo-Saxon relics also occurred on the site.

Recent Research on Cancer

THE thirty-sixth annual report of the Imperial Cancer Research Fund, which has just been published, is the first to appear since the Fund moved into new laboratories at Mill Hill. It summarizes the work carried out during the last year on carcinogenesis, the nature of tumour viruses, the action of radiations and of hormones and the properties of tissue cultures. Dr. F. R. Selbie and Dr. C. Foulds have extended knowledge on the carcinogenic action of radioactive substances. They obtained tumours at the site of injection with thorotrast (a colloidal preparation of thorium oxide) in rats, mice and guinea pigs. There would seem to be little doubt that thorotrast should not be used clinically on account of its possible carcinogenic action on man. Dr. W. Cramer and Dr. E. S. Horning investigated the antagonism between oestrogens and the hormones of the pituitary acidophil cells. In a preliminary experiment they have been able to inhibit the spontaneous incidence of mammary cancer in mice by treatment with preparations of the pituitary thyrotropic

hormone. If fibroblasts and sarcoma cells are grown as tissue cultures in plasma, the sarcoma cells liquefy the clot more rapidly than do the non-malignant cells. Dr. R. J. Ludford has found that some trypanocidal agents such as Trypan Blue and Bayer 205 promote this liquefaction of the clot by cells, but this action is not specifically associated with tumour cells. Mr. H. G. Crabtree, in conjunction with Dr. L. H. Gray of the Mount Vernon Hospital, found that the ability of isolated tumour tissue and isolated retina to produce lactic acid are both equally inhibited by equivalent doses of γ -radiation, β -radiation or X-radiation when applied *in vitro* at low temperature.

Tubercular Allergy without Infection

F. R. Sabin and A. L. Joyner (*J. Exp. Med.*, 68, 659; 1938) found that guinea pigs could be rendered hypersensitive to tuberculo-protein by small, repeated, intradermal injections of active tuberculo-protein. The process of sensitization could be accelerated by the addition of tuberculo-phosphatide to the protein, so that the reactions became indurated and necrotic and closely simulated tuberculous disease. Injection of active tuberculo-protein induced a new formation of monocytes and some epithelioid cells, and the addition of phosphatide to the protein brought about a massive formation of epithelioid cells. The writers regard the intradermal route as the best for these sensitizations probably because it provided the largest dose per cell of the sensitizing agent. They compare the degree of sensitization artificially obtainable by the synergic action of tuberculo-phosphatide and tuberculo-protein to the degree of sensitization naturally occurring in tuberculous animals.

Reactions of House-flies to Light of Different Wave-lengths

J. W. MACBAIN CAMERON, of Macdonald College, Montreal, has recently described experiments which were conducted with the object of testing the reactions of house-flies to different wave-lengths of light (*Canadian J. Res.*, 16, 307; 1938). The insects were reared on an artificial medium and tested by means of different wave-lengths of spectral light obtained from a quartz-mercury vapour lamp. The range of the spectrum tested was from 3022 Å. to 5780 Å. and the lines were made of approximately equal intensity throughout. In addition, 5461 Å. and 4078 Å. were tested at several other intensities. The comparison standard, which was used in all cases, was white light obtained from a tungsten filament frosted bulb. Flies to be tested were removed from breeding cages ten hours before the tests began and were kept in darkness until used. It was found that the house-fly is much more strongly stimulated by ultra-violet light of wave-length 3656 Å. than by any other part of the spectrum tested. The influence decreases as the longer wave-lengths are reached and also on the short wave-length side of the peak. The available spectrum extended as far as 3022 Å. into the ultra-violet, and at this point there is still an attractiveness greater than that exercised either by yellow or green.

Original Home of the Coco-nut

UNDER this title P. V. Mayuranathan, curator of the Botany Department, Government Museum, Madras, has published an interesting discussion of this subject (*J. Bombay Nat. Hist. Soc.*, 11, (2); September 1938). His paper examines particularly the question of the antiquity of the coco-nut in India, and whilst discussing previous suggestions as to the original home and the subsequent course of distribution of this palm, it pays particular attention to the geological history of the regions under discussion and supplements botanical evidence with that drawn from philological and ethnological sources. So old is the coco-nut in India that the Arabs from early times called it the Indian nut. On the other hand, *Cocos* is an American genus with no other living representative of that genus anywhere except in the continent of America. The author's solution is that it originated in that ancient Papuan land which included the island continent of New Guinea as we know it to-day; from there the strong eastward current during the north-east monsoon carried it through the Straits of Malacca into the Bay of Bengal, and primitive man brought it over to the shores of India. The discovery of fossil *Cocos* in the Pliocene deposits of New Zealand would be in accord with this view.

Northern Californian Earthquakes during 1937

As is well known, California forms part of that well-established ring of instability, the circum-Pacific circle, and it was in the Californian region that on April 18, 1906, occurred the great earthquake which wrought havoc in San Francisco and caused such remarkable displacements along the San Andreas rift. During 1937 there was no shock so great as this one, but there were approximately 277 earthquakes and earth tremors of varying intensity. Their intensities and distribution have been examined by Perry Byerly and John N. Adkins (*Bull. Seis. Soc. Amer.*, 28, No. 4, 263-268; Oct. 1938). One hundred and forty earthquakes were sufficiently well recorded at the various stations for their seventy-five epicentres and initial times to be determined, and for these a map has been drawn by the authors. The epicentres form a broad band parallel with the coast-line with, as in 1936, a region comparatively free from epicentres between Humboldt County and San Francisco Bay, a very active region east of Monterey Bay, and very few epicentres along the San Andreas Fault between Monterey Bay and San Francisco. Compared with 1936 there was increased activity in the region east of San Francisco Bay. There appears to have been also a line of epicentres roughly at right angles to the coast, approximately through the towns of Greenfield and Merced. Seventeen earthquakes occurred in known regions the epicentres of which could not be located accurately owing to poverty of data, and the following observatories recorded shocks not felt by persons or recorded at other observatories: Berkeley, 26; Mount Hamilton, 28; Palo Alto, 38; San Francisco, 2; Ferndale, 8; Fresno, 3. Finally, fifteen shocks were recorded at more than one station, not felt by people and insufficiently well recorded for their epicentres to be located.

Analysis of Mine Dusts

PAPER No. 101, on the analysis of mine dusts, by A. L. Godbert, Safety in Mines Research Board (H.M. Stationery Office, London, S.W.1, 1938. 1s. 6d.) gives an alternative method of

determining the carbon dioxide contents of mine dusts containing carbonates and a method of determining separately the free and combined water in mine dusts containing gypsum. These data are important in relation to the suppressing action on inflammation of coal dusts known to result from carbonates and combined water.

Density Condensation of Cepheid Variables

ZDENĚK KOPAL has recently published the results of his research on 88 δ Cephei stars and 30 variables of the RR Lyrae type (*Mon. Not. Roy. Astro. Soc.*, 99, 1; Nov. 1938). He makes use of the well-known period-luminosity and mass-luminosity relations and also assumes that the cepheids radiate like black bodies, from which two tables are compiled showing the following results: P , the period of pulsation; Sp , the spectral type; $\log T_*/T_\odot$, $T_\odot$ and T_* , referring to the temperatures of the sun and star respectively; absolute visual and also absolute bolometric magnitudes; $\log \sqrt{\rho m}$; $\log P\sqrt{\rho m}$, ρ being the density. Although it has been assumed for a considerable time that P has nearly the same value for all cepheids, it is shown in the tables that there is practically no foundation for this assumption. There is a well-defined relation between $P\sqrt{\rho m}$ and the spectrum, and it seems that there is a close connexion between the density condensations of cepheids and their spectral class. This, of course, depends on the hypotheses involved in the present state of the pulsating theory being correct. There is a gap in the values $P\sqrt{\rho m}$ between the long- and short-period cepheids at spectral type $F5$, and it is suggested that the sudden change of $P\sqrt{\rho}$ takes place when a certain temperature has been reached so that there is an alteration in the ratio of specific heats. This explanation, however, is ruled out, and a real change of density condensation is believed to take place. This affords good reasons for the assumption that the long- and short-period cepheids are of essentially different structure.

A Comparison Sequence for Nova Lacertæ

S. A. Mitchell and C. A. Wirtanen have published a paper with this title which will prove useful to variable star observers (*Mon. Not. Roy. Astro. Soc.*, 99, 1; Nov. 1938). The paper is the outcome of an informal meeting of the leaders of the American, British and French variable star associations during the sessions of the I.A.U. held at Stockholm last year. A request was made that the Leander McCormick Observatory should publish the magnitudes and co-ordinates of sequence stars for long-period variables that have been determined since *McCormick Publications*, 6, appeared in 1935, and a special request was made for Nova Lacertæ, No. 2. A table gives visual and photo-visual magnitudes for thirty stars with their co-ordinates, and, assuming equal accuracy for each method, the probable error of one magnitude is 0.02 magnitude. Three of the faintest stars of the sequence, magnitudes 14.6, 15.0, 15.3, have no photovisual magnitudes and these have been observed independently by W. H. Stevenson. Mitchell, using the 26-in. refractor, made visual sequences of grade estimates, and it will be shown in the forthcoming variable-star publication that the scale of his visual magnitudes agrees very closely with the international photovisual system to which the values of Nova Lacertæ are reduced.

Science and Philosophy

IN a Friday evening discourse delivered at the Royal Institution on December 2, the Right Hon. Viscount Samuel discussed the importance of obtaining closer co-operation between science and philosophy than there has been in the past. The scientific worker, intent on special problems, has tended to ignore the need to examine the general principles on which his studies rest. Separation has come from the other side too. Nineteenth century philosophy of the idealist tradition went on its way regardless of science, with disastrous consequences. The question is not a purely academic one. At the present time, he said, "every land resounds with the tramp of armies, and the air throbs with the droning of their aircraft. Behind the armies are the dictators or the parliaments. Behind them are the political creeds—Communism, National-Socialism, Fascism, Democracy. And behind the creeds are the philosophers—Marx and Engels; Hegel, Nietzsche, Spengler, Sorel and Croce; Mill and the other protagonists of liberty. Some of the creeds, it is true, are anti-intellectual; but irrationalism also is a philosophy of a kind".

If philosophies of this kind are to be avoided, a reasonable basis must be found for ethics and religion in place of the confusion and uncertainty now prevailing. The first step in this direction is for the philosopher frankly to accept the main conclusions and point of view of science. In particular, he must admit that the universe exists independently of human thought. Men and their thoughts enjoy no special privilege except as parts and products of this universe. The realist tendencies that are noticeable in recent philosophy in Great Britain and in the United States are therefore to be welcomed. As a consequence of such a realist attitude some old metaphysical difficulties about space and time, and about substance and qualities, should disappear. Lastly, it is necessary to abandon the notion that what we call 'values'—truth, beauty and goodness—are ingredients of the world at large. As Alexander has said, "Values are human inventions". This means that, in the sphere of ethics, actions are to be judged by their

consequences, not in terms of any supposed *a priori* moral principles.

These are examples where the philosopher should look to the man of science for guidance; but there are others where the philosopher should be able to help the man of science. For one thing, he can urge the need of caution in accepting the paradoxes that have been prominent in recent scientific thought. An example of this is the tendency to attribute physical properties to space. Strictly, space indicates only an interval between things or processes. If it is really empty, it cannot have physical properties. If any such properties have to be attributed, it should be openly acknowledged not to be empty, as was admitted by the old 'ether' hypothesis. Another example is the tendency to make Heisenberg's Uncertainty Principle an argument for abandoning the notion of causality, on which scientific procedure is based.

The philosopher may also be of use in directing attention to unfilled gaps in scientific theory. One of these is the absence of any explanation of gravitation. In spite of the Theory of Relativity, gravitation is still, as it was in Newton's day, a 'brute fact' unconnected with anything else known about matter. Conceivably the internal structure of the atom may provide the answer. Another, and perhaps a more scandalous, gap in theory is that the great problem of the relation of mind and body remains apparently untouched. Although science itself is a process of thought, science tells us nothing about the nature of thought. A serious mistake has perhaps been made in supposing that perception is necessarily confined to the known functions of the human sense organs. The solution of the problem may possibly come from the science of electro-physiology, which is still only in its infancy.

There are already encouraging signs, Lord Samuel concluded, that science and philosophy are coming closer together. If this union becomes complete, and if the long-standing isolation of religion can also be overcome, it may be possible at last for mankind to possess a unified and harmonious basis for thought and action.

The Expanding Universe

A DISCUSSION on the subject of the Expanding Universe was held on January 27 under the joint auspices of the Physical Society and the Royal Astronomical Society, the chair being taken by the Astronomer Royal. The discussion was opened by Prof. G. Temple and Dr. G. C. McVittie in two papers which gave general surveys of the theory of relativistic cosmology and of the information to be derived from astronomical observations.

The first of these papers dealt especially with the developments in relativistic theories of the large-scale structure of the universe since the publication of Robertson's report in 1933¹. The more important of these developments are the investigations of Milne

and his school into the possibility of solving the cosmological problem by the methods of the special theory of relativity, and the researches of Whittaker and his fellow-workers on the form taken by the astronomical distance functions in general relativity.

A cosmological theory which endeavours to explore world structure by means of terrestrial observations is necessarily speculative, and the relativistic theories rest upon two main hypotheses—the uniformity of space-time and the homogeneity of the nebular distribution. The first of these leads to either the special or the general theory of relativity, according as the uniformity is taken to be 'global' or 'local'. The second hypothesis, first formulated satisfactorily

by Milne, then shows that the space-time is stratified in such a way that the line element may be written in the form

$$ds^2 = dt^2 - e^{2\alpha(t)}((1 - kr^2/R_0^2)dr^2 + r^2d\theta^2 + r^2\sin^2\theta d\phi^2),$$

where the world-lines of nebulae ($r, \theta, \phi = \text{constants}$) are orthogonal to the hyper-surfaces of stratification $S, t = \text{constant}$. The general theory provides an expression for $g(t)$ in terms of the cosmological constant λ , the curvature constant k of the hyper-surfaces S (which may be $+1, 0$, or -1), the radius R_0 of S , and the number α of nebulae per unit volume on some specified S . Prof. Temple concluded by directing attention to the fact that the system of real co-ordinates (t, r, θ, ϕ) covers only that region of space-time actually traversed by the nebulae, and he indicated the possibility that an empty region of space-time might exist outside the system of expanding nebulae—as it actually does in Milne's theory.

Dr. McVittie then gave a critical account of the construction of the semi-empirical equations summarizing the observed relations between the red-shift δ , the apparent photographic magnitude m and the number N_m of nebulae with magnitudes less than m . He pointed out that Hubble's equations depend upon a number of *ad hoc* assumptions which are entirely arbitrary in character and unsupported by the general relativistic theory. In these circumstances, the obvious course is to utilize the relations between observable quantities furnished by the general theory. These alone, however, are insufficient and an additional datum is required, which McVittie finds in the estimate of the average mass of the visible nebulae, $M_0 = 4 \times 10^{44}$ gm. His analysis of the observations leads to the surprising conclusion that $k = -1$, so that the hyper-surfaces S are 'hyperbolic' in character, the radius R_0 lying between 10^3 and 10^4 parsecs. The average density is probably of the order of 10^{-29} gm. cm. $^{-3}$ and the effective temperature of the nebular radiation lies between $5,000^\circ$ and $7,500^\circ$. The cosmical constant λ is expressed by the difference of two numbers of the same order of magnitude, and, owing to the considerable uncertainty in their values, no reliable information is forthcoming concerning the value of λ .

In the subsequent discussion, an important point

was raised by Sir James Jeans, who inquired if the sign of k is sensitive to changes in the estimation of the average nebular mass M . In reply, Dr. McVittie stated that the conclusion $k = -1$ would probably persist even if his estimated value of M_0 were increased by a factor of about 50.

Sir Arthur Eddington stressed the importance of basing cosmological investigations upon a standard of length which would be accepted not only in relativity, but also in quantum theory and in metrology. Since such a standard can only be specified in terms of dimensionless numbers, it would necessarily be a structure with definite quantum numbers or composed of a definite number of atoms, as, for example, 10^8 lattice spaces of calcite. Finally, he stressed that theoretical cosmology is a normal and natural extension of well-known physical principles and deplored the mystery with which this subject is sometimes cloaked.

Prof. W. H. McCrea referred to recent nebular counts by Shapley which appear to indicate that the distribution is not isotropic, and he showed by a very simple argument that Hubble's velocity-distance relation would still remain true in any assigned direction. The Astronomer Royal also referred to the lack of homogeneity revealed in Shapley's observations, and appealed to mathematicians to develop a more general theory capable of dealing with this more complex situation. Dr. McVittie in replying to these comments stated that in his very latest paper Shapley admitted that his former conclusion is rendered uncertain by an error of calibration, but he believes that when the correct calibration is completed, there will still remain some lack of isotropy in the nebular distribution.

Prof. W. Wilson stated that in spite of its simplicity, Milne's cosmological theory suffers from the defect that it does not incorporate detailed gravitational phenomena such as planetary motions. On the other hand, he felt that in the domain of general relativity the early simple theory of de Sitter may be an adequate expression of the facts. Prof. Temple said in reply that the de Sitter universe is in fact the ultimate state of all the continually expanding models proposed by general relativity.

¹ *Rev. Mod. Phys.*, 5, 62.

A Congress of Aeronautical Geography

THAT there are relations between geography and aviation was officially acknowledged, so to speak, for the first time in the week of November 28–December 3, when the First Congress of Aeronautical Geography (Premier Congrès de Géographie Aérienne) was held in Paris under the auspices of the French Ministers for Air and National Education. It had been organized by the Union Syndicale des Industries Aéronautiques (not by a geographical body), the vice-president of which, General Duval, acted as chairman, and eminent representatives of French science and aviation served as chairmen of various sessions. Twenty-two papers were read, dealing with the different aspects of aviation so far as they may be of interest to the geographer.

The programme commenced with two meteorological papers, read by Messrs. G. Dedeant and A. Viant, of the French National Meteorological Office, and

an excellent discourse on the international regulation of civil aviation, given by Dr. A. Roper, secretary-general of the International Commission for Aerial Navigation. M. R. Bureau, of the Meteorological Office, discussed the stratosphere, and the well-known pre-War pilot and aeronautical inventor, M. R. Esnault-Pelterie, spoke on interplanetary space. A number of papers dealt with the geographical and economic conditions and the statistical results of commercial aviation in general (M. J. Vivant, sub-director of civil aeronautics in the Air Ministry) and of different long-distance air-lines (Messrs. R. Perret, vice-president of the Association des Géographes Français: line France-Madagascar of Régie Air-Afrique; Prof. J. Martin: lines France-South America and France-Indochina of Cie. Air-France; Prof. J. Weulersse: line London-Capetown of Imperial Airways Ltd.; F. Ruellan, director of studies: line Amsterdam-Batavia

of Koninklijke Luchtvaart Mij.; Prof. E. Denny: line New York-San Francisco of United Air Lines, Inc.). The services which aviation is able to render to geography and allied sciences were discussed by the following: M. A. Carlier, manager of the Société Générale de Photo-Topography (on aerial photography); Prof. P. George (on the role of aviation in the exploration of the polar regions); Father Poidebard (on the exploration of ancient civilizations by aeroplane); Prof. A. Demangeon (on the investigation of agricultural systems from the air); M. F. Blondel, chief mining engineer (how to employ the aeroplane for geological investigations and for prospecting); Prof. E. de Martonne (on the contribution of aviation to morphological studies); M. G. Huismann, director-general of Fine Arts (on the aid of aviation in studying and conserving the architectonic treasures of France). There was also an interesting *causerie*

by the well-known airman, M. P. Codos, on trans-continental and trans-oceanic flights. A number of other papers were of a more technical character.

It is to be regretted that the attendance at the Congress was not large; the date of the meeting had been chosen with regard to the sixteenth International Aeronautical Exhibition held at the Grand Palais des Champs-Élysées, but it is obviously not very convenient for a scientific congress. Though the meeting had been intended to be an international one, the speakers were, without a single exception French, and nearly the same is true of the hearers among whom there were only half a dozen foreigners. It is to be hoped that the next Congress of Aeronautical Geography, which will be held in 1940, again in Paris, may have larger and more international support.

CARL HANNS POLLOG.

The Testing of Electrical Switchgear

THE Department of Scientific and Industrial Research stated last year that at the request of a number of manufacturers of switchgear, it was considering the establishment of a short-circuit testing station at the National Physical Laboratory which would be capable of testing switchgear specified to be able to break a circuit having a current I flowing in it with a possible maximum voltage V across the gap of the circuit breaker, when the product of V and I is 250 million volt-amperes, certain limitations being made as to the value of V and I . The cost of such a laboratory would be very high, as it would have to be built at an appreciable distance from other laboratories and it would have to generate its own power. Only a limited number of full-scale tests could be made per annum and so it would need a large Government grant.

The Department, therefore, issued a questionnaire to interested firms and bodies, inviting their views on various aspects of the proposal and on certain tentative proposals by means of which the National Physical Laboratory might be able to issue certificates that the gear has successfully passed certain specified tests. The replies disclosed a considerable measure of agreement. It was desirable to provide testing facilities which would be available for those manufacturers who did not possess testing stations, and that it should also be possible for such manufacturers to obtain certificates issued by an independent body in respect of such tests. At the same time, those companies which have already erected short-circuit testing stations for their own use indicated some doubt as to whether additional testing capacity in Great Britain was justified as there were already in existence greater testing facilities than are available in any other country in which switchgear is produced. They pointed out that they had spare capacity available. They offered to assist the Department in exploring the proposal further by supplying information from their own experience. As the result of most friendly discussions with the Department, it appeared possible to collaborate with the owners of existing short-circuit testing stations and so provide facilities in those stations for testing for any British manufacturer. Negotiations to this end began in 1937.

Agreement has been recently reached on a scheme which it is hoped will be adequate to meet requirements. This scheme permits the existing testing stations to continue to issue their own certificates and in addition provides facilities for the issue of N.P.L. certificates when required in respect of circuit-breakers coming within the agreed range which attain a standard of performance defined in the appropriate British Standards specification. The negotiations were made much easier by the fact that the owners of existing stations had already taken preliminary steps to co-ordinate their work and had provisionally decided to form an 'Association of Short-Circuit Testing Authorities' which would act as a testing or certifying body. This Association is now being incorporated. The main features of the new scheme are as follows. Owners of testing stations will provide facilities to any British manufacturer without distinction, and will undertake that the full time use of one test bay will be made available collectively, by the existing testing plants, for tests for those manufacturers who do not themselves own testing stations. Tests will be normally carried out to the requirements of a definite British Standards specification. While the Association of Short-Circuit Testing Authorities will issue its own certificates of rating and records of performance, it will be possible to obtain N.P.L. certificates. Application for N.P.L. certificates under the arrangements should be addressed to the Director, National Physical Laboratory who will decide at which station any individual test can be made. Strict confidence will be observed in connexion with the design of circuit-breakers submitted for test.

The stations at present included in the scheme are those of: The English Electric Co., Ltd., the General Electric Co., Ltd., the Switching Testing Co., Ltd. Trafford Park, which is jointly owned by the British Thomson-Houston Co., Ltd., Messrs. Ferguson Pailin, Ltd., and the Metropolitan-Vickers Electric Co., Ltd.; The British Short-Circuit Testing Station Ltd., Hebburn-on-Tyne, owned by Messrs. A. Reyrolle and Co., Ltd. As soon as the National Physical Laboratory is ready to receive orders for test leaflets giving full details of the arrangements for tests including particulars of charges, will be available.

Protective Films on Metals

TWO papers presented at the Autumn Meeting of the Institute of Metals by Drs. L. E. Price and J. J. Thomas dealing respectively with "The Tarnishing of Silver and Silver Alloys and its Prevention" and "Oxidation Resistance in Copper Alloys" may well represent the commencement of a new era in the investigation of alloy systems resistant to oxidation and scaling. It has been suggested by Wagner that for a film to provide marked resistance to further oxidation high electrical resistance, such as is offered by films of the pure oxides of aluminium, beryllium or silicon is required. This hypothesis is abundantly confirmed by the present authors' work.

When, however, alloys of silver or copper are heated in air under normal conditions, such resistant films cannot be produced owing to the fact that both the constituents of the alloy oxidize simultaneously, yielding a coat, the electrical resistance of which is not high. Optimum results can only be expected when films of a suitable pure oxide are formed. The problem, therefore, with which the authors were faced was the production of films of this type, and their solution of the difficulty calls for the highest praise. By an appropriate pre-treatment protective films of alumina have been formed on alloys of silver or copper con-

taining 1 per cent of aluminium, and remarkable resistance to oxidation and tarnishing both at room and at elevated temperatures has been obtained.

Two methods have been developed for the formation of such films of alumina or beryllia; first by a selective oxidation of the aluminium or beryllium in the alloy by heating in hydrogen containing a partial pressure of water vapour of 0.1 mm., or by the cathodic deposition of films of these oxides. Some idea of the magnitude of this research even in its present stage will be gathered from the fact that 70,000 specimens of silver and its alloys have been exposed for periods up to one year in fifteen different locations.

This work is as yet in its experimental stage, and until data are available regarding the mechanical properties of the films, and particularly their resistance to abrasion, it is not easy to visualize the practical possibilities of the process. It is probably true to say, however, that no more serious disservice to such practical application could be done than by inducing the authors prematurely to abandon their present purely scientific treatment of the subject and to devote their attention to the empirical and routine examination of alloys of possible industrial significance.

F. C. T.

Research on Concrete

THE steadily increasing use of concrete in the construction of buildings and roads has given added impulse to the efforts being made to ascertain how its quality may be improved and how it can be used to the best advantage. One of the most important of the factors which influence the properties of this material is the grading of the aggregate and new and valuable light has been thrown on this by the investigations made at the Building Research Station and at the Road Research Laboratory, the results of which have now been published*.

That the strength of concrete depends directly upon the ratio of water to cement and that other factors are of importance mainly in so far as they affect this ratio is now well established. It follows that the grading of the aggregate determines the strength of the concrete inasmuch as it influences the water content required to bring it to the desired degree of workability. The now widely known method of consolidating concrete by vibration may be used to obtain increased strength because it is possible thereby to consolidate a drier mix, thus reducing the necessary water-cement ratio. The term 'workability' has generally been held to convey an impression of the ease or otherwise with which a mix can be placed, but no precise definition has previously been attempted. It is shown here that the only part of the applied work which is usefully employed in the preparation of the mix is that used in overcoming the internal friction of the concrete and the friction between concrete and mould or reinforcement. Of this useful work, the only portion

depending on concrete alone is due to the internal friction and, from this consideration, workability is defined as the property which determines the amount of internal work required to compact the concrete.

For the measurement of this property, the slump test is shown to be defective in two respects, and the compacting factor test, finally chosen as suitable, is based on the above definition and measures the amount of compaction produced by the application of a standard quantity of work. In order to determine the effect of compactness a series of tests was carried out in which the specimens received different amounts of tamping and therefore contained different proportions of air-voids. The loss of strength due to a degree of under-compaction, as measured by the proportion of air-voids, was found to be 30 per cent when the voids were 5 per cent and as much as 90 per cent with 25 per cent of air-voids. It was shown also that, provided the specimens were fully compacted and had the same water-cement ratio, quite large variations of aggregate grading and shape of particles had no appreciable effect on strength. The grading is of importance only in so far as it affects workability and the water-cement ratio necessary to obtain the required workability, and its suitability should be judged in relation to the cement content and the degree of workability required.

The paper fully describes the tests made, and gives photographs in illustration of them, while the quantitative results are adequately set out in tables and curves. From the various data supplied it should be possible for the engineer to obtain the best combination of workability and strength for any particular purpose.

* Department of Scientific and Industrial Research and Ministry of Transport, Road Research, Technical Paper No. 6. "The Grading of Aggregates and Workability of Concrete." (London: H.M. Stationery Office) 1s. 3d.

Science News a Century Ago

Royal Astronomical Society

At the anniversary meeting of the Royal Astronomical Society held on February 8, 1839, the council congratulated the Society on the flourishing conditions of its finances, and on the activity and zeal which were displayed in all branches of astronomical science, marked more especially by the recent discovery of the parallax of the fixed stars, by two of the fellows of the Society in different hemispheres. Obituaries of deceased members were read and mention made of the services they had rendered to science; special reference was made to the late Dr. Bowditch of Boston. The gold medal for the year was awarded to the Hon. John Wrottesley for his catalogue of the right ascension of 1318 stars—a work which had been of great assistance in the formation of the new general catalogue then in course of reduction.

Sir John Wrottesley, afterwards Baron Wrottesley, was born in 1798 and died in 1867. A barrister by profession, he served as president of the Royal Astronomical Society in 1841–43 and as president of the Royal Society in 1854–57.

Nitrogen in Plants

"Some experiments made by Boussingault," said the *Athenaeum* of February 9, 1839, "show that trefoil, cultivated in a soil previously calcined to a red heat, admits a certain quantity of nitrogen into its organisation, which probably proceeds from the atmosphere. On repeating the experiment with peas, a similar result was obtained; and besides this, the peas, with no other nourishment than that which had been derived from water and air, have flowered and yielded perfect seeds, and the nitrogen was more than double in quantity to that originally contained in the peas. On comparing these experiments with those made on oats, etc., it appears that only certain plants are apt to derive nitrogen from the air, but the manner in which this elementary body fixes itself in vegetables is not known."

University Events

LONDON.—Dr. John McMichael has been appointed to the University readership in medicine tenable at the British Postgraduate Medical School. He will take up his duties early in March. Since 1936 he has been Johnston and Lawrence research fellow of the Royal Society of Edinburgh and extra honorary assistant physician at the Royal Infirmary, Edinburgh.

Dr. W. T. J. Morgan has been appointed as from January 1, 1939, to the University readership in biochemistry tenable at the Lister Institute of Preventive Medicine. Since 1929 he has been biochemist and first assistant in the Serum Department of the Institute at Elstree.

The title of professor emeritus of mycology in the University has been conferred on Prof. E. S. Salmon, formerly University professor of mycology at the South-Eastern Agricultural College.

Mr. C. C. L. Gregory, lecturer in astronomy at University College, has been appointed director of the University Observatory.

Societies and Academies

Paris

Academy of Sciences (*C.R.*, 208, 57–131, Jan. 9, 1939)

A. LAGROIX: Silent stages in the formation of a new crater of the caldera type at the summit of the Piton de la Fournaise (Reunion Isle).

E. ESCALANON: Definition of force in the special theory of relativity.

B. STIEGLITZ: A fundamental theorem of geometry on algebraic surfaces.

S. EILENBERG: Co-homologies and continuous transformations.

R. SALEM: Mean convergence of Fourier series.

L. KANTOROVICH and A. PINKUS: General forms of partially additive functions in certain semi-ordered spaces.

N. OBRUCHKOFF: Zeros of some *fonctions entières*.

C.-T. CHUANG: Holomorphic functions in the *cercle unité*.

E. LEFEBVRE: Functions of a complex variable defined by a linear relation between the variable and logarithm of the function, the coefficients being some polynomials related to the function.

O. YADOFF: A method of measuring the speed of the 'front' of a gaseous jet.

O. SALOMANU: The velocity of sound in binary mixtures of liquids, by a resonance method.

T. V. IONTSOU: Mode of action of ionized gas oscillators in the magnetic field.

MM. Z. SOUBARW-CHATELAIN: Application of the conductimetric method to the simultaneous determination of molybdic acid and of ammonia in the ammonio-molybdates.

G. CHAUDRON and A. MICHEL: Thermo-magnetic characteristics of cubic iron sesqui-oxide.

L. DUNOYER: Emission from the ends of luminous tubes: numerical results.

G. DÉCHÈNE: A new type of photo-electric cell. The contact resistance of a semi-conducting piece or treated 'Cellophane' applied to a layer 2–3 mm. thick of yellow or red mercuric oxide can be used for qualitative work in the visible and ultra-violet.

Mlle. M. PERRY: Element 87, a derivative of actinium. There would appear to be two isotopes of atomic number 87, one of short life (21 min.) announced here, and another of long life found by M. Hulubei.

B. PONTECORVO and A. LAZARD: Nuclear isomerism produced by a continuous spectrum of X-rays.

G. OCHIALINI: Measurement of the effect of latitude on cosmic ray showers. Measurements at sea between Bahia and Trieste suggest that the showers are due to radiation of the same quality in both equatorial and temperate regions.

R. DELAPLACE and C. BÉCHARD: Determination of freezing point and boiling point, at reduced pressure, of mixtures of ethylglycol and water.

P. BASTIN: Researches on the evolution in air in water and in a vacuum, of brittleness due to acid pickle in extra-soft annealed steel.

P. CARRÉ and L. PRIGNÉ: Some anti-oxygen effects from the point of view of the practical rule of the 'electronic strain'.

L. PALFRAY and S. SABBATAY: Catalytic dehydrogenation, by means of Raney or ordinary nickel.

J.-H. HOFFET: Genesis of iron beds on the right bank of the Red River (Tonkin). There is a large reserve of iron capable of exploitation.

C. DAUXÈRE: Geographical distribution of lightning strokes in the Département du Gers.

MILLÉ, M. CHLÉN: New preliminary researches on the synapses of red algae.

R. GAUTHERET: Possibility of realizing indefinite culture of tissues of carrot tubercules. Such tissue has been maintained for more than a year, and is very resistant to changes of conditions.

M. AUBERTOT: Presence of a dorsal contractile vessel in the genus *Acerentomon*.

P. CHABANAUD: Geonemy of unsymmetrical eleutherozoans.

P. CHAUCHARD: Chronaximetric analysis of the block of conduction in nerves; realization of a analysing heterochronism.

A. POLACK: Correcting glasses for those operated on for cataract.

P. LÉPINE and P. SÉDALLIAN: Presence of poliomyelitic virus in the intestinal contents of a living infant in an infected family; isolation of the virus.

Amsterdam

Royal Netherlands Academy (Proc., 41, No. 9, 1938).

L. RUTTEN: Geological investigations in mid-Dalmatia and Herzegovina.

J. G. VAN DER CORPUT: Hyperconvex aggregates in the plane.

T. L. DE BRUIN and J. N. LIME: Absorption spectrum of thorium.

B. J. D. MEUSE: Some observations on special structures in the cell walls of plants.

J. VAN SOEST: Tilted late breccias on the southwestern Biokovo slopes (Dalmatia).

F. DE WITT PUYT: The Klobuk (a mountain) at Ljubuški, a tectonic klippe.

D. G. MONTAGNE: Some Rudistæ and Nerineidæ from mid-Dalmatia.

F. KUIJER: Middle Eocene Foraminifera from the lyach in the neighbourhood of Omiš, Dalmatia.

A. TEN DAM: Foraminifera from the Oligocene and Miocene of the Eastern Netherlands.

M. J. L. DOIS and B. C. P. JANSSEN: Studies on phosphorus metabolism in normal and rachitic rats with a radioactive phosphorus isotope (2). The total phosphorus and lipid phosphorus content and the formation of lipid phosphorus.

E. FREY: Studies on the hypothalamic optical nerve of the Amphibia (1). *Rana mugiens*, *Rana esculenta*, *Bombinator pachypus* and *Pipa pipa*. (2) *Proteus anguinus* and the phylogenetic significance of the hypothalamic optical nerve.

A. MOCHTAR and W. K. MEERTENS: Single cell culture of *Leptospira*.

Brussels

Royal Academy (Bull. Classe Sci., No. 11, 1938).

C. J. DE LA VALLÉE POUSSIN: Irregular points. The determination of masses by potentials (2).

P. BURNIAT: Note on certain varieties of Segre.

L. LINSMAN: Certain topological evolutions.

L. DEBRUIDT: Fundamental surfaces of the second kind of the birational transformations of four-dimensional space.

J. THORAU and J. VERHULST: Atacamite from Katanga. Crystallographic, optical and X-ray investigations on this mineral.

J. PASTERELS: Sensitizers and an organizer in the activation of the egg of *Barnes candida*.

J. BRANDIS: Effects of the local application of ultra-violet rays on the blastula and gastrula in the *Discoglossa*.

Copenhagen

Royal Danish Academy of Sciences and Letters, October 21.

NIELS BOHR: Reactions of atomic nuclei. In connexion with the communication of a paper, written in collaboration with G. Placzek and R. Peierls, a general survey is given of the use of simple mechanical ideas and thermodynamic analogies to explain several characteristic features of nuclear reactions.

November 4.

FRIEZ BUCHTAL and J. LINDHARD: Physiology of the striated muscle fibre. On the basis of the experimental results from work on isolated cross-striated muscle-fibres, a new contraction hypothesis is put forward. The anisotropic segments of the myofibrils consisting of myosin-chains are more or less stretched in an electrostatic field in the resting fibre. On excitation, this electric field decreases, the myosin micellæ become coiled up, whereby the fibre contracts.

November 18.

J. N. BRONSTED: Foundation and formulation of the thermodynamic laws. On the basis of points of view previously stated concerning the impossibility of heat-work transformation in ordinary thermodynamics, the fundamental conceptions and principles in thermodynamics are developed in a form which to some extent deviates from the traditional treatment of the subject.

December 2.

OTTO NEUGEBAUER: An edition of an Egyptian astronomical papyrus (Pap. Carlsberg 9) prepared in collaboration with A. Volten. The papyrus contains a calculation of new moons and for the first time gives some insight into a mathematical astronomy among the Egyptians. [See also NATURE of January 21, p. 115.]

December 16.

C. M. STERNBERG: An examination of the Skrydstrup woman's hair and the material of her dress.

Vienna

Academy of Sciences, December 7.

H. HABERLANDT: Radiobarytes from Teplitz and Karlsbad. It is found that the radioactive material is concentrated on the surface of the barytes crystals, and in particular along cracks. The fluorescence spectrum of the barytes from Teplitz indicates that the radioactive material is uranium, while the Karlsbad mineral contains no uranium and probably owes its activity to radium.

F. WERNER: Report of eight scientific expeditions to Greece.

S. BLATTMANN: Stratigraphy and tectonics of the Radstädter Tauern.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Monday, February 6

UNIVERSITY COLLEGE, LONDON, at 5.—Prof. J. H. Burn: "The Action of Drugs in Muscular Fatigue and as Circulatory Restoratives" (succeeding lecture on February 8).*

UNIVERSITY COLLEGE, LONDON, at 5.30.—Prof. H. S. W. Massey: "Quantum Statics" (succeeding lectures on February 20, March 6, 17 and 20).*

BIRCKBECK COLLEGE PHYSICAL SOCIETY, at 6.—Prof. G. I. Finch, F.R.S.: "Structure of Work Surfaces".*

Wednesday, February 8

UNIVERSITY COLLEGE, LONDON, at 7.30.—Dr. E. C. Willatts: "The Use of Land in Planning the London Region".*

ROYAL SOCIETY OF ARTS, at 8.15.—R. Kronfeld: "Gliding and Soaring".

Thursday, February 9

BEDFORD COLLEGE FOR WOMEN (in collaboration with the SOCIETY FOR THE PROTECTION OF SCIENCE AND LEARNING), at 5.15.—Prof. Gilbert Murray: "Why should Science and Learning be Protected?"*

CHEMICAL AND PHYSIOLOGICAL SOCIETIES, at 5.30.—Discussion on "The Use of Isotopes in Biology", to be opened by Prof. G. von Hevesy.

Friday, February 10

ROYAL INSTITUTION, at 9.—Prof. Max Born: "Cause, Purpose and Economy in Natural Laws".

Appointments Vacant

APPOINTMENTS are invited for the following appointments, on or before the dates mentioned:

SCIENTIFIC OFFICER in the Air Ministry Scientific Research Pool—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (Ref. No. 301 O. February 17).

ASSISTANT LECTURER IN ZOOLOGY in University College, Exeter—The Registrar (February 20).

PROFESSOR OF VETERINARY SCIENCE and PROFESSOR OF ANATOMY in the University of Sydney—The Universities Bureau of the British Empire, 88a Gower Street, London, W.C.1.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Philosophical Transactions of the Royal Society of London. Series A: Mathematical and Physical Sciences. No. 782, Vol. 237: The First Spark Spectrum of Platinum. By A. G. Shenstone. Pp. 453-470. 2s. 6d. No. 783, Vol. 237: Rotational Analysis of the First Negative Band Spectrum of Oxygen. By Thomas B. Nevins. Pp. 471-507. 6s. Series B: Biological Sciences. No. 561, Vol. 235: A Study of some Factors governing the Choice of Hosts and Distribution of Progeny by the Chalcid *Oncophanes lucorum* Howard. By Dr. D. O. Lloyd. Pp. 275-332. 6s. No. 562, Vol. 235: Studies of the Post-Glacial History of British Vegetation. 1: Origin and Stratigraphy of Fenland Deposits near Woodwalton, Hunts.; 2: Origin and Stratigraphy of Deposits in Southern Fenland. By Dr. H. Godwin and M. H. Clifford. Pp. 323-406. 10s. (London: Cambridge University Press.) [61]

National Physical Laboratory. Collected Researches. Vol. 24: Standards. Pp. ii+450+19 plates. (London: H.M. Stationery Office.) 22s. 6d. net. [61]

Twelfth Annual Report, October 1, 1937, to September 30, 1938, of ULAWB (the University of London Animal Welfare Society.) Pp. 32+xi. (London: ULAWB.) [61]

Second International Conference for the Protection of the Fauna and Flora of Africa, London, May 1938. Final Act. Pp. 149. (London: H.M. Stationery Office.) 2s. 6d. net. [91]

Proceedings of the Royal Society of Edinburgh, Session 1938-1939. Vol. 59, Part 1, No. 2. The Establishment of the Trichromatic Theory of Colour Vision. By Prof. W. Peddie. Pp. 15-21. 6d. Vol. 59, Part 1, No. 3: Importance of Dialysis in the Study of Colloids. 5 Colloidal Gold; 6: Colloidal Vanadium Pentoxide. By Dr. B. N. Dool, P. M. Barve and Y. S. Paranjpe. Pp. 23-37. 1s. 6d. Vol. 59, Part 1, No. 4: Some Mesozoic Ostracods from North-West India. By Mary H. Latham. Pp. 38-48. 1s. (Edinburgh: Robert Grant and Son, Ltd; London: Williams and Norgate, Ltd.) [9]

Other Countries

Memoirs of the Faculty of Science, Taihoku Imperial University. Vol. 21, No. 2 (Mathematics No. 30): On a Pair of Surfaces Mutually Related (7). By Sôji Matsumura. Pp. 25-32. Vol. 21, No. 3 (Mathematics No. 31): Beiträge zur Geometrie der Kreise und Kugeln (24). Von Sôji Matsumura. Pp. 33-68. Vol. 21, No. 4 (Mathematics No. 32): Beiträge zur Geometrie der Kreise und Kugeln (25). Von Sôji Matsumura. Pp. 69-93. Vol. 21, No. 5 (Mathematics No. 33): Beiträge zur Geometrie der Kreise und Kugeln (26). Von Sôji Matsumura. Pp. 94-126. Vol. 21, No. 6 (Mathematics No. 34): Beiträge zur Geometrie der Kreise und Kugeln (27). Von Sôji Matsumura. Pp. 127-170. (Taihoku: Taihoku Imperial University.) [9]

U.S. Department of Agriculture. Circular No. 495: The Sweet potato Leaf Beetle. By Loyd W. Brannon. Pp. 10. 5 cents. Circular No. 508: The Comparative Attractiveness of Various Small Grain to the Ounce Bug. By Curtis Benton and W. P. Flint. Pp. 8. 5 cents. (Washington, D.C.: Government Printing Office.) [9]

Smithsonian Miscellaneous Collections. Vol. 97, No. 10: Four Contributions to Nomenclature of Cambrian Fossils. By Charles R. Resser. (Publication 3487) Pp. 44. (Washington, D.C. Smithsonian Institution.) [9]

U.S. Department of the Interior: Office of Education. Bulletin 1938, No. 12: Development of State Programs for the Certification of Teachers. By Benjamin W. Fraser. Pp. vi+166. (Washington D.C.: Government Printing Office.) 20 cents. [9]

Report on the Administration of the Meteorological Department of the Government of India in 1937-38. Pp. iii+43. (Delhi: Manager of Publications.) 12 annas; 1s. [9]

Gold Coast. Report on the Forest Department for the Year 1936 Pp. i+18. (Accra: Government Printing Department; London: Crown Agents for the Colonies.) 1s. [9]

Report of the Committee on the Measurement of Geologic Time 1937-1938. Presented at the Annual Meeting of the Division of Geology and Geography, National Research Council, April 30, 1938 Pp. ii+123. (Washington, D.C.: National Research Council.) [9]

Pasteur Institute of Southern India, Ooroor. The Annual Report of the Director for the Year ending 31st December 1937, together with the Thirty-first Annual Report of the Central Committee of the Association for the Year ending 31st March 1938. Pp. 80. (Ooroor: Pasteur Institute.) [9]

Conseil International des Unions scientifiques: Union Internationale de Géodésie et de Géophysique: Association Internationale d'Hydrologie scientifique. Bulletin N. 23: Sixième Assemblée Générale à Bâle du 14 au 26 Septembre 1938. 2: Partie de Travaux de l'Association. Comptes-rendus et Mémoires des Commissions des Neiges et des Glaciers. Pp. xiii+804. (Paris: Association Internationale d'Hydrologie scientifique.) [19]

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 171: A New Transformation in the Iron-Nickel Aluminum System. By Syûichi Kiriti. Pp. 553-582. (Tôkyô: Tôkyô Tohoku Kaisha Ltd.) 15 sen. [23]

Herbertia. Vol. 5, Dedicated to Ernst H. Krelage. Edited by Hamilton P. Traub. Pp. 218. (Orlando, Fla.: American Amalyn Society.) [23]

Report of the Danish Biological Station to the Ministry of Agriculture and Fisheries. 43, 1937. By Dr. H. Blegvad. Pp. 64. (Copenhagen: O. A. Reitzels Forlag.) [23]

Fisheries Experiment Station of the Government-General of Tyosen. Annual Report of Hydrographic Observations. No. 8. For the Year 1937. Pp. v+194. (Husan: Fisheries Experiment Station.) [23]

University of Sydney Publications in Geography. No. 2: The Broken-Pastoral Problem of the Western Division of New South Wales. By Macdonald Holmes. Pp. 52. (Sydney: University of Sydney.) 2s. [23]

Bulletin of the Madras Government Museum. New Series, General Section, Vol. 3, Part 3: Catalogue of Venetian Coins in the Madras Government Museum. By T. G. Aravamudan. Pp. ii+60+1 plate (Madras: Government Press.) 1.8 rupees. [23]

Memoirs of the Geological Survey of India. Vol. 72, Part 2: The Geology of parts of the Minbu and Thayetmyi Districts, Burma. By B. L. G. Glass. Pp. vii+137-318+xxx+plates 13-17. (Calcutta: Central Book Depot.) 6.2 rupees; 9s. 6d. [23]

Memoirs of the India Meteorological Department. Vol. 26, Part 8: Measurements of the Radiation from the Sun and the Sky at Poona in 1936. By P. K. Raman. Pp. 151-164+plate 10. (Delhi: Manager of Publications.) 1.4 rupees; 2s. [23]

Contributions from the Biological Laboratory of the Science Society of China. Zoological Series, Vol. 12, No. 8: Study of some Forest Insects of Nanking and its Vicinity, Part 1. By C. P. Miao. Pp. 181-192. Zoological Series, Vol. 12, No. 9: Birds of Nanking and its Vicinity, Part 1. By L. T. Chong. Pp. 183-374. (Shanghai: Science Society of China.) [23]

League of Nations. Survey of National Nutrition Policies, 1937-38 (Official No.: O.478.M.331.1938.II.A.) Pp. 120. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 2s. 6d. [23]

Annals of the New York Academy of Sciences. Vol. 38: Molluscan Faunas of the Domergue and Arroyo Hondo Formations of the California Miocene. By Harold H. S. Vokes. Pp. iii+236+22 plates. (New York: New York Academy of Sciences.) [23]

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Agricultural Research and Education

THERE can be few to-day who would deny that scientific research lies at the base of material progress. Ninety years ago or more, the Prince Consort recognized the fact ; but it was not until the middle of the Great War that the Government in Great Britain first embarked upon a comprehensive scheme of State assistance for industrial and scientific research. Agriculture was a little more fortunate, because, thanks to the perspicacity of Mr. Lloyd George, a Development Fund was established in 1910-11 which, among other objects, was designed to aid and develop agriculture and rural industries. Since that time, an increasing amount of money has been given to promote and maintain agricultural research, and in the year 1938 the State spent at least £700,000 on this object in Great Britain. This sum represents about 90 per cent of the total expenditure on agricultural research and advisory services, to which farmers themselves contribute very little, and is distributed among some fifty institutions, of which twenty-eight are devoted solely or primarily to research.

The chief recipients of grants are agricultural colleges and university departments of agriculture, which also have educational functions ; State institutions, like the Veterinary Laboratory at Weybridge, Surrey ; and private institutions, like Rothamsted, the Rowett Institute, and the Royal Veterinary College, London. There are 673 research workers at the chief institutions and the total number in Great Britain is rather less than one thousand. Propagation of the results of research, and general advisory work, are delegated to seventeen principal advisory officers located in sixteen provincial advisory centres which are usually university departments or agricultural colleges, and lower down the scale are advisory officers and

agricultural organizers appointed by agricultural education committees of county councils. The councils make small grants for research to university departments, agricultural colleges and research institutes. Research is also conducted by private interests like Imperial Chemical Industries Ltd. at Jealott's Hill, and the Welloome Physiological Laboratories at Beckenham, Kent. Lastly, there are nine Imperial bureaux and two Imperial institutes which collect and collate information and abstract the scientific literature for research workers throughout the Empire.

The above and many more interesting and relevant facts are set out in an admirable report published by PEP*, which records the findings of a special committee it appointed to examine the adequacy of the provision made for agricultural research in Great Britain, how it is administered, and to what extent the measures taken to get farmers to utilize the results have been successful. The report sees much to commend in the provisions made for agricultural research, but it is also critical, and in the interests of progress, our remarks will be confined in the main to two objects of criticism : the cumbersome machinery of administration and finance, and the failure to 'put over' the results of research to working farmers.

Responsibility for the administration and finance of agricultural research in Great Britain is divided among numerous authorities of the central Government : the Agricultural Research Council, the Development Commission, the Ministry of Agriculture for England and Wales, the Department

* Report on Agricultural Research in Great Britain : a Survey of its Scope, Administrative Structure and Finance, and of the Methods of making its Results known to Farmers, with Proposals for Future Development. Pp. vi+146. (London : PEP 1938.) 8s. 6d. net.

of Agriculture for Scotland, the Dominions Office (for the Imperial institutes and bureaux), the Privy Council, and the Treasury. This multiplicity of authorities has many drawbacks, and PEP advises that the Development Commission, which has already lost some of its initial functions, should be abolished as a piece of "superfluous stage property". Many will think that the pruning process might be extended, but excessive devotion to old forms and traditions, and a propensity to compromise, seem to be a characteristic of the governmental mind in Great Britain. Government departments are, of course, always fair game for carping critics, but more than one Government inquiry in recent years has recommended the application of the axe.

The organization of agricultural research institutes is criticized by PEP in so far as it is based too largely upon departmental science: more husbandry institutes are wanted, each of which would specialize in a particular crop or product rather than upon a particular science. The low salaries paid to research workers are deprecated, and the creation of a central agricultural research fund, with larger contributions from the industry, is advocated.

The most serious criticism against the existing order is failure to get the results of research translated into farming practice, a failure which, in our opinion, cannot be ascribed entirely to the agricultural education authorities or to the systems under which they work. Agricultural education in England is under three administrations: the Ministry of Agriculture, the Board of Education, and the county councils. From the agricultural colleges and university departments some 2,000 students pass out every year, but surprisingly few of them take up farming on their own account, either because they lack the necessary capital, or because no managerial posts are open to them; most of them take up teaching, or go into administrative service, or join the larger commercial firms.

Agricultural education for the rank and file is administered by the county councils, each of which commands the services of a county agricultural organizer, district organizers, and special instructors. The staffing varies greatly between county and county, and in general the number of instructors appears to be inadequate. Of the 22,000 students who come under the county councils, about half receive their instruction in evening classes only. In addition to itinerant

teaching, the county staffs undertake demonstrations and advisory work. Education is also provided, mostly during the winter months, by the residential farm institutes, in which the teaching is essentially practical. Technical instruction is given in senior schools and in instruction classes financed by the county education committees and the Board of Education. The Young Farmers' Clubs also have educational functions; and lastly, the farming community can gather knowledge and advice from broadcast 'talks', from departmental publications designed to popularize recent advances in technique, and from the agricultural press.

With this medley of administrative organs and public and private agencies, it is small wonder that results have proved disappointing. Agricultural education, like many other institutions of the civilized world, has become far too complex, and only the surgeon's knife followed by Occam's razor can bring us back to simplicity and efficiency. PEP proposes that the county advisory services be transferred to the provincial advisory centres, but other critics would have all the agricultural educational functions of the county councils so transferred. Many would like to see a great extension of the farm institutes, which have accommodation for only a fraction of the youth destined for the land, and their utilization for short courses of instruction for skilled specialized workers.

But perhaps the greatest handicap to the spread of new scientific knowledge is the character of the farmers themselves. Farmers of the old type—they are still in a large majority—who have inherited the prejudices as well as the consummate skill of their forbears usually shy at the sight of the scientific adviser, a reaction that may be partly due to unhappy experience of projects they were induced to adopt by well-meaning but unpractical enthusiasts. On the other hand, there is arising a new generation of farmers, more appreciative and keen, who, if less skilled than their fathers in the old methods applicable to bygone conditions, are open to new ideas and thoroughly progressive in outlook. The day of the old practical farmer is passing—of the man who could himself efficiently perform all the manual tasks of the farm. He was, in essence, a farm labourer with capital. Unless we are to perpetuate peasant farming, it is as unreasonable to expect the modern, and especially the future, farmer to be an expert in the everyday jobs of the farm, as it

is now to insist on the manager of an engineering works being able to undertake all the tasks in his workshop.

As the P E P report indicates, the main hope for the future lies in reformed education in the primary and secondary schools, rather than in the higher seats of learning. Agricultural research is far ahead of agricultural education. Vocational instruction is not wanted in primary schools. The claims of English, arithmetic, geography and an outline of world history must be recognized, but more scope is required for what is termed 'general science', the teaching of broad outlines largely through applications. The pupil who is destined for the land should, we suggest, leave school at fourteen to fifteen years of age, and

serve an apprenticeship lasting one to two years on an up-to-date farm, where he would be encouraged to relate his school science to the facts of farming. He should then return to school, continue his general education, and pursue a more specialized course of instruction in those sciences that bear directly upon agriculture. So trained, it is difficult to conceive of any youth, other than a 'throw-back', entering agriculture without an informed mind and a progressive outlook. Besides instilling knowledge and training the mind to think, education for agriculture, or for any other pursuit, can only be worthy of the name if it inculcates such essential social virtues as willingness to co-operate and consideration for others.

State Control of Private Forests

Forestry and State Control

By Prof. R. S. Troup. Pp. vii + 88. (Oxford: Clarendon Press; London: Oxford University Press, 1938.) 3s. 6d. net.

THE condition of private woodlands in Britain has been the subject of increasing concern ever since the British people began to realize that their former complacent reliance on continuous supplies of timber from abroad is not so well founded as they supposed. The main part of the task of building up a reserve of softwood timber in the country for use in times of emergency has been entrusted to the Forestry Commissioners, but in assigning them their share in this work, it was assumed that through their encouragement and example private woodlands, both hardwood and softwood, would be restored to their pre-War area and their productivity improved. Unfortunately, it has become evident that this assumption was not justified and, as questions of national defence, economic self-sufficiency and political interferences with the flow of trade and commerce seem to be increasing rather than diminishing in importance, it is not surprising if the advisability of taking more intensive measures in regard to private forestry has come to the fore.

The whole tradition of Britain has been against State interference with private productive enterprise, and State action as regards private forestry up to the present has been confined to attempts to induce the private owner to practise more and better forestry by propaganda, provision of

technical education and advice, taxation concessions, planting subsidies and assisted marketing. In many countries, however, the action of the State goes far beyond such measures as these, and may extend to legal restrictions on felling, and insistence on the regeneration of felled areas, employment of certain sylvicultural systems, etc. The degree of control exercised may extend from mere inspection of the forests, to see that the law is not evaded, to the actual management of private woodlands by State forest officers.

In this book, Prof. R. S. Troup gives an account of the methods of control over private forests practised in the chief European countries, and discusses, in the light of knowledge gained by personal visits and inquiries, the actual working of these measures and the attitude of private owners to control by the State. The first half of the work is devoted to a general account of the nature and ownership of forests and a discussion of the question of whether, and in what circumstances, State control of private forests is justified.

After a review of the position of British forestry, the author expresses the opinion that, besides the incidence of death duties and the economic forces acting against forestry in Britain, the main cause of the poor productivity of private woodlands is the absence of adequate technical knowledge on the part of those responsible for their management. The remedy for inefficient management is the employment of properly trained forest managers, but most woodland estates are too small to justify

the appointment of a whole-time manager; the difficulty might be got over by a scheme of co-operation by which a number of estates would be placed under the charge of a single manager. Subsidies would be better devoted towards improving silviculture and forest management (including planting) than towards encouraging planting alone. The author finds it difficult to see how any permanent improvement in private forestry in Britain is possible without some form of compulsion and State supervision, in return for which it may be necessary to offer further concessions and assistance to landowners. "Legislation directed towards imposing State control, should aim at preventing, rather than encouraging the break up of estates; it should avoid penalizing well managed estates, but should aim rather at bringing others into line with them."

As Prof. Troup remarks, it must be admitted that the question of reforming private forestry in Britain is one in which it is easier to indicate the ideal to be attained than to devise workable measures for carrying it out. If the time should come when it is adjudged necessary to formulate legislation for the purpose, the information as to the methods adopted and experience gained in other countries, set out in the second part of this book, should be of the utmost value. These measures naturally vary greatly from country to country, according to geographical situation, social and economic conditions and past history. Perhaps the most interesting to us are the forest

laws of Denmark, which approaches most nearly to Britain in the smallness of its forests and the nature of its government. Most of the woodlands of Denmark are 'reserved forests', and they must be maintained under a high forest crop, the proportion of hardwoods must not be diminished, fellings must be succeeded immediately by afforestation and the crops managed under approved silvicultural principles. Inspection by State forest officers ensures the carrying out of these provisions. Speculation in woodlands is checked by a law that, after a sale of reserved forest, the purchaser, for a period of ten years, can only make fellings necessary for the domestic use of the estate or for the proper management of the woods (sustained yield). On the other hand, reserved forests are subjected to lower land taxes, and State assistance is given by providing technical advice.

Though control in Denmark is strict, there are remarkably few complaints from landowners, and this appears also to be generally the case elsewhere. The limitation of the freedom of the owner is compensated by the benefit he obtains financially from properly managed woodlands and his sense of security that his forests will not be devastated by his successors in title.

Prof. Troup has succeeded in presenting in a limited space a great deal of information which has hitherto not been easy of access and will be welcomed, not only by students of forestry but also by a wider public.

T. T.

Karl Pearson

Karl Pearson:

an Appreciation of some Aspects of his Life and Work. By E. S. Pearson. Pp. viii+170+9 plates. (Cambridge: At the University Press, 1938.) 10s. 6d. net.

THIS handsome volume is a reprint of two articles recently published in *Biometrika* (vols. 28 and 29), with the addition of a couple of extra appendixes giving respectively the full syllabuses of Karl Pearson's Gresham College lectures on statistics during 1891-94, and notes of his lecture-courses on that subject at University College, London, in 1894-95 and 1895-96. The author asks "that wider audience" to which the memoir is now made available to bear in mind that it is "in no sense a Life" of his father. That seems to be going a little too far. In so far as a man's labours are his life—and for Karl Pearson they

were that to a greater extent than for most men—this is an admirable Life: brief certainly, with plenty of room for filling in details, but well-ordered, and very readable at all events by the statistician, to whom it is mainly addressed, much being inevitably more or less technical. But there is more in it than this. Portraits, letters, lighter sketches of life on vacation or in the laboratory, and friendships, serve to fill in the human side of the picture.

Prof. Pearson divides the life into nine periods into which it naturally seems to fall. 'K.P.' was born in 1857. The early years of school and university carry us to 1879, and there is a delightful portrait (Plate II) of the schoolboy Karl. Then came the wander-years, 1879-84, the years in Germany, the years of historical research and of many lectures afterwards collected in the "Ethic of Freethought"; the years of "The New Werther"—

a most interesting revelation this, 'K.P.'s' first published work and a striving after a creed of life; and of "The Trinity: a Nineteenth Century Passion Play". This period closed with his election to the chair of applied mathematics and mechanics at University College, London, in June, 1884, at the early age of twenty-seven years. The first years of his occupation of the chair, from 1884 until 1890, apart from the heavy work of preparing and delivering his over-numerous lectures and supervising the drawing-classes in connexion with them, must have been largely dominated by the "History of the Theory of Elasticity" and "The Elastical Researches of Barré de Saint-Venant"; but the period covers also some of the later lectures of the "Ethio".

Then came the publication of Galton's "Natural Inheritance" in 1889 and the appointment of Weldon to the chair of zoology at University College in 1890, and 'K.P.'s' main energies were step by step diverted into the channel in which they were to flow for the remainder of his life, though it was still to be some twenty years before all the labour of the lectures to engineers and B.Sc. students could be dropped. They were years of incredible activity. In 1892 came the "Grammar of Science", in 1893 vol. 2 of the "History of the Theory of Elasticity". Then, during the same years, there were the Gresham Lectures, and from 1893 onwards the succession of fundamental memoirs in the *Proceedings* and the *Transactions of the Royal Society* in which the foundations of modern statistical methods were laid. In 1900 came the rediscovery of Mendelism, and the unfortunate controversy that followed in connexion with the Evolution Committee of the Royal Society. In 1901 *Biometrika* was started, and there followed several years in which much active work was done in the collection of data relating to inheritance.

The tragic death of Weldon in 1906 brought this period to a sudden end, and, as the author says, seems to have made a definite dividing line in his father's life: thereafter there was less biology and more theory of statistics, more miscellaneous papers, in his output. Galton's death in 1911 made another break. By the foundation of the Galton professorship of eugenics, 'K.P.' was at long last, after twenty-seven years' tenure of the post, enabled to resign the chair of applied mathematics, and the diversion of energies it had entailed came to an end. But not for long was he to have leisure and opportunity for developing the new department and celebrating its founder in the magnificent "Life, Letters and Labours". War came in 1914, and with the war the diversion of all available staff to war-work: the strain, heavy enough in itself, was made the heavier by

inevitable anxiety as to the future. Revivification, however, came rapidly with peace. Funds to meet the enormous rise in building costs were obtained from one source and another, the new laboratory arose, and the years from 1920 until his retirement in 1933 saw a steady output of work and an activity that is truly amazing when 'K.P.'s' age is recalled. Retirement left but a brief space, still spent in activity, before death came with merciful suddenness in the spring of 1936.

There was no one like 'K.P.' in his generation. To find his like I think one must go back to the seventeenth century: in many respects—in his outstanding ability, his width of knowledge and interests, his energy, his complete self-confidence, his 'trespassing' into divers fields, and his continual immersion in controversy from early manhood almost to the grave—John Wallis not a little resembled 'K.P.'.

Prof. Pearson has well acquitted himself of the task within the limits he set. In each period the work that mainly dominated it is clearly set out and the principal memoirs discussed. In particular his treatment of controversies, which must often have been difficult, is highly to be commended for its balance and restraint. Here I would like to make one comment, thinking less of the past than of the present and the future. "Writers rarely . . . understand," wrote 'K.P.' in 1914 (p. 66), "the almost religious hatred which arises in the true man of science when he sees error propagated in high places." Surely neither in the best type of religion nor in the best type of science should *hatred* enter in at all. One may appeal to the earlier 'K.P.' who wrote of the freethinker ("Ethio", p. 22), "he has no right to abuse, he can only endeavour to teach". In one respect only has scientific controversy perforce improved since the seventeenth century. If *A* disagrees with *B*'s arguments, dislikes his personality and is annoyed by the cock of his hat, he can no longer, failing all else, resort to abuse of *B*'s latinity, cf. Hobbes *v.* Wallis.

To those of us who knew the living man, such a memoir as this shows us some aspects of him that we could not have known or did not know, and other aspects, that we did know, seen by another eye from another point of view. We are grateful for Prof. Pearson's work. But there is a younger generation who scarcely knew him, or did not know him at all, to whom he is only the shadow of a name, to whom even his work is known only at second hand or at third, seen through the distorting medium of text-books. It is to be hoped that this younger generation of statisticians will read and digest the memoir, and make use of the select bibliography it contains. It will do

much to enable them to visualize the man who founded modern methods in statistics and will, it is to be hoped, send them back from text-book statements to the original sources. Let it be added that the price is very low for so handsome a

volume with its wealth of portraits—though there isn't one of the Karl who returned from one summer vacation (somewhere about 1888, I think) to startle his class with the possession of a beard like a Viking.
G. UDRY YULE.

Protein Chemistry

Chemistry of the Proteins

By Dr. Dorothy Jordan Lloyd and Agnes Shore. Second edition. Pp. xi+532. (London: J. and A. Churchill, Ltd., 1938.) 21s.

DURING the twelve years which have elapsed since the publication of the first edition of this book, the constitution, structure and properties of the proteins have been studied by an ever-increasing number of workers, employing every available method of experiment. Fundamental and far-reaching advances in knowledge have been made, and the volume under review, which includes references to most of the papers published up to the end of 1936, as well as a few in later years, is considerably larger than the first edition.

The general plan of the original book has been retained, except that two minor chapters, dealing with the industrial uses of the proteins, have been omitted, and a few of the remaining chapters rearranged. In the preface to the second edition, the authors express regret at having had to omit references to the industrial aspects of protein chemistry, but the decision was certainly wise, because adequate treatment would demand a separate volume for each industry, and some such volumes are now available. On the other hand, the co-ordinating effect of recent advances in knowledge is such that the point of subdivision of the book into two parts is both artificial and unnecessary.

The new volume, like the old, commences with a survey of the nature and properties of the amino acids. This is followed by an outline of the biological classification of the proteins in a chapter which reflects both the former empiricism of the subject and the clarification which has resulted from recent research. Besides being greatly enlarged, the succeeding summary of available methods of protein analysis is a model of lucidity, as is the account of the methods used for establishing the homogeneity and identity of the proteins. The relationships between constitution and nutritional value are discussed in a section which includes an excellent summary of the work

of Rose and his collaborators, and the obscurity which has cloaked the subject of indispensable amino acids seems now to be disappearing.

A brief but interesting survey of the nature and classification of the enzymes, including a summary of Bergmann's work with simple peptides, forms an excellent introduction to the consideration of molecular size, structure and shape. It is here that the influence of recent research is most strongly felt, and due consideration is given by the authors to the results of X-ray and ultracentrifuge methods of experiment, as well as the more theoretical treatment of Wrinn and Bergmann. The manner in which these several methods of reasoning and experiment concur in revealing an ordered arrangement of amino acids in the protein molecule, and in fixing its size, is so striking that little regret need be felt that the authors were unable to emphasize the general agreement by considering the subjects of osmotic pressure and protein films in the same chapter. In the remainder of the book, the structure of the protein molecule, so far as it is known, is made the basis of a discussion of combination with acids and alkalis, the related phenomena of osmotic pressure and swelling, denaturation, and the theory of protein solutions. As regards the concluding chapter, which contains a number of misprints, it is difficult to avoid the conclusion that the authors might have increased the cogency of their argument by including the subject-matter in appropriate earlier sections of the book.

Besides being a lucid and concise survey of the present state of protein chemistry, the volume includes exhaustive lists of references, and there can be no doubt that it will be even more welcome than its predecessor. The authors' treatment of the subject is sufficiently, but not unduly, coloured by their own views to make interesting and provocative reading, and, in the words of Sir Frederick Gowland Hopkins's introduction, "even the specialist . . . may well find as the result of reading this book that the fertile mating of facts, which for him were previously disconnected, has yielded him a progeny of happy suggestion for research".
J. B. SPRAKMAN.

Academic Psychical Research

(1) Science and Psychical Phenomena

By G. N. M. Tyrrell. Pp. xv+379. (London: Methuen and Co., Ltd., 1938.) 12s. 6d. net.

(2) Psychical Experiences

Evidence of Purpose. By Zos Richmond. Pp. viii+112. Foreknowledge. By H. F. Saltmarsh. Pp. viii+120. Ghosts and Apparitions. By W. H. Salter. Pp. vii+138. Hypnosis: Its Meaning and Practice. By Eric Cuddon. Pp. viii+169. 3s. 6d. net each. (London: G. Bell and Sons, Ltd., 1938.)

TO the impartial and independent observer, the relations between psychical research and spiritualism are always of interest. The one can scarcely be active without the other: co-operation is often urged and as often rejected; and a kind of armed neutrality is the result. The more earnest psychical researchers are perfectly well aware that as long as they support and treat with consideration the large number of dubious mediums who prey upon the credulous, their own claims to serious attention are put in jeopardy; whilst the spiritualists demand from them something more than passive inaction as the price for the privilege of investigating the more promising cases.

In the last ten years, a gradual separation has been taking place, for the psychical researchers have now become fully aware that the scientific citadel is not to be stormed by the motley crowd, which has for so long formed a part of their supporters. Not only the method of approach but also the subject matter itself has had to undergo revision. For the time being, the scientific world is not to be presented with accounts of floating tables and phantoms looking as if they were made of chewed paper. It is hoped that better success will be achieved by statistical formulæ and philosophical disquisition. An illustration of these tendencies can be seen in the five volumes now under review.

(1) Mr. Tyrrell, in his summary of a good deal of the field included under the term 'psychical research', has given us one of the best surveys so far published. No one who reads this persuasive and thought-provoking volume can fail to be impressed by the author's obvious sincerity and enthusiasm; neither can he fail to conclude that if this be psychical research, then it is indeed strange that the scientific world remains so aloof and seemingly unfriendly. For here he will find, set out in orderly sequence, accounts of the principal mental phenomena, graded under such terms

as telepathy, clairvoyance, precognition and retro-cognition. After past work is viewed from its historical aspect, the more recent cases, both spontaneous and experimental, are examined and criticized. In the latter part of the book the philosophical and psychological implications are described; and the problem of the nature of human personality is considered in its relation to the phenomena which have been discussed.

(2) If Mr. Tyrrell's book be regarded as an admirable text-book for study, then the other volumes, the titles of which are noted above, can be used as supplements, containing as they do additional cases and discussions. This new series is really a highly condensed selection of material published for the most part in the *Proceedings* and *Journal of the Society for Psychical Research*. Thus the student who wishes to become acquainted with the best cases the Society has to offer cannot do better than read these books, and then, if he wishes, he can go back to the original sources for additional information.

It can scarcely be denied that, viewed as attempts to claim scientific recognition, these volumes are of great interest. To one wholly untrained in psychical research and with no knowledge of what lies behind much of the impressive façade, the effect must be considerable. Only careful analysis and years of experience will weaken that effect, for it is but here and there that the authors under review cite cases as good, which are so clearly full of flaws that suspicion of their critical faculties is aroused. Moreover, the difficulty of appraisal is increased when it is remembered how hard it is to obtain repetitions under varying conditions, and how disinclined experimenters in this field generally are to permit critical and well-informed persons to test their results and examine their evidence.

This does not by any means imply that the value of the evidence here so carefully collected is worthless. But it does suggest that extreme care should be exercised before accepting fully the claims made by these writers and by others like them. Psychologists would do well to remember that these obscure problems belong properly to their own studies; and a neglect of them merely indicates a wish to remain in ignorance of some of the more important aspects of human mental activity. To them, therefore, these volumes can be heartily recommended as text-books, which illustrate better than most what serious psychical research is and what its exponents are doing.

The Kandy Flora

By A. H. G. Alston. Pp. xvii+109+101 plates. (Colombo: Government Record Office, 1938.) 3.50 rupees.

THIS is the first of four local Floras proposed for the island of Ceylon. It was actually ready in 1928, but financial stringency dictated its being withheld until 1938. The area comprised is "all the country within easy walking distance of Kandy" at an average elevation of 1500 ft.

Naturalized aliens as well as all known native phanerogams are briefly described, with the exception of the representatives of the Eriocaulonaceae, Cyperaceae, and Gramineae which, together with the cryptogams, are merely listed in an appendix. The commonly cultivated plants are mentioned without description. Short descriptions of the 98 families (101 including the three mentioned above) and the genera are given. There is a handy artificial key to the families, which, so far as the Dicotyledons are concerned, are arranged according to the phylogenetic scheme of Dr. J. Hutchinson. The sequence for the Monocotyledons is that of the "Pflanzenfamilien". Generic keys are provided for each family with more than one genus, and for each genus represented by more than one species. Altogether 501 species of flowering plants (excluding the cultivated) are included, and 299 cryptogams are listed. Vernacular names are cited for most of the species. A glossary of botanical terms and a comprehensive index are provided. Finally, 404 of the species of phanerogams are illustrated by good, if rather small, drawings, mostly accompanied by enlargements of floral or other distinctive features.

As is to be expected from the author of the supplementary volume to Trimen's "Handbook of the Flora of Ceylon", the nomenclature is up to date, at least for 1928. The printing is good and the general 'get up' quite satisfactory, but the format might have been smaller for easy transport in the field. Mr. Alston is to be congratulated and thanked for producing a work that will be most useful to field workers in the area, and it is to be hoped that the project of the remaining three Floras will not be allowed to lapse or be delayed for long.

Textbook of Organic Chemistry

By Prof. George Holmes Richter. Pp. viii+711. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 20s. net.

THIS book is designed for "ambitious students who wish to study beginning organic chemistry and gain more than a superficial knowledge of the subject". The author confesses that he has presented more material than can perhaps be covered in an average one-year course: some of it, indeed, would be deferred in Great Britain until the student had entered his honour year.

A short introductory chapter (8 pp.) is followed by a systematic description of aliphatic (451 pp.), aromatic (190 pp.), and heterocyclic (33 pp.) compounds. Alicyclic types are omitted. Although, on the whole, the treatment is sound, the ambitious

beginner will need to make great strides in order to keep pace with an exposition which introduces full structural formulae for vitamins A and D, cholesterol, and ergosterol, on pp. 78-79. Such statements as "van 't Hoff and Le Bel . . . were the first to suggest that the structure of the carbon atom was a tetrahedron" (p. 319) could be improved; and in the following instance (p. 324) the text is misleading: "The crystallization of a racemic mixture may lead to either one of two results: the crystals separating from the saturated solution may be a mixture of the crystals of the individual enantiomorphs; or the crystals may be the molecular complex . . . if the latter situation obtains, crystallization at a higher temperature will usually cause the molecular compound to break up into the two components which separate as individual crystals".

The book is well produced, with clearly printed formulae. J. R.

British Coracles and Irish Currachs: with a Note on the Quffah of Iraq

By James Hornell. (Published for the Society for Nautical Research.) Pp. xii+168+23 plates. (London: Bernard Quaritch, Ltd., 1938.) 7s. 6d. net.

IN this volume, Mr. Hornell reprints a series of articles which appeared originally in *The Mariner's Mirror*, the official publication of the Society for Nautical Research. It is, he points out, the first connected account of these interesting survivals of the primitive British boats, the coracle and the curragh, which are still to be seen on the rivers of Wales and the Welsh marches, and on the west coast of Ireland. In England and Scotland they are now extinct. The English coracle, the author holds, has a common ancestry with the quffah of Iraq, but is not related to the Irish curragh. This latter is of composite origin and a product of an indigenous Celtic development. Mr. Hornell discusses details of construction with the thoroughness he has taught us to expect from him in his studies of canoes and other craft.

The Universe of Science

By Prof. H. Levy. (The Thinker's Library, No. 67.) Revised and Expanded. Pp. xiii+242. (London: Watts and Co., 1938.) 1s. net.

THE publication of this inspiring essay in a popular series makes Prof. Levy's views accessible to a much wider public. This is in keeping with the author's main thesis that science is not something mysterious, but a weapon forged by man to extend control over Nature; and that as such it should be a mental and material possession of the common man. Even those who have read the first edition of this work will find it refreshing to ponder again over Prof. Levy's views on the processes of science, on the nature and role of mathematics and on determinism. At a time when the wealth of scientific discoveries is apt to confuse the mind of specialists and laymen as to the value of our knowledge, books such as the "Universe of Science" can perform a useful service in orientating and encouraging constructive thought. T. G.

Safety in Coal Mines

ON December 14, 1935, a Royal Commission under the chairmanship of Lord Rockley was appointed to inquire into what steps could be taken to improve the health and safety of workers in coal mines in Great Britain, having regard to the many changes that have taken place in organization, equipment and experience gained since the Coal Mines Regulation Act of 1911. The Commission held fifty-two public meetings, and after hearing evidence from the principal interests concerned, as well as visiting a number of mines, presented its report in December last*. The Government has announced that it has accepted the report as the basis for new legislation. The report itself extends to about 250,000 words and, in addition to a volume of appendixes, 1,500 pages of evidence involving nearly 37,000 questions and answers have been published.

Though lengthy and containing many details the report of the Commission is in general unanimous; the few reservations do not to any material extent affect its general tone. It is divided into twelve chapters each of which deals thoroughly with a phase of mining legislation or practice. The Commissioners have not examined exhaustively the details of the existing acts and regulations which form the present safety code, but instead have endeavoured to give the industry a new start by appealing to its sense of co-operation. They have attempted to frame a scheme for promoting a higher standard of safety which shall be positive or constructive rather than merely prohibitive or restrictive. The report is a considerate and reasonable document which in many respects differs fundamentally from the reports of the Royal Commissions on which the 1887 and 1911 Coal Mine Acts were based. These relied largely on compulsory compliance with rigid rules and regulations and tended to place the technical officers of the Department in the invidious position of being regarded by the industry as detectives instead of technical advisers.

If the suggestion of the Commission is to have any effect in reducing the accident rate in mines, a change of attitude to each other by all the partners in the industry, namely the administration, now the Mines Department of the Board of Trade, the coal owners, the colliery officials and the work people is essential. The point is emphasized that the problem of safety in mines, if substantial improvement is to be secured, must be attacked simultaneously from all sides by adequate

strengthening of the administration, the setting of a higher standard of enforcement or observance of regulations, an improvement in the material conditions under which work is carried out, and the co-operation of all parties. This will have the effect of imposing heavy duties on the shoulders of the administration and inspectorate, and heavy obligations on the owners and managing officials.

The majority of mine owners, engineers and workmen do everything that is humanly possible to encourage and maintain safe working conditions; but there remain some who, while paying lip service to the ideals, fall far short of them in practice. Until the standard of professional conduct of everybody working in coal mines rises to such a peak that deliberate evasion or lack of enthusiasm in enforcing safety principles is ostracized, no safety measures will be wholly effective. (By 'professional' is meant all classes, owners, managers, engineers, officials and workmen.) The only alternative to this voluntary change of attitude is a coercive policy as exemplified by 'thousands of regulations' or 'hordes of inspectors', a policy that the vast majority of mining men regard with despair.

The science and art of mining is in a state of constant change; quite literally, nothing is ever static in a mine, and it is to be hoped that the Mines Department, when framing the new Coal Mines Bill which will be drafted as the result of the Commission's deliberations, will pay due consideration to the recommendation that the Bill itself should be concerned with principles only, details being dealt with by orders and regulations which can be amended from time to time without having recourse to Parliament to meet the changing conditions in mines.

After a general introduction, the report gives a historical summary of the development of safety legislation in mines and traces briefly the origin and subsequent history of the mines inspectorate of Great Britain. It then goes on to discuss in detail various phases of mining organization, methods of working and ancillary operations as well as problems concerned with the preservation of health and the prevention of industrial diseases.

It is proposed that both the administrative staff at the Mines Department and the inspectorate should be strengthened and reorganized with a view of giving the Department and the inspectors a bigger sphere of activities, greater authority, wider powers and better opportunities of keeping in touch with the research stations. It is hoped

* Royal Commission on Safety in Coal Mines Report. (Omd. 5990.) Pp. xxxii + 520. (London: H.M. Stationery Office, 1938.) 7s. 6d. net.

that the senior inspectors will then be able to keep in closer personal touch with the mines in their districts and that, because of their opportunities of gaining wide experience of various mining problems, they may come to be regarded even more in an advisory capacity than has in fact been the custom heretofore. The chances of promotion and suggested general all-round increase in salary, combined with appointment by selection after interview instead of by written examination, ought to attract more experienced and better trained recruits into the ranks of the inspectorate. In the past, many men who wanted to become inspectors of mines, and if selected would have made good inspectors, have been afraid to enter into open competition against younger men owing to the time that has elapsed since they studied the fundamental sciences.

At the present time, the Mines Department, through the Board for Mining Examinations, controls the examinations for the certificates of competency that have to be held by colliery managers and under-managers in Great Britain. The Board was subjected to two kinds of criticism from witnesses, (a) against its present constitution, and (b) against the character of the examinations. It was pointed out that there is no system of rotational retirement and that no representative of any education authority or class of official other than the mine manager has a seat on the Board. The complaint about the character of the examinations was that they may allow candidates to pass without showing any real evidence of adequate scientific training. The Commissioners recommend the extension of statutory certificates to several other classes of officials besides managers, under-managers and surveyors and, as a consequence, propose that the present Board be reorganized into a central controlling board of seven members who shall retire in rotation. They further recommend that the Board might accept as fulfilling part of their requirements the examinations held by various technical societies or institutions. They also suggest that the new board should investigate the principle of compulsory attendance, by every candidate, at his local technical school or other institute. The Commission's second recommendation at present applies particularly to institutions which cater for officials junior to the colliery manager. The institutions concerned with other branches of engineering have their own professional examinations, but the Institution of Mining Engineers has so far held back.

The Commissioners have examined the whole question of mining research and suggest that a central research organization under the control of the Secretary for Mines ought to be an integral part of the Mines Department, with arrangements

for interchange and close co-operation between its staff, the staff of the Department's Testing Station and the inspectorate; at the present time, research in the mining industry is mainly financed by grants from the Safety in Mines Research Board, though a separate organization is maintained by the British Colliery Owners' Research Association, and numerous items of local interest are investigated by individual mining engineers and institutes.

The value of research is realized by the mining industry, but the results are not so well co-ordinated as they might be and take a long time to reach the individual colliery manager. Another point emphasized is that the majority of mining research work can be divided into two complementary sections, namely, that carried out in the laboratory and that in the mine respectively. The Commission is aware that a vast amount of possibly valuable information obtained in the laboratory at the research stations has not been translated into practice, and thinks that the Mines Department, through its research organizations, should be responsible for making arrangements for testing out in practice the results obtained in the laboratories. In this respect the close co-operation of the inspectorate would be invaluable.

Another matter of general interest in the report is health, and in particular silicosis, the incidence of which has greatly increased in recent years in portions of the South Wales coalfield. The Commissioners have recommended the use of definite and well-tried palliatives but, in view of the widespread, in fact international, interest that is being taken in the question, have not been too rigid in their conclusions. They are further agreed in recommending strongly that the Mines Department should employ a sufficient staff to ensure that the problem is pursued with the utmost vigour.

The Commissioners also recommend that a permanent 'General Staff' should be formed at the Mines Department with an advisory committee representative of all interests concerned to stimulate local safety propaganda, to collect, digest and circulate to similar voluntary organizations in each coalfield, material and ideas for a continuous safety campaign. They add that the principle of medical examination and certificates of fitness before employment should be applied to all young persons, and the minimum age of entry into a mine should be raised from fourteen to fifteen years. They also direct attention to the need of systematic training for all new entrants into the mining industry.

In the Commissioners' opinion, the amalgamation of mines into large and singly-owned groups renders necessary a redistribution of the statutory responsibilities of owners and managing officials,

so that the responsibility for safe working shall be fixed on those who have the effective powers of control and not solely, as at present, on the technical employees. Among the many technical recommendations relating to mining practice are important proposals for laying down and maintaining more definite standards of ventilation, for improving and intensifying the system of supporting the underground workings and securing the general application of the principles of roof control, which have been the subject of much recent research work, for improving the physical and material conditions under which haulage opera-

tions are conducted below ground, and for strengthening the precautions in connexion with explosives, electricity, shot-firing and coal dust.

In conclusion, while doubtless many of the recommendations of the Commissioners will be hotly debated when the new Bill is passing through the House of Commons, its most bitter opponent must acknowledge that the Commissioners have carried out their difficult task with moderation and vision. They have attempted to be helpful to everybody engaged in the production of coal, and appear to have held the scales of equity admirably.

J. A. S. RITSON.

Liquid Helium

By Dr. J. F. Allen, Royal Society Mond Laboratory, and
Dr. H. Jones, Imperial College, London

THE properties of liquid helium can best be considered under two headings: (a) properties in thermal equilibrium, (b) transport effects. The equilibrium properties, which have been the subject of many careful investigations in Leyden and elsewhere, may be regarded as fairly well established. These include the determination of the specific heat for different temperatures, the variation of density with temperature at different constant pressures, and the relation of the saturated vapour pressure to the absolute temperature scale. The investigations of transport effects such as the flow of the liquid through tubes, heat conductivity and associated effects are still in an early stage of development, and no clear understanding of these phenomena has yet been reached. The subject was discussed at a meeting following the International Refrigeration Congress in July, and also during the Cambridge meeting of the British Association. In this article we shall confine our attention largely to the interesting newly discovered transport effects, and give an account of recent experiments the results of which at present seem to find general acceptance.

EQUILIBRIUM PROPERTIES OF LIQUID HELIUM

Helium at atmospheric pressure liquefies at 4.22° K.; the critical temperature is 5.2° K. Generally speaking, the temperature range over which the properties of liquid helium have been measured extends only down to 1° K., since this is the lowest temperature conveniently reached by lowering the vapour pressure over the surface of the liquid. At 2.19° K. under its own vapour pressure,

liquid helium undergoes a remarkable transformation. As the liquid is cooled through 2.19° K., the specific heat jumps suddenly from a value of 0.4 cal. per gm. per degree to more than 5 cal. per gm. per degree, thereafter falling rapidly, approximately as T^2 . Simon has recently shown that at very low temperatures (0.02°–0.05° K.) produced by adiabatic demagnetization of iron ammonium alum, the specific heat of liquid helium varies as T^2 .

The transformation at 2.19° K. has also a remarkable effect on the expansion coefficient of liquid helium. Above that temperature it is positive, while below it is negative, although there is no discontinuity in the value of the density itself at 2.19° K.

Phase transformations of the type that liquid helium undergoes at 2.19° K. are known in other branches of physics; for example, the Curie-point transformation of a ferromagnetic, the order-disorder transformation of certain alloys, and the transition between the superconductive and the normal state of a metal. The temperature of the transformation in liquid helium is known as the λ -point, a name introduced by Ehrenfest. The modification of the liquid below the λ -point is generally referred to as helium II, that above the λ -point as helium I.

Liquid helium at 1° K. can be solidified under an external pressure of 25 atmospheres. At higher temperatures, greater pressures are required to produce the solid. The properties of liquid helium I are such as would be expected of an ordinary liquid of very low boiling point. It is far otherwise with liquid helium II. In the first place, it is an

immediate inference from the phase diagram that liquid helium II under its own vapour pressure remains liquid at absolute zero, for even in the neighbourhood of 1° K. the boundary line between the solid and liquid phases tends to become parallel with the temperature axis at a pressure of approximately 25 atmospheres. Since dp/dt (the slope of the boundary line) approaches zero as the temperature is lowered, and since the volume change, Δv , is not zero, it follows from Clapeyron's equation $dp/dt = \Delta s/\Delta v$, that Δs , the change in entropy on passing from liquid to solid, also approaches zero. There can thus exist the paradoxical situation of a liquid with zero entropy. On this account the possibility has been considered by several investigators that condensed helium at absolute zero has a space-ordered structure, and that the λ -point is of the nature of an order-disorder transformation.

An experimental investigation of this point has been carried out by Keesom and Taconis. They examined the reflection of X-rays in a column of liquid helium II at about 1.6° K., as well as in helium above the λ -point. No essential difference between the reflections in the two cases could be observed. Confirmation of the space-ordered theory, therefore, is still lacking, although it should be borne in mind that at 1.6° K. an appreciable degree of disorder would in any event be expected.

We may mention here that F. London, in a very interesting letter to NATURE, has recalled a prediction by Einstein that a perfect Bose gas at sufficiently low temperatures should show a discontinuity in the temperature derivative of the specific heat. Applying Einstein's formula to liquid helium, London shows that the discontinuity would occur at 3.09° K. Although Einstein's discontinuity is only in the temperature derivative of the specific heat, not in the specific heat itself, London suggests that there may be some connexion with the λ -point of liquid helium. The advantage of such a theory of the λ -point is that it appears not to necessitate a space-ordered structure for the liquid at low temperatures.

TRANSPORT EFFECTS

Flow Phenomena. Experiments designed to measure the viscosity of liquid helium II have led to the most surprising and apparently contradictory results. The first attempt in this direction was made at Toronto by Burton and Misener, who measured the damping of an oscillating cylinder immersed in the liquid. The value for the viscosity was found to drop suddenly at the λ -point from approximately 10^{-4} c.g.s. units for helium I to 10^{-6} c.g.s. units for helium II. Recent and more precise measurements by the similar method of an

oscillating disk, made by MacWood at Leyden, give values varying from 3×10^{-4} c.g.s. units for helium II just below the λ -point to 2×10^{-4} c.g.s. units at 1.1° K. Liquid helium II thus appears to be very much less effective in damping the motion of a body immersed in it than helium gas at room temperature.

Attempts to measure the viscosity of helium II by measuring the rate of flow through a tube were first made by Kapitza* and by Allen and Misener in the Royal Society Mond Laboratory at Cambridge. On account of the anticipated low viscosity, the latter used very narrow tubes to lessen the rate of flow, with the extraordinary result that the rate of flow was far in excess of what would occur in a liquid of viscosity 10^{-4} c.g.s. units. Moreover, the velocity of flow did not vary linearly with the pressure head. Kapitza found a velocity proportional to the square root of the pressure head, and interpreted this as evidence that the flow was turbulent. He gave a value of 10^{-4} c.g.s. units as an upper limit to the viscosity of helium II. Giaque in California has also observed the flow of helium II through an annular tube and has obtained a temperature variation of viscosity of from 10^{-4} to 10^{-6} c.g.s. units. Allen and Misener endeavoured to reduce the velocity of flow by using finer capillaries to obtain more nearly the condition for stream-line flow, and found that the rate of flow varied as a power of the pressure head of even less than one half. It was found that the dependence of velocity on the pressure head decreased with decreasing capillary size. For glass capillaries of 0.0015 cm. radius, it was found that the velocity varied as the $1/8$ power of the pressure, whilst for capillaries of 5×10^{-4} cm. in radius, obtained by packing a metal tube with parallel wires and then drawing the tube through dies, the velocity became absolutely independent of the driving pressure. In the latter case, the velocity increased very rapidly with decreasing temperature and reached a value of 20 cm. per second at 1.1° K. The flow also appears to be non-classical in the case of the variation of length of the capillary, since a variation of length by a factor of 70 produced only a fourfold change in the velocity.

On the other hand, experiments made by Burton in Toronto showed that with relatively wide and short tubes and rapid flow, the velocity is linearly proportional to the pressure head, and that the viscosity so determined agrees with the value obtained by the damping of oscillating disks. The anomalous features appear, therefore, when the flow takes place through very long and fine capillaries (radii less than 10^{-4} cm.).

*Actually Kapitza used the essentially similar method of radial flow between two parallel plates with small separation.

A little light is thrown on these curious results by the experiments of Mendelssohn and Daunt on the creep of liquid helium II in the form of mobile films over solid surfaces. If an open vessel be partially immersed in liquid helium II, it was observed that liquid gradually collected in the vessel until the liquid levels in vessel and bath were coincident. The rate of filling increased rapidly with lowering temperature. The mechanism was found to consist not in evaporation and recondensation, but in the transfer of liquid by means of surface films. At all temperatures in helium II the rate of transfer of liquid by means of the surface films was found to be independent of the difference in level. Both the thickness and the velocity of propagation of a film have been measured. The thickness is of order 5×10^{-6} cm. and the velocity increases from zero at the λ -point to 20 cm. per second at 1° K., which gives a rate of transfer of about 10^{-1} cubic centimetres per second per centimetre width of film. If films are formed above the λ -point, that is, by helium I, they are not more than 10^{-1} cm. thick.

A rough synthesis of the experimental results on flow of helium II can be attempted as follows. In flow through a tube, two distinct but by no means separate processes are taking place*: (a) the normal flow of a fluid with a viscosity (of order 10^{-4} c.g.s. units) which increases with decreasing temperature, and (b) creep along the inside walls of the tube by means of a surface film (of thickness of the order of 5×10^{-6} cm.), the velocity of which increases rapidly with decreasing temperature. For wide tubes, effect (a) predominates and the flow approximates to that of a normal viscous fluid. As the size of the capillary decreases, effect (b) becomes more pronounced, whilst for capillaries less than 10^{-4} cm. in radius, effect (a) becomes negligible and the quantity of liquid flowing per second is directly proportional to the circumference of the capillary.

Heat Conduction. The first experiments in the transport of heat through liquid helium II were made by Rollin and Keesom; their observations showed that helium II was a most efficient agent for the transport of heat, being far more effective than copper at the same temperature. It was observed later by Allen, Peierls and Uddin, and shown more convincingly by Keesom and Saris, that the rate of heat transport was not proportional to the temperature gradient. It is thus impossible to measure a true thermal conductivity for the liquid. The rate of heat transport is greater the smaller the gradient, and reaches a value corresponding to a conductivity several thousand times as great as that of copper at room temperature with gradients of the order of 10^{-3} of a degree per cm.

For a given gradient the 'conductivity' increases rapidly below the λ -point to a maximum at 2.0° K. and then falls again. Simon and Pickard of Oxford have found that the anomalously high conductivity disappears at the temperature at which the specific heat becomes normal.

Fountain Effect. The fountain effect, which was discovered in the Mond Laboratory, shows in the most striking manner the fundamental difference between helium II and any other known liquid. In its simplest form, the effect may be described as follows. A tube is partly immersed in helium II; the lower end of the tube is a capillary; both ends are open and an arrangement is made to heat the liquid in the upper part. A steady flow of heat is thereby maintained down the capillary. Under these conditions, it is observed that the liquid inside the tube rises above the level outside, showing the existence of a pressure in the reverse direction to the heat flow. A more spectacular demonstration can be given by placing powder in the lower half of the immersed tube through which the heat flows. To produce the heat current in this case, it is sufficient to shine light on the powder. With this arrangement the liquid may be made to rise right out of the tube, and in fact a steady 'fountain' several centimetres in height can easily be produced.

Quantitative measurements on the magnitude of the reaction pressure are very incomplete. Some data, however, are available from measurements* on the reaction to heat flowing in helium II through a tube filled with powder particles. The reaction pressure was found to attain a maximum value of approximately half an atmosphere for a gradient of 1° per cm. at 1.7° K. The value of the heat conductivity through the powder-filled tube was lower by a factor of a hundred than that through a smooth capillary of the same open cross-section. It seems, therefore, that the very large conductivity observed for helium II when the heat flows through smooth tubes is caused by violent convection currents which are set up by the reaction mechanism. This might be the reason for the apparent variation of conductivity with temperature gradient.

A complete understanding of the fountain effect must naturally await a satisfactory theory of the constitution of liquid helium II. However, a few interesting deductions can be made. In the first place, in the simple arrangement described above, the force holding the liquid above the bath level can only come from some form of interaction of the liquid with the walls of the tube or the attached heating wire. No other support is available, and the vapour pressure above the bath and inside the tube are sensibly the same. Secondly, this

*To be published shortly by J. F. Allen and A. D. Misener.

*Proc. Camb. Phil. Soc. (in the Press).

interaction must result in a downward thrust on the tube equal to the weight of liquid above the bath level. From the atomic point of view, this means that the interacting atoms are steadily transferring momentum in a downward direction to the tube, just as the thrust on the walls of a vessel containing gas implies that the atoms steadily lose momentum to the walls as they are reflected. This has the interesting consequence that the main heat transport in helium II at these temperatures (below 2.19° K.) cannot be due to the propagation of elastic waves as in ordinary liquids and solids, since elastic waves do not carry momentum.

Many and varied hypotheses have been made concerning the constitution of helium II. Michels, Bijl and de Boer and the present authors independently suggested that certain atoms which have more than the average energy in helium II

have, as well, a larger than average mean free path inside the liquid, and that heat flow represents a drift of these moving or 'excited' atoms. Later, this idea of energetic particles moving through the unexcited or 'condensed' atoms was developed by Tisza to include a theory of flow. This theory has not yet reached a quantitative stage, but has proved interesting and suggestive.

Note added in proof: Since this article was written, F. London has published (*Phys. Rev.*, 54, 947; 1938) an enlargement of the theory which he based on the consideration that helium at low temperatures exhibited Bose-Einstein condensation phenomena. His theoretical interpretation of the behaviour of liquid helium II appears to be quite in accordance with the experimental deductions given above, particularly with regard to the properties of flow of both heat and liquid.

The Earthquake in Chile

THE recent earthquake in Chile (*NATURE*, Feb. 4, p. 197) may justly be regarded as one of the greatest of such catastrophes in that country, and also in the world. According to local reports by survivors, the shock started about 11.35 p.m. local time on the night of January 24, and during the two or three minutes which it lasted ruined four towns and several villages, whilst doing severe damage to several others. The earthquake was felt from Valparaiso in the north to Puerto Montt in the south, the area affected now being estimated at 300,000 square miles. Large-scale damage was done from Talca in the north to Valdivia in the south, the area chiefly concerned being the province of Nuble, and the damage to property is estimated at £1,500,000. Altogether approximately 30,000 people were killed, 50,000 injured and there are about 100,000 homeless refugees.

At Chillan, a town of 45,000 inhabitants forty miles east of Concepcion, in the neighbourhood of the epicentre, two walls of the massive cathedral, the post office and telegraph building, the O'Higgins Infantry Barracks and most of the houses collapsed immediately. A theatre and a cinema collapsed, killing all the people inside. The hospital, although badly cracked, was one of the three or four buildings left standing after the initial shocks; but owing to the number of casualties the supply of anaesthetics ran out and the surgeons were obliged to operate without. Immediately after the shock the supply of electric power and

water ceased, so that the surviving firemen with the one remaining engine were powerless against the fires which followed. Moreover, transport was impossible on the railway and difficult on the roads around. After rescue operations, the Government ordered the evacuation of the town, it being estimated that here 10,000 lost their lives.

Parral, San Carlos and Egun, within the isoseismal 10, were also razed and evacuated. The villages of Retiro, Copihue, Zongavi, Bulnes and Quirihue were completely demolished. Andotro was very severely damaged, San Rosendo had 2,000 dead, and at Cauquennes, the town celebrated for its mineral springs, half the property including the hospital and prison was destroyed, killing 4,000 and injuring 800. At Concepcion, the fourth largest city in Chile, situated near the mouth of the Bio-Bio River and having a population of 89,000, three fifths of the city is in ruins and there are 2,000 dead. Many famous buildings, including the Teatro Campo Club and hospital, were destroyed. Here also a cinema collapsed killing 300 people inside it at the time, and fires added to the destruction in the city. It is expected that some of the fine modern buildings such as the Banco Central, the University and the Plaza Hotel which have been built to withstand earthquake shocks will have survived, unlike on the fifth occasion when Concepcion was completely destroyed on February 20, 1835. The damage was severe, but not so great at Los Angeles, Longavi and Linares. At Talcahuano, the port

and naval base, 19 are reported dead and 100 injured, fires adding to the destruction caused by the shock. At Talca many buildings were injured and the prison collapsed killing 10 convicts and injuring 20 others. Farther away, at Valparaíso, the church spire was damaged and at Santiago, 250 miles north of Concepción, the earthquake was strong enough to cause cracks in buildings.

Faulting has been on a considerable scale, and in the Province of Nuble the fissures caused by the earthquake are several kilometres long and often five metres deep.

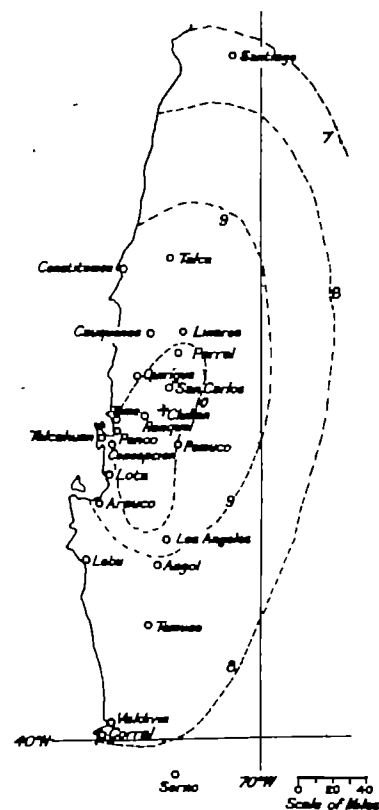
So far as instrumental evidence is concerned, the shock was world shaking. At Santiago the shock was felt about 11.35 p.m. local time on January 24 (Jan. 25, 3h. 35m. G.C.T.). From Fordham, New York, the shock was reported double with an interval of 10 minutes between the shocks and the needle swung approximately eight inches for both shocks at maximum. It was recorded by instruments in Great Britain, and at Stuttgart in Germany the registration was complete, including *eP* at January 25, 3h. 46m. 51s., *ePP* 51m. 45s., *SKKS* 58m. 25s. and *LQ* at 4h. 25m. with $T = 50-55$ sec. all in G.C.T. At Hamburg one *eP'* was registered at 3h. 47m. 8s. and another at 50m. 49s., both on the vertical seismograph, *e₁PP* at 51m. 44s., *eL_{III}* at 4h. 20m. and *eL₂* at 4h. 24m. all in G.C.T. together with other pulses. Taking into consideration all the above evidence, it appears that the epicentre was near lat. $36^{\circ} 45' S.$ and long. $72^{\circ} 15' W.$, probably correct within 10 minutes of arc, that the depth of focus was normal and that for the first shock the origin time was January 25 at 3h. 32.0m. G.C.T.

Since the first shock, aftershocks have been frequent and often of considerable severity. The frequency and intensity has as usual in general

diminished, though there have been notable exceptions. There were severe disturbances on the night of January 27 and on January 28. On January 30, at 3h. 45m. G.C.T. a severe shock with the same epicentre occurred and completely demolished the three or four remaining buildings and walls at Chillan.

Sympathetic occurrences in the Andes probably due to the disturbance of the Chilean shock or resulting from the same deep initial cause are reported, including further earthquakes and tremors, and on January 29, the Mt. Lliama volcano was in eruption.

Further news of the catastrophe is expected in reports of the Chilean seismologists and geologists who left Santiago for the epicentral region immediately after the shock.



Obituary Notices

Prof. H. H. Woollard, F.R.S.

THE very sudden death of Prof. H. H. Woollard on June 18, at the age of forty-nine years, is a tragic loss for the science of anatomy in Great Britain.

Woollard was a product of the University of Melbourne, where he took his medical degree in 1910. During the Great War he saw active service with the Australian Army Medical Service and attained the rank of Lieut.-Colonel. After the War he intended to work for the fellowship of the Royal College of Surgeons, and to this end went to University College, London. Here he came under the inspiring influence of the late Sir Grafton Elliot Smith, an influence

which led him completely to change his original plans; for he now decided to take up the study of anatomy as a scientific career. He was appointed to the staff of the Department of Anatomy at University College, where he worked until 1928. He was afterwards appointed to the chair of anatomy and histology in the University of Adelaide, to the chair of anatomy at St. Bartholomew's Hospital Medical School, London, and finally as successor to his distinguished teacher Elliot Smith, in University College, London, in 1936.

Woollard's contributions to anatomy, direct and indirect, were outstanding. His early papers were mainly morphological in character, and of these may be mentioned an important and comprehensive

monograph on the anatomy of *Tarsius*, and comparative studies on the cerebral cortex of *Tarsius*, the brain of *Oryzomys*, and the retina of primates. He was, however, essentially an experimental anatomist, and he received a great stimulus from his contact with American anatomists during the year which he spent at Johns Hopkins University as a Rockefeller research fellow. As a consequence of the experience which he gained from this visit, Woollard published the results of several important experimental studies; for example, the development of the vascular patterns of the limbs as demonstrated by the micro-injection of living embryos, the phagocytic activity of haemal glands, and the vital staining of the leptomeninges. Probably some of his best work was that dealing with the innervation of the heart and blood vessels, which was completed in 1925 and 1926. In 1927 he published his "Recent Advances in Anatomy" which attracted vigorous attention to the development of experimental anatomy in other countries, and did much to stir his contemporary colleagues to work for the revivification and re-orientation of anatomical teaching and research in Great Britain.

During his brief tenure of office in the University of Adelaide, Woollard made full use of his opportunities by his detailed and original studies of the Australian brain and of the distribution of blood-groups among the native populations. On his return to England, he concentrated his research activities on the peripheral nervous system. He had acquired extraordinary skill with the difficult technique of vital staining with methylene blue, and he applied this technique to very good effect in his experimental studies of peripheral innervation. Mention has already been made of his work on the innervation of the heart and blood-vessels. This is work to which continual reference is made by those who are concerned with the neural control of the cardio-vascular system. He applied the same technical methods to problems of cutaneous innervation, and for this purpose he used himself as an experimental subject. He aimed at correlating the localization of different sensory spots in his own skin with different morphological types of nerve ending, a study which involved a considerable amount of discomfort in the small operations which he permitted to be carried out on himself in order to obtain material for histological examination. The results of some of these observations were published during 1936 and 1937, and in 1938 he was elected a fellow of the Royal Society.

Woollard died in the middle of a scientific career when he had already achieved much, but his research activities were so productive that his colleagues confidently looked forward to a great deal more from him and from those whose work he was directing in his department. More than this, he aspired to raise the science of anatomy to a level of achievement and activity which he regarded as its proper status. His energetic example had inspired many of his fellow anatomists to work with him to this end, and the first fruits of these efforts were already becoming evident. Hence, his death will be felt as an extremely serious loss for the subject which he represented.

His friends mourn a devoted worker who spared himself not at all in his scientific and departmental duties, a colleague who was always ready to give help and advice in all manner of difficulties, and a man who had a very lovable character.

W. E. LE GROE CLARK.

Mr. A. B. MacDowall

WE regret to record the death, which occurred on January 10, of Alexander Baird MacDowall, who was a frequent contributor to *NATURE* a generation ago.

Mr. MacDowall was born at Alloa on December 18, 1843. At fifteen years of age he was sent to the Old College in High Street, Glasgow, long since swept away, where he came into contact with Prof. W. Thomson, afterwards Lord Kelvin. Next he went to Berlin, returning after six months to take his degree at Glasgow. This was followed by a trip to Melbourne in a sailing vessel for reasons of health, the return journey being made via Cape Horn.

On his return to Great Britain, Mr. MacDowall settled in London and started upon a career of general journalism, working in the British Museum and at the Patent Office. There he met Sir William Harcourt, Thomas Carlyle and others, including D. E. Hughes, inventor of the microphone. He followed closely the development of the telephone, and long before it was in general use, he had an experimental installation set up in his house.

About this time, Mr. MacDowall was contributing to *NATURE*, and also to the Royal Meteorological Society, on the subject of terrestrial and solar meteorology and the relationship between them. In 1895 he brought out a small book "Weather and Disease: a Curve History of their Variations"; the mode of representation adopted was that commonly used at the time to illustrate the relation between two variables, namely, the production of smoothed curves recording the averages of five or ten consecutive values. A similar method was used in a paper on the relation of terrestrial weather statistics to the sunspot cycle presented to the Royal Meteorological Society in 1897.

In recent years, Mr. MacDowall travelled a good deal in the British Isles and on the Continent, settling down some twelve years ago at Rothesay in the Isle of Bute. He retained to the end his lively interest in scientific developments. His wife, Emily, a daughter of William Liddon and Emily Howard, died in 1935.

WE regret to announce the following deaths:

Paul Séjourné, free academician of the Paris Academy of Sciences, who was known for his work on the design and structure of bridges, aged eighty-seven years.

Prof. Josef Šimon, professor of roentgenology and radiology in the Masaryk University, Brno, aged forty-one years.

News and Views

A New Type of Nuclear Reaction

ON p. 251 of this issue of NATURE, an account is given of recent investigations by Prof. O. Hahn, Prof. L. Meitner and F. Strassmann on the bombardment of uranium by neutrons. Prof. Meitner and Dr. O. R. Frisch have discussed the development and implications of these results in a letter which also appears in this issue (p. 239). Experimental confirmation of these conclusions, it is claimed, is announced in the following cable, dated February 3, received from R. D. Fowler and R. W. Dodson, of the Chemical Laboratory, Johns Hopkins University. "We have bombarded uranium nitrate in a three millimetre ionization chamber with deuterium neutrons and found that particles causing a very intense ionization, at least five times that from natural uranium alpha particles, are produced. Fast neutrons from one milliamperere two hundred and fifty kilovolt deuterons produced thirty-five particles per minute. Placing paraffin around ionization chamber increases this to seventy counts per minute. We believe this to be confirmation of work of Hahn and Strassmann (*Naturwissenschaften*, Jan. 6; Frisch and Meitner NATURE [Feb. 11, p. 239—Editor]) in which activity ascribed to barium was found after neutron bombardment, and that these particles are barium ions of about one hundred million volts energy.

"We have also bombarded thorium oxide in similar ionization chamber, with deuterium neutrons. Fast neutrons in same intensity as above produce thirty intensely ionizing particles per minute. Paraffin does not increase the effect. We believe thorium is also disintegrated by fast neutrons into fragments of about one half thorium mass, having energies of about one hundred million volts."

Dr. W. D. Coolidge

THE Faraday Medal of the Institution of Electrical Engineers given annually "either for notable scientific or industrial achievement in Electrical Engineering or for conspicuous service rendered to the advancement of electrical science", has been awarded to Dr. W. D. Coolidge, director of the research laboratories of the General Electric Co., Schenectady. Dr. Coolidge was born in 1873, and educated at the Massachusetts Institute of Technology and at the University of Leipzig, studying especially physical chemistry. After holding certain academic posts, he joined the staff of the General Electric Co. in 1905, was promoted to be associate director in 1928 and in 1932 was appointed director of research. The name of Coolidge is associated with advances in many fields, but perhaps all his later work may be traced back to his important researches into the production of ductile tungsten, which revolutionized the design of electric lamps and had immediate applications in thermionic devices of several types. In the Coolidge X-ray tube, which was developed just before the Great War, the

tube was evacuated as thoroughly as possible and the electrons necessary to produce X-rays were emitted by tungsten filaments heated to a suitable temperature. In this tube, for the first time, the X-ray worker was able by simple means to control separately the voltage and current applied to his tube, while the steadiness of running and constancy of X-ray output were much greater than had been possible with the earlier ionic type of tube. Later, Coolidge developed tubes capable of operating at tensions up to a million volts in which the electrons were accelerated in stages. Somewhat similar tubes were made of such a design that the electron beam, instead of being intercepted by a target and producing X-rays, passed through a thin window and gave rise to remarkable fluorescent, chemical and biological effects, the possibilities of which have not yet been completely explored.

Josiah Willard Gibbs (1839-1903)

ON February 11 the centenary occurs of the birth of the distinguished American physicist, Josiah Willard Gibbs. Born at New Haven, he was the son of Josiah Gibbs (1790-1861), professor of sacred literature in Yale Divinity School. He entered Yale College in 1854 and graduated four years later; he continued his studies there until appointed a tutor in 1863. The years 1866-68 he spent in Paris, Berlin and Heidelberg. In 1871, he was appointed to the chair of mathematical physics in Yale College, and this appointment he held until his death, which occurred at New Haven on April 28, 1903. Gibbs' first contributions to mathematical physics were two papers on thermodynamical problems published in 1873. These papers were followed by his memoirs "On the Equilibrium of Heterogeneous Substances" published in two parts in 1876 and 1878. This was translated into German by Ostwald and into French by H. le Chatelier. He also investigated certain problems in connexion with the electromagnetic theory of light and other subjects. He was a foreign member of the Royal Society, and in 1901 received the Copley Medal. He was also a corresponding member of the Paris Academy of Sciences. At the anniversary meeting of the Royal Society when the award was announced, Sir William Huggins, the president, said that Gibbs "was the first to apply the sacred law of thermodynamics to the discussion of the relation between chemical, electrical and thermal energy and the capacity for external work. To chemistry his most important result is the so-called phase rule, the law which governs the general case of complete heterogeneous equilibrium and which is applicable to chemical change generally".

Refugee Settlement in British Guiana

THE United States has offered to send an expert Commission to investigate the possibilities of refugee settlement in British Guiana, and the offer has been

accepted by the British Government, who have appointed additional members to the Commission. The terms of reference of the Commission are: To study and report upon the suitability and practicability of large-scale colonization in British Guiana for involuntary emigrants of European origin, from the physical, climatic and economic points of view; to estimate the approximate numbers that might be settled there (a) immediately, (b) over a term of years; to calculate the probable cost of such settlement: if mass colonization appears feasible, to recommend a general plan of settlement. The names of the members are: Dr. Edward C. Ernst, assistant director, Pan-American Sanitary Bureau (chairman); Colonel Howard U. Nicholas, United States Army Engineering Corps, Panama Canal; Dr. Joseph A. Roese, Jewish colonization expert and agronomist; Mr. Emile C. Bataille, colonization expert with Canadian experience; Dr. Anthony Donovan, sanitary engineer; Mr. Desmond Holdridge, who has previous experience of the Colony (secretary). Sir Crawford Douglas-Jones, formerly Colonial Secretary of British Guiana; Sir Geoffrey Evans, formerly principal of the Imperial College of Tropical Agriculture, Trinidad, now economic botanist at the Royal Botanic Gardens, Kew. Dr. D. W. Duthie, agricultural chemist to the British Guiana Government, is being attached to the Commission for the purpose of advising and co-operating with the Commission.

Science and World Resources

THE December issue of *Fact* (No. 21. 6d.) contains a study "Science and World Resources" by Richard Palmer, which gives a comprehensive but readable survey of the way in which the world economy is changing under the impact of scientific advance. Mr. Palmer gives a dynamic picture of the way in which scientific discoveries and their technical development from synthetic dyes such as indigo and alizarin to synthetic rubber, the new textile fibres such as rayon and more recently 'Lanital' and 'Nylon' and the numerous synthetic resins or plastics, are influencing not merely the development of new industries or the displacement of old industries but also the distribution and availability of materials in the world, the location of industry, etc. Mr. Palmer's survey ranges over the whole field of materials, including beet sugar, alcohol, petroleum, coal, fertilizers, and light metals, and indicates admirably even to the non-technical reader the new freedom which the organic chemist is giving us and some of the possibilities if the new powers and opportunities are wisely used. Other chapters range over the possibilities in the way of power production which we owe to science and their significance in world economy, as well as the possibilities in agriculture and the way in which science has made it possible to improve working conditions and thus both industrial efficiency and the climatic or geographical zones within which effective production by human beings is possible. The essay provides an excellent background against which to discuss such current problems as those of raw materials and their bearing on the colonial question,

the limits of self-sufficiency policies, sanctions, economic nationalism and the like. The realistic picture he gives enforces the necessity for strengthening, while there is yet time, our efforts to create a social and international order in which knowledge will be used to the full in the service of all mankind.

The Empire Service Broadcasting Station

Mr. L. W. Hayes and Mr. R. N. MacLarty presented an interesting paper to the Institution of Electrical Engineers on February 2. They first gave an account of how broadcast transmissions with short waves initially started at the Chelmsford works of Marconi's Wireless Telegraphic Co. in 1927. This gave intelligible reception at practically every place on the earth's surface at almost every period of the day and year. A serious difficulty that had to be overcome was due to the wide difference in longitude of the different Dominions and Colonies of the British Empire. For this reason, a transmission sent out at a given time in England would arrive at very various local times of the night and day in the different Dominions. Broadly, the aim of the service is to give listeners anywhere in the Empire a daily programme of about two hours' duration; the installation of the new broadcasting service started in 1933 practically does this. Earlier than this, reports received in the West Indies also gave a service at the same time in Western Australia, and the announcement of "London calling the African and West African Zones" was being heard simultaneously at night in Africa, in the early evening in South America and the West Indies, and at breakfast time in New Zealand. This showed that dividing the earth into geographical zones could cause confusion. Accordingly, the daily transmission from the Empire Station at Daventry was divided into five sessions: Transmission No. 1, Transmission No. 2, etc., in accordance with a time schedule, the programme from the first zone being recorded and then transmitted at the most suitable times to the other zones. In 1935, a sixth transmission was added, primarily intended for evening listening in western Canada, but serving also North America generally and giving an early morning service to India.

Conditions of Engineering Contracts

THE subject-matter of an engineering contract necessitates that the documents of which the contract is composed must make provision for contingencies and events of a special nature. In this respect, it has peculiarities not to be found in other forms of contract, and is often inevitably of considerable length. The Council of the Institution of Civil Engineers asked Mr. E. J. Rimmer to write a paper on the subject which will be discussed by correspondence until May 15. The Council gave the author of this paper a very wide discretion in the choice of the title and in the scope of the paper. He has wisely chosen to give a comprehensive survey of the whole subject of engineering contracts. Many engineering contract works are to be constructed in, or erected and fixed on to, land. They cannot, therefore, be rejected and sent back to the contractor

if they prove to be unsatisfactory; the material and labour may have to be carried out in the open air with material and labour of varying quality; the conditions of excavation and foundation cannot be entirely foreseen until the ground is opened up; the execution of the works also may result in damage to property belonging to other persons. In addition, the completion of the work may extend over several years, and the employer may desire to use the completed parts of the work before the final completion of the whole.

It was formerly the custom to prohibit assignment and to allow subletting only when the previous permission of the engineer had been obtained. Recently it has become fairly common to provide a form to be attached to and filled up with the tender, upon which the contractor declares the names of the firms to which he desires to sub-let portions of the works, and if these firms are approved before the contract is sealed the contractor may straightway sublet work to these firms. The retention in the hands of the engineer of supreme power as sole arbitrator has, considering the terms and circumstances of present-day contracts, become rather an anachronism. Old forms change slowly and some of the reforms suggested are not quite satisfactory. In Mr. Rimmer's opinion, some phrases and clauses now accepted as standard practice are confusing and ambiguous. The basic conditions upon which standard conditions should be framed must first be decided by the parties concerned. If the persons have different views, they are sometimes determined on the basis of compromise. But if the conditions are to be clear and unambiguous, there is no room for compromise on the manner and phraseology on which these principles are to be stated.

Changing the Face of London

In his Friday evening discourse at the Royal Institution delivered on February 3, Sir Charles Bressy dealt with the question of "Bigger London or Better London?" He illustrated by lantern slides the growth of Greater London since the Great Fire and described the complex administration of the area, now that its population has reached $9\frac{1}{2}$ millions, equivalent to the entire population of Norway and Sweden. In twelve years time the population within a thirty-mile radius of Charing Cross may reach a 'peak' figure of $10\frac{1}{2}$ millions. Meanwhile growth continues with such alarming rapidity that the inadequacy of British road communications has necessitated the preparation of the Highway Development Survey published by the Minister of Transport last May. Its recommendations, looking thirty years ahead, include the construction of about 123 miles of new routes in the L.C.C. area, 368 miles outside the L.C.C. area (exclusive of motorways) and motorways to a total length of 307 miles. The total cost will lie between £180,000,000 and £230,000,000. Sir Charles stressed the urgent need for a new east-west route across London (the east-west connexion), for the completion of the South Circular Road, the formation of a loopway around the City, and the

extension of the Thames Embankment so as to form a continuous riverside promenade extending for eight miles from Putney Bridge to the Tower of London. The incessant congestion of London's main roads in time of peace was some inkling of what might happen if a hurried evacuation had to be undertaken. If the Government decides that the present time is not propitious for the undertaking of extensive works of road construction, nothing can justify the postponement of measures for safeguarding the course of new routes, which include tunnels adapted for use as part of London's air-raid defence schemes.

Sir Arthur Evans: Gifts to the Ashmolean Museum

SIR ARTHUR EVANS has presented to the Ashmolean Museum, Oxford, of which he was keeper for a period of twenty-five years ending in 1908, his unique collection of Minoan sealstones and gems, gold rings and jewels, as an accession to the recently rearranged 'Minoan Room'. The collection, as is recalled by the Oxford correspondent of *The Times* of February 2, is "far-famed and unrivalled", embracing every period and class of the Minoan gem-cutter's art—prisms, button-seals, cylinders and ring bezels in steatite, cornelian, ivory and other materials, engraved with pictographs, scenes of ritual, bull-fighting and other sports. Among the rings is the famous great gold ring of Nestor, the group of gold beads known as the Treasure of Thisbe, all engraved with scenes of ritual, combat and ancient legend. Since Sir Arthur began his archaeological explorations in Crete in the early nineties of the last century, both while he was keeper of the Museum and after, he has been liberal in contributing to its collections examples of the objects discovered by him in his excavations. With this latest gift, the Ashmolean collection of Minoan antiquities becomes the most important and the most complete outside Crete itself. Recent alterations of the Museum, in which the largest archaeological gallery has been divided into three sections, have made it possible for Sir Arthur, with the assistance of Miss Mercy Money-Coutts, to make a new installation of Cretan antiquities, in which the older collections have been supplemented by groups of casts, numerous photographs, diagrams and water-colour drawings, with figurines, smaller antiquities and pottery which he has transferred to the Museum from his private cabinets. His benefactions have not, however, been confined to the donation of antiquities from Crete. They include classical antiquities, large series of Greek, Roman and Anglo-Saxon coins, and other objects, as well as the great collections of stone and bronze implements, Anglo-Saxon jewellery and other material which belonged to his father, the late Sir John Evans.

Morbid Heredity in Isolated Communities

An interesting study of morbid heredity in man in an isolated community by Dr. J. W. McFeeters, for which the Sir Charles Hastings Clinical Prize for 1937 has been awarded (*Brit. Med. J.*, Feb. 4, p. 218), is made the basis of a suggestion that in view of the facilities for tracing family pedigrees in small isolated communities and the inbreeding imposed upon such

communities for generations, similar studies should be undertaken, distributed as widely as possible over the country; before improved communications break down this isolation. The present observations appear to bear out the author's contention that such a series of records is bound to throw light on the occurrence of rare recessive characters, which are much less likely to occur when random mating is the rule rather than the exception. The village here under study consisted of about fifteen hundred inhabitants. Observations of numerous morbid data extended over a period of years, and led to the conclusion that heredity plays an even more important part in many varied conditions than is generally recognized. Of the many conditions studied, eight were chosen for discussion—hereditary cerebellar ataxia, progressive muscular dystrophy, the lymphatic diathesis, otitis media, hernia, cancer of the bowel, rodent ulcer and hydranmios. Among the more significant points which emerge, it is noted that in progressive muscular dystrophy, the condition is definitely sex-linked. It is transmitted by apparently healthy females in three generations. In three cases it was associated with failure to bleed, a peculiarity not previously recorded in this connexion. The incidence of hernia is curiously restricted. Out of twenty cases, fifteen occurred in two families; and heredity evidently played a part even more important than strain. The possibility of the occurrence of a xgotic lethal factor in the male—a possibility suggested with some doubt by Ruggles Gates—receives support from the study of hydranmios, where there may be a relationship of the cases on the paternal, and not the maternal side.

Natural and Synthetic Fibres: Sisal and Flax

INTERESTING information on the development of natural and synthetic fibre industries is published in the *Journal of the Royal Society of Arts* (87, No. 4494). Discussing sisal and flax production in East Africa, Dr. W. H. Gibson maintains that the sisal industry is now well established in Kenya, binder twine and string being at present the chief uses for the fibre. Sisal is also finding a ready market for matting and upholstery filling, and tests regarding rope manufacture are giving satisfactory results. The flax industry in Kenya, on the other hand, has so far been less successful, due largely to the difficulties encountered in the process of retting, that is, the preliminary steeping process during which the fibres are loosened from the woody stem. Experiments recently carried out in the United Kingdom, however, have shown that it is possible to eliminate this process and extract the fibre from the natural flax, and with this discovery the way for the development of the industry in Kenya and other suitable parts of the Empire seems most promising.

THE modern counterpart of these vegetable fibres, namely, the synthetic textiles, are the subject of a paper by Dr. E. F. Armstrong. Artificial silk produced from wood pulp and its more recent development, staple fibre, are well-known supplements to, and competitors with, natural silk, wool and cotton. A new textile called 'Nylon' has, however, recently

been produced by the du Pont Laboratories in the United States. This thread is of an entirely different origin to rayon, as it is a plastic substance derived ultimately from coal tar, with dyeing properties akin to natural silk or wool, and it appears to have a most promising future. Two other types of fibre may be mentioned. The first is 'Lanital', an Italian product made from casein and used as a wool substitute, but as it lacks wet strength, attempts are being made to produce a better product from the protein of the soya bean. The second is spun glass which, though unsuitable for clothing, is used for electrical insulation, gas and liquid filtration and decorative purposes. In spite of the popularity of synthetic textiles, it is noteworthy that in 1937 the world production of these fibres was only in the ratio of 1.8 to 28 of natural spinning materials.

Forestry in Finland in 1937

THE annual report of forestry activities in Finland (XVII *Metsätilasto Forststatistik—Kartomus Metsähallinnon Toiminnasta* 5, 1937. *Berättelse över Forstförvaltningens Verksamhet*, Ar 1937), published in Helsinki last year, sums up the work of this progressive Forest Department. The great advance made by Finland since the Great War and the position she has taken in European forestry circles may to some extent be attributed to the fact that the Forest Department had a large forest capital at its back already under exploitation. Consequently a variety of problems were presented to the trained forester, from forestry education through sylvicultural management and protection down to the study of utilization, the improvements possible in extraction, statistics and prices, and so forth. The forestry reforms of 1921–23 prescribed the division of the country into four districts containing ten forest inspections and ninety cantonments (subdivisions of an inspection). Each district was administered by a local forestry bureau, under whom were the inspections, each in charge of an inspector. An important outcome of a decree of July 1934 is the gradual replacement of the untrained forest guards by *chefs de travail* or overseers, all of whom will have received training at one of the forestry schools, of which there are six. Considerable progress has been made with working plans and maps required in connexion with their preparation—revision of these plans is undertaken every ten years. The report deals in detail with the commercial activities, since the forests play so important a part in Finnish economy, and the British market is a very valuable one. An interesting point in the report is the policy undertaken by Government of settling a proportion of the population within the large forest areas owned by the State.

The Phenological Survey

THE new phenological forms distributed by the Royal Meteorological Society to its six-hundred-odd observers for 1939 have a further reconstruction of selected specimens of fauna and flora on a much more scientific basis. A noticeable feature is a considerable increase in the number of Lepidoptera selected for special observation, there being fifty selected

indigenous Lepidoptera the appearance of which is to be recorded, and three immigrants. This has been at the expense of a considerable reduction in the bird migration list, as many of those subjects had been reported on continuously for many years. There has been an extension in the selected observations on trees, chiefly in regard to leafing times. The modern system of Latin bird names is now used, although observers are warned that the old system is still used in some reference books. Particular stress is laid on the importance of recording the effects of abnormal weather upon the vegetation, etc. Spring and early summer appearance dates of the peacock and red admiral butterflies should help gather additional information regarding the question of their hibernation. A valuable addition to the recording of flowering of plants and leafing of trees is the recording, as well as the date, of the sheltered or open position of the plant. On the whole, the amount of observation called for has been considerably increased, but individual phenologists are encouraged to send in returns of any one group if they wish.

Norman Lockyer Observatory

Bulletin No. 2 of the Norman Lockyer Observatory, Sidmouth, recently issued, contains an appreciation of the late Sir Robert Mond, chairman of the Observatory Corporation for twenty-one years and a generous benefactor to the Observatory. A further note of a personal nature gives an account of the unveiling of the memorial to the late director, Dr. W. J. S. Lockyer, at which Sir Robert Mond presided just three months before his death. Part of the memorial alluded to is the Oxford microphotometer, a description of which is given in the present *Bulletin* by the director, Mr. D. L. Edwards, together with illustrations of representative tracings of stellar spectra and of several line-contours, obtained with the instrument. Mr. D. R. Barber contributes two papers. The first is a detailed account of the magnificent auroral display of January 25, 1938, which appears to have been visible over practically the whole of Europe and the North American continent. The second paper deals with the objective prism-spectra of Finsler's Comet obtained at its apparition of 1937. In a preliminary investigation (N.L.O. *Bull.*, No. 1), Barber had found that a visual comparison of the intensities of the cometary bands at 4700 and 3880 Å. due to O(IV) and CN(IV) radiation respectively indicated that the former was about $2\frac{1}{2}$ times stronger than the latter, a result in the opposite direction from that deduced from slit spectrograms secured at the Mt. Wilson and the Lick Observatories. The Sidmouth spectrograms have now been analysed by means of the new microphotometer, and Barker confirms his first result with, however, a reduction of the ratio of relative intensities from $2\frac{1}{2} : 1$ to $1\frac{1}{2} : 1$.

Literature for Adult Education

AN important factor in the success of discussion groups or public lectures as a means of education for citizenship is the provision of books and other

suitable material for reading. A pamphlet, "Printed Page and the Public Platform", which has recently been issued by the Office of Education, United States Department of the Interior (Washington, D.C.: Gov. Printing Office, 20 cents), analyses the different factors involved and gives an account of experiments and experience in the United States which should be highly useful to those interested in adult education in Great Britain. The necessity for close co-operation between libraries and such discussion groups is emphasized, and a number of practical suggestions are detailed to facilitate co-operation. The scope and functions of reading lists are critically discussed and the importance of having the reading material as accessible as possible to those taking part in the discussions or attending lectures is recognized. Equally important is the suitability of the material, and while the criticism is not specifically directed at scientific literature, it applies equally to that intended for the general public. Able exposition is a first condition of success, involving an understanding not only of the subject handled but also of the readers to whom the book or article is addressed, and if pamphlet literature admittedly presents special difficulties, the problem is one which deserves greater attention because of its greater appeal to many readers in spite of the distribution difficulty.

The International Seismological Summary

THE I.S.S., compiled at Oxford, is a work which increases in volume and range as it progresses. The volume for January, February and March 1933, which commences the sixteenth volume, has just appeared, and deals with 165 epicentres, 67 being new and 98 repetitions from old epicentres. Nine of the earthquakes mentioned have foci which are below normal. The epicentres have, in general, been determined from observations of *P* alone, instead of by the old method of using *S*—*P* differences. This is said to make very little difference in the case of well-observed earthquakes, but is greatly to be preferred on theoretical grounds. During the last five years, the range of numbers of earthquakes with determinable epicentres recorded in the I.S.S. has been from 569 in 1932 to 653 in 1930. It appears, therefore, that notwithstanding the greater number of stations sending readings, and the greatly improved registration, the numbers of such earthquakes have reached a probable limit. In this volume, stations which send additional readings to the usual *P*, *S*, *L* and *M* are thanked especially, and for the future all are requested to classify wherever possible their *L* readings into *LQ* and *LB*, and to state whether the initial *P* reading is compressional or dilatational.

The Medical Press and Circular

THE issue of January 25 of the *Medical Press and Circular* is a centenary double number. This journal is, as the name suggests, the combination of two, namely, the *Dublin Medical Press*, founded in Dublin in 1839, and the *Medical Circular*, founded in London in 1852, the union taking place in 1866. Prof. Rowlette of Dublin contributes a short history of the journal during the hundred years, with biographical

notes on the various editors. Dr. Cecil Wall and Mr. Walter Spencer discuss the progress of medicine and of surgery, respectively, during the period; an illustrated article on "Some Medical Celebrities of the Victorian Age", as depicted in cartoons of *Vanity Fair*, is contributed by Sir St. Clair Thomson, the cartoons being reproduced together with actual portraits; and a chronological list of medical societies and journals in Great Britain and Ireland is furnished by Mr. Reginald West. Other articles and reviews complete a very interesting number.

Art and Psychiatry

UNDER the auspices of the Government Federal Art Project and of the Bellevue Hospital psychiatric department, the Harlem Art Centre in New York City has organized the first exhibition of its kind in the United States, consisting of pictures showing the work of disordered minds. The artists include moronic children; chronic alcoholics, advanced epileptics, manic-depressives and general paralytics. Most of the exhibits indicate mental conflict, being shapeless, lurid and grotesque. The idea underlying the art classes at Bellevue Hospital is to attempt a cure of the mentally sick by encouraging them to express their conflicts and at the same time to give psychiatrists a clearer picture of their patients' emotional life.

Earthquake in Ecuador

SEVERAL earthquakes of sufficient intensity to crack buildings shook a considerable area in Ecuador on the night of February 1, 1939. Altogether nine tremors were felt at Valledumbos and four other towns, and five tremors at Quito. Quito was ruined with the loss of 40,000 lives on February 7, 1797, and simultaneously there was volcanic eruption in Guadeloupe. In the present instance, Cotopaxi, the highest volcano in the world, is in eruption. It was in 1768 and 1877 that previous disastrous eruptions of Cotopaxi took place.

Announcements

THE council of the Institution of Electrical Engineers has elected Sir Archibald Page, chairman of the Central Electricity Board, and a former president of the Institution, to be an honorary member.

M. EMMANUEL DE MARGHERIE has been elected a member of the Section of Mineralogy of the Paris Academy of Sciences in succession to the late L. de Launay.

THE Goethe Medal for Art and Science has been awarded by the German Chancellor to Dr. Theodor Kitt, professor of veterinary pathology in the University of Munich.

RESEARCH CORPORATION, of 405 Lexington Avenue, New York, from time to time makes awards to universities for the work of men of science. The Corporation has now made grants to Columbia University, New York, of 2,500 dollars each and Research Corporation plaques, to be made the basis

of awards to (1) Dr. H. S. Taylor, of Princeton University, "for his work in the field of catalysis, wherein he has advanced the theory of catalytic action and the art of using catalysts in industrial operations in this field"; (2) Dr. V. Bush, of Massachusetts Institute of Technology, for his work "in the development of powerful and rapid methods of computation and the solution of equations through the invention of automatic apparatus".

ON December 22, the French Minister of Public Health inaugurated the new laboratories of the Pasteur Institute at Garches near Paris where Pasteur made his studies on rabies in 1884.

THE King has commanded that the recently founded British College of Obstetricians and Gynaecologists shall be known as the Royal College of Obstetricians and Gynaecologists.

THE Royal Sanitary Institute will hold its Annual Congress at Scarborough on July 3-8 under the presidency of the Earl of Harewood. Further information can be obtained from the Secretary of the Institute, 90 Buckingham Palace Road, S.W.1.

THE sixth Biennial Congress of the International Hospitals Association will be held at Toronto next September. Further information can be obtained from the Secretaries of the Association, 17 Bloomsbury Square, W.C.1.

THE Mary Putnam Jacobi fellowship of 1000 dollars is offered to a woman graduate of an approved medical school for post-graduate work in the medical sciences. If the appointed fellow is not resident in the United States, she should preferably undertake work there. Applications should be sent to the Secretary of the Fellowship Committee, Dr. Phebe L. DuBois, 150 East 73rd Street, New York City, before April 1.

THE German Society for Balneology and Climatology will hold its annual meeting at Vienna on March 23-26, when the following subjects, among others, will be discussed: meteorological and physical report; medical report, importance of high mountain climate in treatment of tuberculosis and asthma; physiology of sport in high mountains; drinking wells and artificial salts; natural and artificial mud baths; and artificial climate. Further information can be obtained from Die Reichsanstalt für das deutsche Bäderwesen, Fürstenstrasse 124, Breslau 16.

THE annual mortality from malaria in India averages 2,000,000, an exceedingly high figure even in a population of more than 300,000,000, 30 per cent of whom suffer from the disease. Two thirds of the malaria-stricken in India have no quinine.

ERRATUM.—In NATURE of January 7, p. 23, "A Rapid Visual Test for Vitamin A Deficiency", para. 4, last sentence, for "hemeralopia" read "hemeralopia".

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 247.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Disintegration of Uranium by Neutrons: a New Type of Nuclear Reaction

On bombarding uranium with neutrons, Fermi and collaborators¹ found that at least four radioactive substances were produced, to two of which atomic numbers larger than 92 were ascribed. Further investigations² demonstrated the existence of at least nine radioactive periods, six of which were assigned to elements beyond uranium, and nuclear isomerism had to be assumed in order to account for their chemical behaviour together with their genetic relations.

In making chemical assignments, it was always assumed that these radioactive bodies had atomic numbers near that of the element bombarded, since only particles with one or two charges were known to be emitted from nuclei. A body, for example, with similar properties to those of osmium was assumed to be eka-osmium ($Z = 94$) rather than osmium ($Z = 76$) or ruthenium ($Z = 44$).

Following up an observation of Curie and Savitch³, Hahn and Strassmann⁴ found that a group of at least three radioactive bodies, formed from uranium under neutron bombardment, were chemically similar to barium and, therefore, presumably isotopic with radium. Further investigation⁵, however, showed that it was impossible to separate these bodies from barium (although mesothorium, an isotope of radium, was readily separated in the same experiment), so that Hahn and Strassmann were forced to conclude that isotopes of barium ($Z = 56$) are formed as a consequence of the bombardment of uranium ($Z = 92$) with neutrons.

At first sight, this result seems very hard to understand. The formation of elements much below uranium has been considered before, but was always rejected for physical reasons, so long as the chemical evidence was not entirely clear cut. The emission, within a short time, of a large number of charged particles may be regarded as excluded by the small penetrability of the 'Coulomb barrier', indicated by Gamov's theory of alpha decay.

On the basis, however, of present ideas about the behaviour of heavy nuclei⁶, an entirely different and essentially classical picture of these new disintegration processes suggests itself. On account of their close packing and strong energy exchange, the particles in a heavy nucleus would be expected to move in a collective way which has some resemblance to the movement of a liquid drop. If the movement is made sufficiently violent by adding energy, such a drop may divide itself into two smaller drops.

In the discussion of the energies involved in the deformation of nuclei, the concept of surface tension of nuclear matter has been used⁷ and its value has been estimated from simple considerations regarding nuclear forces. It must be remembered, however,

that the surface tension of a charged droplet is diminished by its charge, and a rough estimate shows that the surface tension of nuclei, decreasing with increasing nuclear charge, may become zero for atomic numbers of the order of 100.

It seems therefore possible that the uranium nucleus has only small stability of form, and may, after neutron capture, divide itself into two nuclei of roughly equal size (the precise ratio of sizes depending on finer structural features and perhaps partly on chance). These two nuclei will repel each other and should gain a total kinetic energy of c. 200 Mev., as calculated from nuclear radius and charge. This amount of energy may actually be expected to be available from the difference in packing fraction between uranium and the elements in the middle of the periodic system. The whole 'fission' process can thus be described in an essentially classical way, without having to consider quantum-mechanical 'tunnel effects', which would actually be extremely small, on account of the large masses involved.

After division, the high neutron/proton ratio of uranium will tend to readjust itself by beta decay to the lower value suitable for lighter elements. Probably each part will thus give rise to a chain of disintegrations. If one of the parts is an isotope of barium⁸, the other will be krypton ($Z = 92 - 56$), which might decay through rubidium, strontium and yttrium to zirconium. Perhaps one or two of the supposed barium-lanthanum-cerium chains are then actually strontium-yttrium-zirconium chains.

It is possible⁹, and seems to us rather probable, that the periods which have been ascribed to elements beyond uranium are also due to light elements. From the chemical evidence, the two short periods (10 sec. and 40 sec.) so far ascribed to ²³³U might be masureum isotopes ($Z = 48$) decaying through ruthenium, rhodium, palladium and silver into cadmium.

In all these cases it might not be necessary to assume nuclear isomerism; but the different radioactive periods belonging to the same chemical element may then be attributed to different isotopes of this element, since varying proportions of neutrons may be given to the two parts of the uranium nucleus.

By bombarding thorium with neutrons, activities are obtained which have been ascribed to radium and actinium isotopes¹⁰. Some of these periods are approximately equal to periods of barium and lanthanum isotopes¹¹ resulting from the bombardment of uranium. We should therefore like to suggest that these periods are due to a 'fission' of thorium which is like that of uranium and results partly in the same products. Of course, it would be especially interesting if one could obtain one of these products from a light element, for example, by means of neutron capture.

It might be mentioned that the body with half-life 24 min.¹ which was chemically identified with uranium is probably really ²³⁸U, and goes over into an eka-rhenium which appears inactive but may decay slowly, probably with emission of alpha particles. (From inspection of the natural radioactive elements, ²³⁸U cannot be expected to give more than one or two beta decays; the long chain of observed decays has always puzzled us.) The formation of this body is a typical resonance process²; the compound state must have a life-time a million times longer than the time it would take the nucleus to divide itself. Perhaps this state corresponds to some highly symmetrical type of motion of nuclear matter which does not favour 'fission' of the nucleus.

LISE MEITNER.

Physical Institute,
Academy of Sciences,
Stockholm.

O. R. FRISCH.

Institute of Theoretical Physics,
University,
Copenhagen.
Jan. 16.

¹ Fermi, E., Amaldi, F., d'Agostino, O., Rasetti, F., and Segrè, E. *Proc. Roy. Soc., A*, 140, 453 (1934).

² See Meitner, L., Hahn, O., and Strassmann, F., *Z. Phys.*, 109, 249 (1937).

³ Curie, I., and Savitch, P., *C.R.*, 236, 906, 1643 (1928).

⁴ Hahn, O., and Strassmann, F., *Naturwiss.*, 26, 756 (1938).

⁵ Hahn, O., and Strassmann, F., *Naturwiss.*, 27, 11 (1939).

⁶ Bohr, N., *NATURE*, 127, 344, 351 (1936).

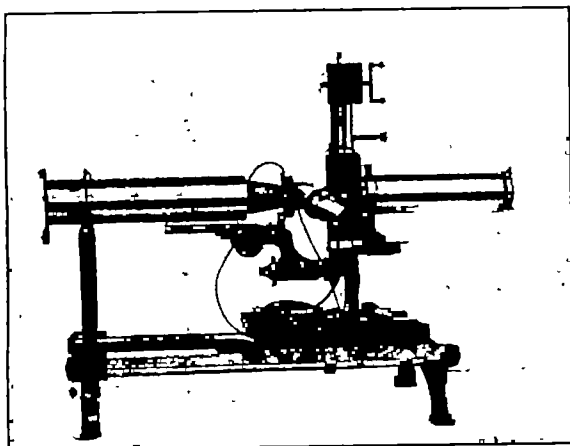
⁷ Bohr, N., and Kalcker, F., *Kgl. Danske Vid. Selskab, Mat. A. Phys. Medd.*, 14, Nr. 10 (1937).

⁸ See Meitner, L., Strassmann, F., and Hahn, O., *Z. Phys.*, 109, 533 (1938).

⁹ Bethe, A. H., and Placzek, G., *Phys. Rev.*, 51, 450 (1937).

A Novel Thermostat

It is often necessary to maintain an apparatus at a constant temperature. This may be done by immersing it in a circulating liquid maintained at a constant temperature by a thermostat, or by jacketing



TEMPERATURE-CONTROLLED APPARATUS.

it with alternate shells of thermally conducting and insulating materials heated to the selected temperature by means of an internal electric heater. These methods have the disadvantages that the thermostat system makes the apparatus less accessible, the

control of the temperature to within a narrow range requires some complication in the whole system, and it is difficult to prevent 'hunting'.

In a measurement which we are making of the electronic charge, it is necessary to maintain the temperature of the air, in which an oil drop moves, uniform and constant so that it has no motion due to convection. As a convenient solution of this problem has been found which seems capable of many applications, it is described here.

A resistance thermometer is formed by winding a single layer coil of copper wire around and in good thermal contact with the microscope condenser which forms part of the apparatus the temperature of which is under control. (In the accompanying illustration the condenser tube is on the right.) This coil forms one arm of a Wheatstone bridge, the other arms being of manganin resistances. Any change in temperature of the apparatus deflects the light spot of the galvanometer connected to this bridge, and for one direction of deflection the spot falls on a photo-electric cell, which operates a polarized relay, which in turn puts off two 30-watt lamps placed on opposite sides of the apparatus. The amplification of the galvanometer current by the photo-electric cell is 10⁶, and including the relay about 10⁷.

The bridge is adjusted to be balanced at a temperature a few degrees above the maximum temperature to which the room rises during a day. The lamps flash on and off every few seconds and maintain the temperature of the external surface of the apparatus constant to about 0.002° C. After the thermostat has been in operation for an hour, we have not been able to detect, by means of a thermocouple, any change of temperature inside the apparatus.

T. H. LABY.

Natural Philosophy Laboratory, V. D. HOPPER.
University of Melbourne.
Dec. 9.

Limitations on the Modern Tensor Scheme of Relativity

It does not appear to have been noticed by anybody that the tensor scheme of relativity is incompetent by itself to include relations of chirality, to use Lord Kelvin's term. For it is developed from a pure Riemannian geometry, as based solely on the use of an ideal mobile a-chiral linear measuring rule. The meaning of relativity has, of course, always been that knowledge consists of the relations of one system to another, especially when one type of system of high simplicity, such as the linear measuring rule, is taken as the standard of comparison for all others. This significance of the chiral property, which is the difference between a chiral system and its mirror-image, for example, between a right-hand glove and a left-hand, goes back to Kant's early writings, and remained fundamental in his trains of thought in relation to space and time; later, in the more amateur hands of Pasteur, it created a fundamental science. Chiral systems can be compared completely only with chiral systems. The frame of reference for a chiral system must itself have chiral property; for example, to be effective, the mobile measuring rod of Einstein would require to possess a screw structure essential to it. When Newton explained how he could tell by experiment

whether his space was rotating, he was perhaps not so far out after all.

It may appear that this argument presents a demurrer to the theory which derives the space-time scheme from the single mental foundation of linear succession in a time which is absolute for all observers everywhere: but it is to be remembered that the assertion of a scalar constant velocity of radiation is there the fundamental postulate. Chiral properties, of the two conjugate types, would thus have to be restricted to imbedded atomic structures. Likewise to our universe based mainly on negative electrons there ought in theory to be a conjugate universe, its mirror-image, based on positive: and to our organic nature based on leval chiral structures there ought in theory to be a conjugate one, its mirror-image, based on dextral.

On the other hand, it is perhaps not easy to see how the tensors can escape the fate that is reserved for all 'unobservable', unless a set of observing apparatus can be devised which is itself beyond the bounds of space and time.

Or may we find refuge in the doctrine that physical science, being concerned largely with statistical aggregates, is unable to construct laws or relations without allowing substantial margins for inherent 'uncertainties' (cf. Laplace on "Probabilities").

Also, co-ordinates must surely be defined or restricted by laws of continuity. All significant tensors would have to be invariant for every linear vector change in the frame of reference; but their components would by no means be separately invariant, thus the energy in a generalized sense which is the final component of the energy-tensor would have no reality. Yet notwithstanding this want of detailed invariance, the vanishing of the complete tensor involves (after Einstein) the separate vanishing of all its components, so would express one law of Nature built on this type, by a representative group of as many simultaneous differential equations as the vanishings provide.

JOSEPH LARMOR.

Hollywood,
N. Ireland.
Jan. 2.

Theory of Mesons and Nuclear Forces

As was first pointed out by Yukawa, it is in principle possible to account for the short-range forces between nuclear particles by the assumption of virtual emission and absorption processes involving intermediary particles of integral spin, the so-called *mesons*¹, the mass of which is determined by the range of the forces. As has been shown by Kemmer², the simplest wave-equations for the mesons which satisfy, besides the claim of relativistic invariance, the condition of giving a positive definite expression for the energy, reduce to four types, characterized by different co-variance properties of the wave-functions, and each allowing the existence of neutral as well as positively and negatively charged mesons. Starting from such wave-equations, including the interaction of the meson field with the heavy nuclear constituents, the estimation of the resulting expressions for the nuclear forces has hitherto been carried out by using the ordinary perturbation method of quantum theory, and taking into consideration only the first non-vanishing approximation, in spite of the well-known lack of convergence of the method.

It would thus seem desirable to discuss more closely the reliability of such results, and for this purpose a possible method of attack is suggested by an analogous situation in quantum electrodynamics, where a suitable canonical transformation allows us to separate, from the expression of the total energy of a system consisting of electrons and an electromagnetic field, a term depending only on the co-ordinates of the electrons and representing the Coulomb potential energy.

A similar method³ is, actually, applicable to a system consisting of nuclear particles and a meson field. For such a system it is, in fact, possible to find canonical transformations effecting the separation of a 'static' interaction between the nuclear particles, defined as the part of the interaction which is obtained when one neglects the time-variations of the variables characterizing the positions, spins and proton or neutron states of the heavy particles. This static interaction is in all cases exactly the same as that obtained as a first approximation in the perturbation method, and there exists a lower limit, smaller but unfortunately not much smaller, than the range of the nuclear forces, to the mutual distances between two heavy particles for which the static interaction is more important than the additional non-static contributions arising from the terms, in the transformed Hamiltonian, which describe the remaining interactions between the heavy particles and the meson field.

Although no improvement can, of course, be obtained in this way as regards the self-energy difficulties, it would seem that consistent results can be derived from the transformed Hamiltonian by considering only the last-mentioned interactions as a perturbation and applying a method of treatment analogous to the correspondence methods used in electrodynamics. It is especially to be noted that if, following Yukawa, we also introduce an interaction between the meson field and electrons and neutrinos, the transformed Hamiltonian contains a term which represents a direct interaction between the heavy particles and the electrons and neutrinos, and which, when treated as a small perturbation, immediately gives the probabilities of β -disintegration processes. It is perhaps to be regarded as a satisfactory feature of the point of view just outlined that, contrary to previous treatments, where the nuclear forces came out in the same stage of the perturbation method as the probabilities of β -decay, account is here taken at the outset of at least the static part of the nuclear forces.

As regards the form of these static interactions, it is well known that the type of potential resulting from the four-vector meson field generally considered hitherto has the defect of including a term of dipole interaction energy which is so strongly singular for infinitely small mutual distances of the nuclear particles that it would not in general allow the existence of stationary states for a system of such particles. In order to remedy this defect, it seems necessary⁴ to introduce besides the four-vector wave-function a further pseudoscalar wave-function for the meson field which has the property of giving rise to a static interaction of a form just capable of cancelling the dipole interaction term without affecting the others. The consideration of such a pseudoscalar meson field would also seem to be useful from the point of view of the theory of β -decay. While, for example, the four-vector theory yields⁴ exactly the same form of the β -spectrum as Fermi's original

theory, the introduction of a pseudoscalar wave-function in addition to the four-vector one gives rise to a modification of the energy distribution of the β -rays which seems to open a new possibility of a better adaptation to the experimental results.

A detailed account of our work will appear shortly in the *Proceedings of the Copenhagen Academy*.

C. MÖLLER.

L. ROSENFIELD.

Institute for Theoretical Physics.

Copenhagen.

Jan. 6.

¹ See Bhabha, *NATURE* (in the Press).

² Kemmer, *Proc. Roy. Soc. A*, 166, 137 (1938); *Proc. Camb. Phil. Soc.*, 34, 354 (1938).

³ Independently of our work, essentially the same method has been proposed by Stueckelberg (*Phys. Rev.*, 54, 899; 1938), to whom we are very thankful for the kind communication of his manuscript.

⁴ Yukawa, Sakata, Kobayasi, Taketani, *Proc. Phys. Math. Soc. Japan*, 20, 730 (1938).

Frequency Interpretations in Probability

THE letter of mine quoted by Dr. W. E. Deming¹ was mostly in the nature of a personal explanation. I have never denied that frequencies may be *relevant* to a prior probability; what I deny is that a frequency is ever the *whole content* of a probability, whether prior, direct or posterior. I have, in fact, pointed out that prior probabilities should be reassessed from time to time to allow for accumulation of information from analogous problems, and the case considered by Deming is an extreme one of this type, since the balls in his box are derived from a large population the composition of which is definitely known. The kind of distinction involved seems to have been noticed by Laplace, if one compares his opening remarks with those of De Moivre. De Moivre begins by defining a probability as simply the ratio of the number of favourable cases to the whole number of possible cases. Laplace puts in the proviso "provided that all the cases are equally possible"; otherwise his statement is practically a translation of De Moivre's.

Consider the following problem. A box contains one white and two black balls; another contains one white and one black. A box is to be chosen at random and then a ball at random from that box. What is the probability that the ball will be white? According to De Moivre's definition, it is the number of white balls divided by the whole number of balls, and therefore is $2/5$. All balls are possible and there is no alternative. But I think that any modern writer would say that the probability is $\frac{1}{2} \cdot \frac{1}{2} + \frac{1}{2} \cdot \frac{1}{2} = 5/12$, and indeed that De Moivre would have said so if the point was put to him. The correct result can be got only by recognizing that the five balls are not "equally possible". Though Laplace is liable to be too brief in places and by modern standards too prolix in others, I think it must be inferred from the comparison of the statements that he had seen that the earlier definition did not cover actual needs, and could be made to cover them only by means of the idea of "equally possible", which is not defined as such. It cannot be defined in terms of frequency and must be taken as a primitive notion.

Now Dr. Deming's presentation involves the same idea, through the notion of randomness, which is not defined. A mere statement of the numbers in the parent population is not enough to ensure randomness. For example, some adhesive might be present that sticks to the white balls and not to the black

ones. Then the extraction of a white ball would tend to pull others to the top, and we should expect a disproportionate number of white balls in a large sample, even although we might be unable to rule out any particular selection as impossible. In fact, the force of the treatment is not in the ratio of the numbers, but in the undefined notion of randomness, which is equivalent to "equally possible"—that is, that all selections from the parent population are equally likely. Without this idea, which may be part of a frequency treatment, but is not part of a frequency definition, we cannot say anything about what the result of a trial is likely to be. If anybody says that we will go on picking out white balls until there is none left, a frequency interpretation by itself provides no answer. It is possible in logic and there the matter ends. Similarly, no meaning could be attached to differences of possible biases in a coin; so long as it is in the least possible for either a head or a tail to occur, the probability, on the frequency definition, is $\frac{1}{2}$.

Of course I agree that there are cases where it is reasonable to expect that the ratio in a large sample will approximate to that in the population; but my point is that if we do that, we are taking "reasonable to expect" as a primitive idea, and it should be stated as such. No practical recommendation can ever be used unless this idea is brought in, though it is liable not to be mentioned by the statistician. That makes no difference in practice because, even if the statistician does not mention it, the person advised uses it. Without it, the latter would be entitled to say: "That is all very well as a piece of pure mathematics, but what has it to do with me?"

I should say myself that the hypothesis of randomness is always what logicians call a *considered* proposition, not an *asserted* one. The point of any type of significance test is to examine cases where the hypothesis may be untrue. It may in fact always be false—if a coin is thrown enough times it will wear and become biased; if a pack of cards is dealt often enough it will become marked and too many aces will go to the dealer, and so on. But it has the advantage that it involves the minimum number of parameters, since it does not need the introduction of one or more parameters to express possible bias or dependence of one trial on the results of previous trials. Consequently it is easy to state, and in actual cases easily discarded if it is found to be unsatisfactory; even if it is untrue it points the easiest way of progress. But it should not be stated as a fact, and if anybody proposes, in order that a frequency definition may give acceptable answers, to restrict himself to cases where randomness holds, he is both using the notion of reasonable degree of belief and artificially restricting its application.

HAROLD JEFFREYS.

St. John's College,
Cambridge.

¹ *NATURE*, 143, 202 (1939).

Antarctica and Glacial Ages

PROF. A. P. COLEMAN¹ contends that the late Palaeozoic glacials of the southern hemisphere could never have been formed upon a large, single continent—Gondwana—as visualized by supporters of the hypothesis of continental drift. He has protested that, for such an ice-cap to have developed, there must have been sources of evaporation at hand in

the shape of warm seas, and has accordingly denied the existence of any such continent and along with it the hypothesis of drift. It is difficult to follow his argument in the face of recent work on this problem.

The mere presence of sea—whether warm or cold—would be no measure of the rainfall upon the adjacent lands, as witness the large desert regions along the coasts of South America, Africa and Arabia. A more important part must be played by the atmospheric circulation.

The coldest place in the world, stated by Prof. Coleman to have escaped glaciation during the Pleistocene, is situated right between the Arctic Ocean and the Sea of Okhotsk, only a short distance from either. The centre of the mighty Antarctic ice-cap is fully 1,500 miles from the encircling chilly ocean, where evaporation cannot surely be large.

According to Antevs the Pleistocene ice-cap was several times larger, but, even assuming with Prof. Coleman that the North American portion was unconnected with those of Europe or the Arctic, that body was still more than two thousand miles across, wholly eccentric to the pole and bounded on the south by a wide strip of continent.

It would seem not unreasonable to argue that during a major glacial period ice could have accumulated in a co-polar position up to at least two thousand miles back from the ocean margin, provided that the atmospheric and oceanic circulations and the solar radiation were favourable.

Applying this to the Permo-Carboniferous epoch, and consulting the reconstruction formerly given by me³, it will be discovered that no part of the great hypothetical ice-cap need have been more than some 1,700 miles from the nearest ocean, the existence of which is indicated by marine deposits, in several cases intercalated in or immediately succeeding the glacials, as mentioned by Prof. Coleman. Such strata were clearly laid down in bays and gulfs penetrating into a low-lying continent or assembly of continents.

There is positive evidence of the successive overlapping of ice-bodies, while it is furthermore unlikely that the entire territories known to have been affected were ever completely ice-covered at one and the same time—precisely as in the case of the Pleistocene glaciation. It is logical to presume—and the geological evidence is in agreement therewith—that the ice started collecting at isolated points, that such bodies increased in size and that the weighting of the continent by snow helped to cause depression and invasion by the sea, with rapid expansion of the ice-caps and their ultimate coalescence. It is unnecessary to suppose that such a continent was pushed polewards for each glaciation and pulled back for each interglacial phase. The observed phenomena could more intelligently be explained by fluctuations in solar radiation, etc. There is internal evidence also to suggest that the Permian coals of Gondwana, unlike the Carboniferous seams of the northern hemisphere, were cold climate interglacial or post-glacial accumulations.

In his monograph², Prof. Coleman has deplored not being able to explain the distribution of past glacial deposits, which suggests that he must have overlooked some vital factor. Others too have failed to interpret such glacial phenomena in terms of existing geographical and meteorological environments.

The hypothesis of drift endeavours to explain the Permo-Carboniferous glacials as formed around the south pole of that period, upon a reassembled

Gondwana, though not centrally thereon, and with adequate oceanic areas at hand for the required evaporation. The principle can furthermore be invoked to account for the still older glacials that, significantly, lie within the very region affected during the Palaeozoic, of which at least five groups of widely different ages are known in southern Africa alone.

Instead of contending that the Permo-Carboniferous glacials could not have been developed upon a single land-mass, as he does, I feel it would be more helpful if Prof. Coleman could show how they could have been laid down at all in the several widely-parted areas in the positions and latitudes which they occupy to-day.

In the various orogenic zones of the earth, for example, in the Appalachian region, hundreds of miles of horizontal sediments have been compressed laterally into a fraction of the space originally occupied by them. When a convincing explanation can be given of how such could have happened, and also what material now fills the corresponding gap in the earth's circumference whence the crumpled-up strata came, an answer should be forthcoming for the elusive mechanism of continental drift.

ALEX. L. DU TOIT.

P.O. Box 4565,
Johannesburg.

¹ NATURE, 142, 998 (1938).

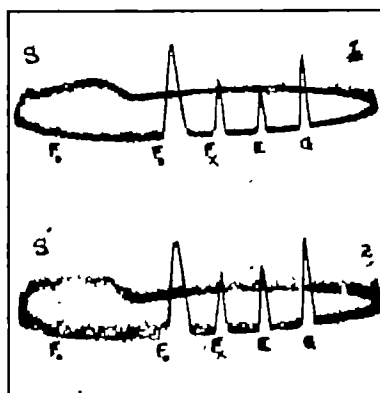
² "Our Wandering Continents". Fig. 9 (1937).

³ "Ice Ages, Recent and Ancient" (1926).

Scattering of Radio Waves in Polar Regions

THE interesting letter by Harang and Stoffregen¹, concerning ionospheric radio wave reflections at Tromsø, prompts the recollection of some observations made by us at the same observatory during the Second International Polar Year, 1932-33, on a type of radio echo which seems peculiar to polar regions.

A reproduction of the radio echo delineation observed at Tromsø using 4.0 Mc./s. waves at 1600 M.E.T. on July 31, 1933, is shown in the



accompanying figure. (In this figure the cathode ray spot provides a time-scale trace by moving around the depicted ellipse in a right-handed fashion.) It will be seen that in addition to echoes from Regions E and F, there is also a distorted echo S with a delay time of 7.5-9.5 milli-seconds, indicating reflection or scattering at a distance of 1,125-1,425 km. from the sending and receiving stations. The special interest of the record, however, arises from the fact that it is

possible in this case to decide whether the echo is due to reflection at vertical incidence or to sideways scattering. Since both first and second order reflections from Region *F* are present, we know that the frequency used is less than the critical penetration value for that region. Moreover, since Region *F* is known to be thick, when measured in terms of a vacuum wave-length, we know that there can only be negligible penetration of the region for frequencies less than the critical value. We can therefore conclude that the echo *S* is due to sideways scattering from some complex ionized centre situated in or below the normal Region *F*, and is not due to reflection from very great heights. In this connexion it may be recalled that Appleton and Piddington³ have shown that the principal scattering centres of the ionosphere are situated at levels between 80 km. and 160 km. above the ground.

E. V. APPLETON.
R. NAISMITH.

Cavendish Laboratory,
Cambridge.
Jan. 6.

¹ *NATURE*, 142, 532 (1938).

² *Proc. Roy. Soc., A*, 164, 467 (1938).

Electric Charge on Soft Hail

IN the course of measurements of the electric current carried down to the earth by precipitation, there have occurred occasions when the results are considered worthy of attention.

On December 19, 1938, during a sharp shower of soft hail (grape), from cumulo-nimbus clouds, the charge brought down to an area of about 1 metre square in the ten-minute period 12.56–13.06 amounted to more than -4.4×10^{-8} coulombs, corresponding to an average current of more than -7.3×10^{-10} amp./cm.². This appears to be a larger precipitation current than has ever been previously observed. Over an area of 1 km.² this amounts to a charge of -44 coulombs in the ten minutes, which may be compared with a value of $+35$ coulombs for the fine-weather current for a whole year, as obtained from the results of Sorase¹.

This particular occasion gave a larger current than in other cases, but there also occurred, on the same and the following day, average currents over a ten-minute period of $+3.8$, $+1.1$, -0.8 (twice), $+0.7$ and -0.7 , as well as many others greater than ± 0.1 , the unit in each case being 10^{-10} amp./cm.²; in addition, there were occasions when the currents were not recorded, and these may have been large currents. In the parts of the earth where such showers are frequent, particularly at high altitudes and in high latitudes, it is probable that the charges brought down to the earth will be very considerable, and will be of much importance in the discussion of the maintenance of the negative charge on the earth's surface. It is therefore desirable that similar measurements should be carried out at such places, if opportunity offers.

J. A. CHALMERS.
E. W. R. LITTLE.

Physics Department,
Science Laboratories,
Durham.

¹ Sorase, F. J., *Geophys. Mem.*, 58 (1933).

Catalytic Exchange of Deuterium and Hydrogen in Hydrocarbons

CATALYTIC interchanges of hydrogen atoms between molecular hydrogen and hydrocarbons of the type $\text{RH} + \text{D}_2 = \text{RD} + \text{HD}$ have already been repeatedly observed¹⁻⁴. The following instances of catalytic exchange seem of special interest as they proceed rather rapidly under mild experimental conditions and give important indications as to the mechanism of exchange reactions in general.

If a mixture of deuterium and cyclohexane or *n*-hexane vapour is brought into contact with a platinized platinum foil (10 mm. $\times$ 10 mm.)⁵, an interchange of hydrogen atoms takes place at the following speeds:

Reaction volume, 78 c.c.; total pressure, 80 mm. mercury.		
Mixture	Temperature ($^{\circ}\text{C}$)	Half-period of exchange (min.)
Cyclohexane-deuterium	57	150
	66	23
	97	11
Hexane-deuterium	55	33
	82	11
	124	3

In each case, the exchange can be followed up until the exchange equilibrium is completely established. Under the given experimental conditions, no chemical change other than exchange occurs. In the case of the cyclohexane, it can be shown that the establishment of the equilibrium $\text{C}_6\text{H}_{12} = \text{C}_6\text{H}_6 + 3\text{H}_2$ cannot account for the observed exchange. The mechanism of these exchange reactions seems to involve the detachment of one hydrogen atom from the hydrocarbon, as was suggested for the exchange reactions of ethylene and benzene². It is most probable that the same mechanism is operative in the exchange reactions of all kinds of saturated and unsaturated hydrocarbons in general.

Finally, it may be mentioned that the present experiments offer a convenient method for the preparation of deuterated hydrocarbons.

L. FARKAS.
A. FARKAS.

Department of Physical Chemistry,
Hebrew University,
Jerusalem.
Jan. 1.

¹ Farkas, Farkas and Rideal, *Proc. Roy. Soc., A*, 145, 630 (1934).

² Horiuti, Ogden and Polanyi, *Trans. Farad. Soc.*, 30, 663 (1934).

³ Morikawa, Benedict and Taylor, *J. Amer. Chem. Soc.*, 58, 1445, 1796 (1936).

⁴ Morikawa, Trenner and Taylor, *J. Amer. Chem. Soc.*, 59, 1103 (1937).

⁵ Farkas and Farkas, *Trans. Farad. Soc.*, 33, 678, 827 (1937).

Availability of Phosphorus in Rice

A LARGE proportion of the phosphorus present in rice, as in all other cereals, exists as the poorly utilizable phytin¹, and to this fact is ascribed the rachitogenic action of cereal diets².

In investigations on the nutritive value of rice varieties³, I observed that the average growth-rates induced in groups of young rats fed solely on the different rice varieties, together with adequate supplements of all the vitamins, were essentially related to their contents of proteins and minerals, particularly phosphorus. In the following test, an attempt was made to determine the growth-promoting qualities of the phosphorus compounds in two varieties of rice

the chemical composition of which, in percentages, is given below :

Variety	Moisture	Protein (N x 6.25)	Bitter ex- tractives	Carbohy- drates	Total minerals	P ₂ O ₅	CaO
Adt. 6	11.2	7.70	2.24	74.8	1.64	1.14	0.09
Adt. 11	12.4	5.77	2.23	77.7	1.23	0.61	0.08

The powdered rice was used for feeding, but in one case (Adt. 11) the rice flour was intimately mixed with 2 per cent of a preparation of rice protein (purity = 94 per cent) so that the protein contents of the two feeds were nearly the same. The rices were then mixed with 5 per cent of a phosphate-free salt mixture composed of calcium lactate (150 parts), magnesium sulphate (30 parts), ferric citrate (12 parts), sodium chloride (10 parts) and potassium chloride (10 parts).

Groups of four young rats were fed on the two diets thus prepared, together with the same supplements of cod liver oil and 'Marmite' extract. The experiment was continued for a period of six weeks. The average weekly growth-rates (increase in weight in grams) were as follows :

Rice	1	2	3	4	5	6
Adt. 6	13.2	12.6	10.8	8.4	7.0	6.2
Adt. 11	9.6	10.4	8.4	6.8	5.4	5.0

In spite of the protein contents having been adjusted to the same level in both the diets, there is observed a definite difference in growth-rate due to the two varieties of rice. This is evidently traceable to the differences in the mineral contents of the grams. Since the salt mixture used contained enough supplements of all the minerals excepting phosphorus, it is reasonable to assume that the better growth induced by Adt. 6 is due to its containing more (about 1.9 times) phosphorus than Adt. 11.

The presence of a phytase in the intestines of the rat⁴ and its possible significance in rendering available the phytin to the animal organism have been indicated, but the evidence is yet inconclusive⁵. The present note would point to the need for further work in this direction.

A. SREHNIIVASAN.

Department of Biochemistry,
Indian Institute of Science,
Bangalore.
Dec. 6.

¹ Bruce, H. M., and Oallow, B. K., *Biochem. J.*, **28**, 517 (1934); Widdowson, H. M., and McCance, R. A., *Biochem. J.*, **29**, 2694 (1935); Lowe, J. T., and Stoenbeck, H., *Biochem. J.*, **30**, 1126 (1936).

² Mellanby, M., *Med. Res. Council, Spec. Repts. Series*, No. 93 (1925); Mellanby, M., *Med. Res. Council, Spec. Repts. Series*, No. 140, chapter v (1929).

³ *Ind. J. Agric. Sci.* (in the Press).

⁴ Patwardhan, V. N., *Biochem. J.*, **31**, 560 (1937).

⁵ Lowe, J. T., and Stoenbeck, H., *Biochem. J.*, **30**, 1991 (1936).

Self-Sterility in *Oenothera*

Oenothera missouriensis is a species with flowers of maximum size. It, and certain related species¹, extend from Missouri through Oklahoma, Texas and adjacent regions in the western States. It differs from ordinary species in being perennial and in developing enormous wings on the fruits. The seeds are also very much larger and fewer. Because of these characters it has been placed by some in a

separate genus, *Megapterium*. Unlike most of the true *Oenotheras*, which have developed catenation of their chromosomes in meiosis, *O. missouriensis* was found to have seven free pairs².

For several years a plant has been grown at the Courtauld Laboratory, Regent's Park, and as it bore

no fruits nor seeds efforts have been made every year to obtain seeds by selfing the flowers by hand. Not a single flower, however, set seed, whether hand pollinated or not, although a large number of flowers bloomed every year. This finally led to the conclusion that the species was probably self-sterile. Last summer this was confirmed by pollinating the flowers from a strain grown at the Merton Laboratory. Four flowers were cross-pollinated and they all showed a good setting of seeds.

Some strains of the species have round red spots on the sepals, and this was true of the Regent's Park plant, while the sepals of the plant from Merton were devoid of the red spots. Certain other differences were also observed, the inheritance of which will be studied.

It thus appears that while the subgenus *Onagra* has developed chromosome catenation as a mechanism for maintaining a heterozygous condition in its species, the subgenus *Megapterium* has produced the same result by developing a mechanism of self-sterility.

R. RUGGLES GATES.

King's College,
London.
Jan. 26.

¹ *Ann. Missouri Bot. Gard.*, **1**, 401-404 (1914).

² Hedleyetullah, S., 'Meiosis in *Oenothera missouriensis*', *Proc. Roy. Soc., B*, **113**, 57-70 (1933).

Induction of Polyploidy in Chilli (*Capsicum annum* L.) by Colchicine

THE discovery by Blakelee¹ in 1937 that treatment with colchicine induces doubling of chromosomes in plant cells, leading to the production of polyploids, is of practical importance to the breeder who is faced with the problem of sterility in hybrids from wide crosses, arising from the different material constitution of the chromosomes of the parents. Except in those cases where sexual propagation made possible their utilization, it has not hitherto been possible to take full advantage of such crosses. The results of experiments so far carried out with colchicine, although mostly of a preliminary nature, have raised hopes of producing vigorous fertile forms from sterile hybrids, and several workers, notably Dermen² (1938), Nebel and Ruttle³ (1938), Levan⁴ (1938) and Kostoff⁵ (1938), have repeated the experiments of Blakelee and reported favourably regarding the efficacy of this alkaloid in producing polyploids.

The study of the effects of this chemical on several economic species of plants has been undertaken and a preliminary account of results obtained with chilli is here reported. Seeds were immersed in 0.05 per cent, 0.1 per cent, 0.2 per cent and 0.4 per cent solutions of colchicine in water for 1, 2, 4, 6 and 8 days and planted in the field with controls. While the control plants were normal in growth and flowered almost at the same time, some of the treated plants showed various degrees of abnormality of growth in the early stages such as roughening and

thickening of the leaves, fasciation of stems and other vegetative organs and doubling of flowers. These were generally slow growing, developed broad and succulent leaves and flowered later than the controls and had varying percentages of sterile pollen, the fertile pollen being nearly double the volume of the pollen of normal plants. The seed setting was considerably reduced in such plants as compared with the normal plants. The abnormal plants on examination by aceto-carminic smears of pollen mother cells proved to be tetraploids. Polyploids of higher order than tetraploids was not observed although 2n and 4n tissue was found to occur in the same plant in some cases. The accompanying table gives the number of diploids and tetraploids occurring in the different treatments.

Strength of aqueous solution of colchicine	0.05 per cent			0.1 per cent			0.2 per cent			0.4 per cent		
Period of immersion of seed in colchicine	Diploids	Polyploids	Per cent of Polyploids	Diploids	Polyploids	Per cent of Polyploids	Diploids	Polyploids	Per cent of Polyploids	Diploids	Polyploids	Per cent of Polyploids
1 day ..	27	2	6.9	20	1	4.8	4	11	73.3	4	6	60.0
2 days ..	19	4	17.4	20	3	15.0	5	11	68.8	2	5	71.4
4 days ..	5	3	37.5	5	2	29.6	1	4	80.0	1	—	—
6 days ..	16	3	15.8	8	4	33.3	2	2	50.0	4	4	50.0
8 days ..	9	4	30.8	4	6	60.0	7	1	12.5	2	1	33.3

Besides the tetraploids, one triploid was also identified among the treated plants. It is at present not possible to say if this arose spontaneously or as a result of the treatment. In addition to polyploids, we have isolated a few diploids among the treated plants showing meiotic irregularities leading to the formation of sterile pollen. A further account of these and the tetraploids will be reported elsewhere.

B. P. PAL.

S. RAMANUJAM.

Imperial Agricultural Research Institute,
New Delhi.
Dec. 13.

¹ Blakelee, A. F., and Avery, A. G., *J. Hered.*, **28**, 393-412 (1937).

² Derrnen, H., *J. Hered.*, **29**, 211-229 (1938).

³ Nebel, B. B., and Buttle, M. L., *J. Hered.*, **29**, 3-9 (1938).

⁴ Levay, A., *Heredities*, **24**, 471-486 (1938).

⁵ Kostoff, D., *Curr. Sci.*, **6**, 549-552 (1938).

Period of Gestation of *Loris*

In a recent communication¹, Dr. W. C. O. Hill suggests from certain evidence that "the gestation period [in *Loris*] is somewhere in the neighbourhood of six months". The following history of a pair of lorises will be of interest, and confirms Dr. Hill's opinion.

Lorises had not been found in Ceylon above about 3,000 ft., where a race occurs differing from the common low-country loris in a few details: it has been named *L. tardigradus grandis*. In May 1937, Mr. A. O. Tutien-Nolthenius sent me two large lorises which had been caught on his estate near the Horton Plains at a height of between 5,000 ft. and 6,000 ft. They are robustly built and have very thick and long fur, and may be considered an extreme type of *L. t. grandis*. These were kept in a large cage (8 ft. square), and in June I introduced into the cage for the purpose of comparison a male which had been caught at 3,000 ft. This male happened to be 'in season', and fighting took place between the two males, so that I was obliged to remove the one newly introduced. I noticed the next day that the

high-country male had come 'into season'. It may have been stimulated by the presence of the other male. I am familiar with two sounds made by lorises, the first is a hissing sound made when they are quarrelling or frightened, and the second is a low oall which can be heard from a much greater distance. On the night of June 23, I heard sounds coming from the cage; these so closely resembled mewling that I thought a kitten was in or on the cage, but on investigation I found that the lorises were mating, and both were emitting the mewling sound. They have been carefully watched from that date. The male has not come 'into season' again. On December 14 the female gave birth. Therefore the period of gestation was 174 days, which is about one week short of six calendar months.

The young loris is about the size of a half-grown mouse; and it is carried about clinging to the hair of the mother's abdomen.

Institute of Bacteriology,
Colombo, Ceylon.
Dec. 20.

LUCIUS NICHOLLS.

¹ *NATURE*, **138**, 107 (1935).

The 'Thumb' of the Giant Panda

THAT Mr. Pocock (see *NATURE*, Feb. 4, p. 206) finds the radial sesamoid and the palmar pad that covers it are "capable of only slight movement" in the dead specimen may perhaps be explained in part by the rigidity of the tissues in the undissected cadaver. For most certainly, during the progress of dissection, a very high degree of mobility is demonstrated; and even in the bones themselves, the same fact is attested to in the large, bevelled cartilage-covered joint surface between the scapholunar and the sesamoid.

Moreover, Mr. Pocock overlooks the most interesting facts in this remarkable adaptation—that powerful muscles inserted to the mobile thumb in normal mammals are, in the giant panda, inserted to the mobile sesamoid, while thumb muscles arising from the fixed trapezium in normal mammals are here transferred to the mobile sesamoid. The whole muscular and articular adaptation is towards the end of producing movements of the sesamoid, and of its free mobility there can be no question.

When Mr. Pocock declares the mechanism in the panda to be "exactly comparable to that produced by bringing the tips of the first and second fingers on to the ball of the thumb in the human hand", he is stating an obvious truth; but he seems to overlook the fact that, like the panda's radial sesamoid, the metacarpal of the human thumb is also mobile.

The University,
Manchester, 13.
Feb. 3.

F. WOOD JONES.

Electrified Motor-Vehicles

WHILE to experience an electric shock from a motor-vehicle appears from a recent note to be unusual in England¹, it is so common in the United States as to call for no comment. An interesting consequence of this phenomenon is to be seen on the San Francisco-Oakland and Golden Gate Bridges, where thousands of cars a day pass the toll gates and where the continuous small shocks suffered by receivers of toll on touching coins handed to them by drivers of cars have proved very unpleasant. Wire brushes standing about one foot high have accordingly been installed immediately before all toll gates so that cars as they approach are relieved of their accumulated charges. In at least one toll station in this country a jet of water is sprayed on the wheels of approaching cars for the same purpose.

In many States and municipalities there is a law

compelling vehicles carrying petrol and similar inflammable products to drag chain behind them in order to discharge continuously any electrostatic charge of the vehicle. On a dark night I have seen a continuous glow coming from such chains dragging over asphalt roads, quite different in appearance from sparks which might be produced by striking stones. In the State of Massachusetts, however, I understand there is a law prohibiting drag chains on the grounds that the frictional or electrical sparks so generated might ignite a leaky truck.

E. C. WILLIAMS.

Shell Development Company,
Fifty-third Street,
Emeryville,
California.
Dec. 27.

¹ NATURE, 142, 713 (1938).

Points from Foregoing Letters

FOLLOWING upon Hahn and Strassmann's observation that isotopes of barium are probably formed when uranium is bombarded with neutrons, Prof. Lise Meitner and Dr. O. R. Frisch discuss a new type of nuclear reaction in which a heavy atomic nucleus after taking up a neutron splits into two roughly equal nuclei, very much as a drop of water breaks into two when its size is large and its surface tension is low. In the case of uranium, if one of the new atoms formed is barium the other will be krypton. Thorium apparently breaks up into barium and lanthanum isotopes.

A new thermostatic arrangement for keeping apparatus at constant temperature within 0.002° C. without the necessity of careful insulation or surrounding with a circulating liquid, is described by Prof. T. H. Laby and V. D. Hopper.

Sir Joseph Larmor points out that the tensor scheme of relativity cannot by itself deal with the relation of an asymmetrical object to its mirror image. To be effective for this purpose, the mobile measuring rod of Einstein would have to possess a screw structure essential to it.

By applying a suitable canonical transformation to a system consisting of nuclear particles and a meson field, and by assuming an interaction between the meson field and electrons and neutrinos, Dr. O. Møller and Prof. L. Rosenfeld arrive at a transformed Hamiltonian containing a term which gives the probabilities of beta-disintegration processes. The introduction of a pseudoscalar wave function, in addition to the four-vector one, offers the possibility of a better adaptation to the experimental results.

Dr. Harold Jeffreys, in reply to Dr. W. Edwards Deming, maintains that the notion of reasonable degree of belief is implicit in every application of the theory of probability, and that the frequency definition, though designed to avoid this notion, in fact fails to do so in actual application.

Commenting on Prof. Coleman's contention that the late Palaeozoic glacials of the southern hemisphere would have necessitated the presence of relatively warm seas in the neighbourhood, Dr. A. L. du Toit states that conditions of oceanic and atmospheric circulation and solar radiation are more important for the formation of an extensive ice-cap than nearness to warm water, and that the hypothesis of a

south polar drift of the Permo-Carboniferous Gondwanaland is not invalidated.

Prof. E. V. Appleton and R. Naismith describe the reception of a medium-delay radio echo at Tromsø during the International Polar Year 1932-33, under ionospheric conditions such that it was possible to interpret the results as due to lateral scattering from a complex ionized centre at a considerable distance, and not to reflection at a very great height above the ground.

Dr. J. A. Chalmers and E. W. R. Little report a measurement of an average precipitation current for a period of ten minutes of more than -7.3×10^{-12} amp./cm.², during a shower of soft hail. This exceeds the vertical fine-weather current for a whole year.

Prof. L. Farkas and A. Farkas find a fairly rapid rate of exchange between the hydrogen atoms in the molecule of hexane (or cyclohexane) and deuterium, when a gaseous mixture of the two is brought in contact with platinized platinum foil.

In experiments on the growth of young rats fed on two varieties of rice, adjusted to the same protein content, but differing widely in regard to their phosphorus contents, Dr. A. Sreenivasan finds that the growth rate is greater with the variety of rice containing the larger percentage of phosphorus.

A variety of *Oenothera missouriensis* grown at the Courtauld Laboratory, Regent's Park, London, has been found to be sterile when self-pollinated. The plant has seven free pairs of chromosomes, and Prof. R. R. Gates suggests that it has developed a mechanism of self-sterility in order to maintain a heterozygous condition.

By immersing seeds of chilli (*Capsicum annum*) in solutions of colchicine of various concentrations, Drs. B. P. Pal and Dr. S. Ramanujam have obtained plants with increased number of chromosomes (tetraploids and one triploid) showing abnormality of growth (thicker leaves, fasciation of stem, doubling of flowers).

Dr. Lucius Nicholls records the mating of a pair of lorises in captivity. They had been caught in the hills of Ceylon at a height of between 5,000 ft. and 6,000 ft. They made a curious mewing sound whilst mating. A living young one was born 174 days after mating had taken place.

Research Items

Diet of Serbian Gypsies

IN Serbia it is known that gypsies feed on carrion, and a number of instances of their addiction to the flesh of animals, which have not been slain for food, but have died a natural death or from disease, have been collected by Dr. Alexander Petrovič in a further contribution to his studies of the gypsies of Serbia (*J. Gypsy Lore Soc.*, Ser. 3, 18, 1; 1939). This is a matter of preference, as it occurs even among the more well-to-do. Mirijevo, a village near Belgrade, where there are some twenty gypsy families whose material condition is comparatively good, is renowned for the fact that its gypsies eat carrion. When a peasant has a sow or hog or an ox that has died of some disease, he buries it in a piece of ground near the road. Someone will then inform the gypsies of the fact, and they will pay a small sum for the information. Then at night two or three will go to the spot indicated, dig up the carcass, and carry it home. At Rakovica, also near Belgrade, when there was a serious pestilence among the sheep in 1937 the peasants were at their wits' end to know what they should do with the dead sheep. Some were buried, others thrown into the fields and meadows. Gypsies from Ripanj, an outlying village, used to come at night, dig up the carcasses, and carry them away. Dead horses are also dug up and their hides, and sometimes the meat as well, are sold; but a gypsy never eats horseflesh, because the horse is a friend of the gypsies and is considered more or less a member of the family. Some of the poorer gypsies eat carrion meat without special preparation; but others prepare it by washing, soaking with nettles or garlic, and boiling until the smell has gone. Sedentary gypsies eat carrion meat only when with gypsies who prepare it in this way. It is then said, however, to be tasteless; while those who express preference for the flesh of animals that have died, say that it is on account of its flavour, which is superior to that of slain meat. Whether the sense of smell among gypsies is deficient is neither clear nor easy to ascertain. Their vocabulary, though not decisive one way or the other, suggests that they do not discriminate very decidedly between smells, good or bad.

Race, Religion and Caste in India

IN the course of a study of the racial affiliations of religion and caste in India, Rai Bahadur Sarat Chandra Roy considers the probable contribution to the formation of caste of the Alpine and Mongol racial elements in the population (*Man in India*, 18, 2-3, 1938). One section of the Alpines appears to have entered India by way of the Pamir plateau and the Hindu Kush in the Chalcolithic period. At the present time the modern Asiatic representatives of the race are found in this region in their greatest purity, and the race is also the dominant element in the Khotanese. Neither among these nor among the European Alpines is there found anything resembling the caste system as it is known in India. In central Asia this is not due to the influence of Islam; for the Tajiks of Kashgar, for example, retain customs and beliefs derived from Pre-Islamic times, which are

not approved by Islam. Even class sentiment neither determines occupation nor prevents inter-marriage between different social grades. Among European Alpines, tribal feeling is still, or was until recently, strong among Balloon peoples; and some have bird names. There is also evidence of bird names among the people of Bengal and the Prabhus of Bombay Presidency, who contain a strong brachycephalic element. In comparatively early times Aryans visiting famous places of pilgrimage in Bengal, Gujarat, Anga and Kalinga, presumably of Alpine or pre-Aryan origin, were required to undergo an expiatory ceremony. Although Indian representatives of the Alpines, such as the Bengalis, Gujrātis and Mārāṭas have long adopted the Hindu caste system, they are not as rigid in observance as, for example, the Dravidian Hindus of the south. Buddhism with its doctrine of equality was especially strong in Bengal and among Gujrātis, as also were Vaishnavism and Jainism. The first historical king of Bengal, Gopala Deva, was elected by the people, and the Mārāṭas have an equally democratic spirit. Modern movements for social and religious reform have been initiated and developed for the most part by men of the Indo-Alpine race; but they appear to have contributed little to the formation of the complex caste system.

Growth of Tissues in Vitro

O. A. TROWELL and E. N. WILLMER (*J. Exp. Biol.*, 16, 60; 1939) made tissue extracts from several organs of growing and adult fowls and tested the growth-promoting properties of these extracts on periosteal fibroblasts growing *in vitro*. They found that these properties were most pronounced in brain extract and diminished in the following sequence—thyroid, thymus, testis, ovary, bone-marrow, liver, kidney and muscle extracts. Extracts made from the spleens of adult cocks were far more efficient growth-promoting agents than extracts made from the spleen of young birds. The growth-promoting power of a tissue extract could not always be correlated with the age of the tissue from which the extract was made, with the rate of growth of that tissue or with its nuclear content.

Rat Fleas in Plymouth

R. B. MAYFIELD (*Parasitology*, 30, 314; 1938) investigated the species and numbers of fleas harboured by rats in a certain section of the Plymouth docks, and also examined a few rats from the town of Plymouth. The total number of rats investigated was 83. Of 77 rats caught in the dock premises, 63 were examples of *Rattus norvegicus* and 14 of *Rattus rattus* which were found to harbour three species of fleas, namely, *Nosopsyllus* (*Ceratophyllus*) *fasciatus*, *Xenopsylla cheopis* and *Leptopsylla segnis* (*musculi*). The presence of *Xenopsylla cheopis* was almost entirely confined to a certain grain store. Four specimens of *Rattus norvegicus* and two of *Rattus rattus* were caught in the town of Plymouth and yielded 32 specimens of *Nosopsyllus fasciatus* and 3 of *Leptopsylla segnis* but no *Xenopsylla cheopis*.

Bird Fauna of a Rocky Island

THE aptitude of some animals to make use of the most unpromising conditions is shown by a short account of the birds of Malpelo Island by James Bond and Randolph Meyer de Schauensee (*Proc. Acad. Nat. Sci. Philadelphia*, 90, 155; 1938). The island is a bleak pinnacle of volcanic rock, 330 miles from the mainland of Columbia; the upper plateau presents "one of the most barren, bleak expanses of rock I have ever seen. Not a single plant living or dead was to be found", says one of the authors; the only vegetation the survey revealed was on a steep cliff about 200 ft. high, where there was a moss and a grass growing from the damp crevices. Yet here was found a small fauna of ten species of birds. Most of them were sea-birds, which depended upon the surrounding ocean to supply them with food—a booby, a small colony of frigate birds, a colony of thirty gulls, and two species of terns. But there were waders, ten spotted sandpipers in company with about twenty-five wandering tattlers (*Heteroscolus incanus*), a duck hawk, and more remarkable still, a martin (*Progne* sp.) and barn swallows which were apparently inhabiting a cave. The latter birds must have been subsisting upon some sort of insect life; it would be of great interest to know the complete fauna of this isolated and barren island. The visit was made on February 8, 1937.

Census of Californian Sea-Lions

COMPLAINTS have been made by commercial and sport fishermen that the sea-lions of California cause inordinate damage to fish stocks and to fishing gear, and that the destruction is increasing with a numerical increase in the seal colonies. It was thought possible that the Californian population had been increased on account of the migration northwards of Mexican individuals, following upon the activities of a company engaged there in killing and canning seal flesh for cat and dog food. To test these suppositions, a census of the seal rookeries was carried out between June 18 and 26, 1938 (*California Fish and Game*, 24, 415; 1938). This census did not reveal any great change in the sea-lion population. During the last census, in 1936, Steller's sea-lion (*Eumetopias stelleri*) had a total population of 4,900, in 1938 it was 5,841; while the corresponding figures for the other species, the Californian sea-lion (*Zalophus californianus*) were 2,501 and 2,020. Indeed, the five counts carried out from 1927 to 1938 show that the sea-lions have remained about the same numerical level, for although the trimming hunters have ceased to kill the adult bulls and the State law protects the animals, a good many are still slaughtered annually by 'sportmen' and fishermen. Natural mortality is heavy, not more than 50 per cent of any year's crop of pups reaching the age of one year, while the death-rate amongst adults is also comparatively high; so that the present birth-rate seems about to balance the death-rate. The conclusion of the authors, Paul Bonnot, G. H. Clark and S. Ross Hatton, is that for the present there seems to be no reason for reducing their numbers.

Host Selection in a Chalcid Wasp

D. C. LLOYD, of the Farnham House Laboratory, Imperial Institute of Entomology, describes his attempts to determine those factors that are involved

in the selection of hosts by the chalcid *Ooencyrtus lucanice* (How.) (*Phil. Trans. Roy. Soc., B*, 227, Dec. 1938). He also describes observations made on the distribution of the eggs in a restricted environment (Petri dishes) such as when the chalcid is kept in immediate contact with the host (eggs of the gypsy moth) in which it lays its eggs. It is shown that egg-laying by this parasite is not at random but has reference to the nature of the host available. Usually the female selects unparasitized hosts. If she is forced to superparasitize, she selects those host-eggs containing the youngest parasites. If only parasitized hosts are available the female parasites tend to retain their eggs rather than deposit them. It is concluded that the oviposition response is to a perceptual complex of stimuli which is such that the female insect tends to select those hosts in which the progeny are able to develop.

Post-Glacial History of Fenland Vegetation

A SERIES of sections and bores throughout southern Fenland show a stratigraphical sequence of lower peat, fen clay and upper peat to occur regularly over the entire area. Past ecological and climatic changes reflected in this succession have formed the subject of an investigation by H. Godwin and M. H. Clifford (*Phil. Trans. Roy. Soc., B*, 229; Dec. 1938). Tree remains are abundant in the lower peat. At Woodwalton Fen this peat formation apparently led to the destruction of pre-existing oakwoods on clay giving rise to, at first, open water or alder brushwood, passing gradually into drier fen woods with oak, birch and pine. The clay bed separating the peats is shown by foraminiferal and diatom analysis to have been laid down in brackish water and hence represents a marine transgression. A freshwater phase developed later with extensive development of *Sphagnum-Eriophorum-Calluna* peat and the formation of raised bogs which were locally submerged later by the formation of meres in which calcareous lake marl was deposited over the acidic *Sphagnum* peat. The correlation of the vegetation phases with archaeological and climatic horizons leads the authors to date the general formation of peat in the fens in the Atlantic period. They became wooded in the Neolithic period and the marine transgression which gave rise to the fen clay occurred at the end of the Neolithic period. The raised bogs were developed during the Bronze and Iron Ages. A second marine transgression occurred in Romano-British times. This gave rise to a layer of semi-marine silt which overlies the upper peat on the seaward side of the fens and along the courses of the estuaries. There were human settlements upon the silt whilst it was forming, and its present surface shows the remains of dense occupation. The great meres of the Fenland probably formed either in the Iron Age or the Romano-British period.

Greenland Plankton

THE Godthaab Expedition visited the waters west of Greenland in 1928, and extensive plankton samples were taken and associated with hydrographic work. The collector, Gunnar Seidenfaden, gives an account of the work of collecting, and his experience of the inadequacies of his equipment should be of value for guidance of future expeditions. The material collected has been worked over and described by

Jul. Grøntved, who has collaborated with Seidenfaden in the account of the distribution of plankton (*Meddelelser om Grønland*, 82; 1938). Previous records of plankton from 1850 onwards for the region are discussed and incorporated in the distribution maps for the species, now greatly extended through this expedition, especially in the more northern waters, and this volume forms an extremely useful basis, upon which more detailed knowledge may be built up. The samples include surface collections, and a considerable number of depth samples, especially down to about 100 m.; the species fall mainly into the groups Diatomae, Peridinae, Flagellate, Ciliatae. (Chlorophyceae were not observed in the material.) The Grinnell Expedition, 1850-51, collected a sample of 'red snow', and it is of interest that this appears to have been from Crimson Cliff, near Cape York, which again on this present expedition showed the same phenomenon. This well-known locality for 'red snow' is due to perennating snow flats, near bird-cliffs, which supply the nutriment for the organism.

Moisture in Wood

A BROCHURE entitled "Recent Work on Moisture in Wood" by W. W. Barkas, issued for the Forest Products Research Laboratory (H.M. Stationery Office, 1938), summarizes the results of recent research undertaken by the Physics Section. The objects of the study were the mode of retention of water by wood, and the part which this water plays in determining the strength and shrinkage of the material. The main conclusions arrived at are (1) the differentiation between the molecular and capillary water held in the cell wall, (2) the demonstration that the water in the cell cavities cannot be sharply differentiated from the capillary water in the cell walls, (3) the proof that strength, shrinkage and vapour pressure changes begin in the wood as soon as it is dried below the waterlogged moisture content, (4) the evidence put forward that wood reacts identically under externally applied loads and under internal shrinkage forces.

Clover Creek Earthquake of July 15, 1938

THIS earthquake was worthy of particular study by H. Landsberg (*Bull. Seis. Soc. Amer.*, 28, No. 4, Oct. 1938) since earthquakes in the Appalachian region of the United States are singularly infrequent. The shock occurred at 5.45 p.m. E.S.T. (22.45 G.C.T.) in Pennsylvania in an area known as Morrison's Cove, a limestone valley between the Tussey Mountains in the east and the Dunning, Short, Loop, and Look Mountains in the west; in the north the boundary is the Juniata River. The shock was not recorded by seismographs and was probably tectonic in origin, though a 'cave-in' is not an impossible hypothesis. From macroseismic evidence collected by the author and the U.S. Coast and Geodetic Survey, the author was able to construct a map and indicate intensities on the modified Mercalli scale, thus making the epicentre known. For the purpose of estimating the focal depth, H. Neuberger (*ibid.*, p. 259) developed the new formula

$$h = \frac{sR_n^2}{4.6 \log \frac{I_0}{I_n}} - \frac{1.15}{s} \log \frac{I_c}{I_n}$$

where h is the depth of focus in kilometres; s an absorption coefficient; R_n the radius of an area within an isoseist n ; I_0 the Mercalli intensity of the shock in the epicentre; I_n the Mercalli intensity at the isoseist n . Microseismically in the district in question $S = 0.1$, and hence the focal depth was between 0 and 7.5 km.

Oxidation of Carbon Disulphide

IN A study of the non-explosive catalytic oxidation of carbon disulphide vapour in dilute mixture with air, R. H. Griffith and S. G. Hill (*J. Chem. Soc.*, 2037; 1938) made the interesting observation that at about 140° in the glass tube oxidation occurred with simultaneous production of ozone. This is probably due to the presence of atomic oxygen. The yield is fairly small, about 0.5 mgm. of ozone per hour with 65 mgm. of carbon disulphide; but the ozone can be detected by the smell and gives characteristic reactions. This homogeneous reaction is difficult to suppress, but this can be done by adding small amounts of ethylene, when the heterogeneous reaction with nickel sulphide as catalyst can be followed and is found to be of zero order with respect to carbon disulphide. Carbonyl sulphide (COS) was also studied and was found not to undergo homogeneous oxidation so readily and no difficulty was found in following the heterogeneous reaction alone, which was found to be of the first order with respect to carbonyl sulphide but to be retarded by sulphur dioxide. The same authors have previously (*J. Chem. Soc.*, 717; 1938) described the preparation of the catalyst of nickel subsulphide, Ni_3S_2 , from finely divided metallic nickel by the action of carbon disulphide vapour carried in nitrogen at 350°, and have investigated its use in the catalytic hydrogenation of carbon disulphide, carbonyl sulphide, mercaptan and sulphur dioxide, the work being extended by B. Crawley and R. H. Griffith (*J. Chem. Soc.*, 720; 1938).

Nuclear Physics

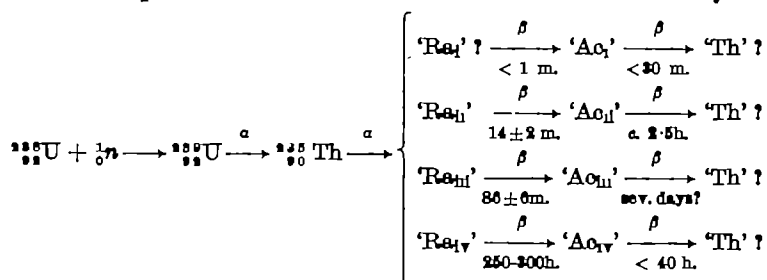
THE issue of the *Review of Scientific Instruments* of December 1938 devotes eighteen pages of its Physics Forum to a review of progress during the past year by T. H. Osgood of the University of Toledo, Ohio. In the section devoted to nuclear physics the author shows how the study of the products of the bombardment of elements by fast neutrons has led to the discovery of isomeric forms of the same nucleus and he points out the value of the "evaporation" theory of the nucleus, according to which an energetic particle injected into the nucleus shares its energy rapidly amongst the components of the nucleus, which remains in an excited state until a chance accession of energy by a particle leads to its evaporation from the nucleus. Progress in mapping energy-levels has been facilitated by the study of resonance effects when the injected particle has some particular energy. The production of controlled beams of particles has been assisted by placing the electrostatic generators in air at 6 or 7 atmospheres and in this way producing several million volts in a small space. Important results are expected from the new method of producing slow neutrons by the intermittent action of cyclotrons, particularly when the number of instruments is increased by the completion of those now under construction in various centres.

Isotopes of the Alkaline Earth Metals from Uranium

DURING the last two years, the bombardment of uranium by neutrons has led to some striking results, due primarily to the combined efforts of Prof. O. Hahn, L. Meitner and F. Strassmann, working in the Kaiser Wilhelm Institute of Chemistry in Berlin-Dahlem. In addition to *three* artificial isotopes of uranium, they have succeeded in establishing the existence of *six* trans-uranium elements of atomic numbers 93-98, and the existence of a seventh trans-uranium element (half-value period = 60 days) is indicated.

In similar experiments, I. Curie and P. Savitch obtained evidence of the production of a substance with a half-value period of $3\frac{1}{2}$ hours. The identity of this substance is uncertain, and although the authors have considered several possibilities, none of them is very satisfactory. Recent experiments on the chemical properties of the trans-uranium elements have led O. Hahn and F. Strassmann (*Naturwissenschaften*, 26, 755, Nov. 18, 1938; and 27, 11, Jan. 6, 1939) to look for this substance (half-value period = $3\frac{1}{2}$ hours), and they have been successful in obtaining it by the same methods as those used by the French workers. Their investigations have led to remarkable results which are summarized in what follows.

The bombardment of uranium with neutrons apparently resulted in the production of *four isomeric isotopes of 'radium'*, which must have arisen by two successive α -ray transformations via thorium. These four 'radium' isotopes emit β -rays and yield four isomeric isotopes of 'actinium', which, in their turn, by further emission of β -rays, presumably give rise to four isotopes of 'thorium', but details of these last products are still incompletely known. The results so far obtained may be represented provisionally by the following scheme, in which the nature of the radiations emitted and the revised half-value periods of the new products are indicated.



Should this scheme adequately represent the facts, these twelve new substances should have atomic weights of value 231, and since a natural thorium isotope (UY) of atomic weight 231 and half-value period 25 hours is already known, it will be of interest to investigate whether one of the four 'thorium' isotopes is identical with UY.

Hahn and Strassmann believe that the substance found by Curie and Savitch is a mixture of the above-mentioned isotopes, each of which has been individually detected and chemically examined. Moreover, the properties of such a mixture would agree with those of the substance detected by the latter authors, who suspect that their substance also contains others of longer life, but of unknown genesis.

An interesting feature of this work is that the production of the new isotopes is enhanced by the use of *slow* neutrons, and the α -particle disintegrations indicated in the earlier stages of the process are believed to be the first instances of α -particle emission effected by *slow* neutrons. It is, of course, possible that the quadruplicity of isotopes resulting from the bombardment of uranium by neutrons takes place in ${}^{238}_{92}\text{U}$, as in the case of the trans-uranium elements, and the intermediate 'thorium' isotope ${}^{235}_{90}\text{Th}$ may also possess four half-value periods.

In the second of their publications mentioned above, Hahn and Strassmann give particulars of the chemical methods employed in establishing their results, as well as a number of activity curves from which some of the half-value periods have been derived. In order to establish beyond question the chemical nature of the products they have designated 'radium' isotopes, which were separated with barium, the authors carried out fractional crystallizations and precipitations with the active barium salts, by the method used for altering the concentration of radium in salts of barium containing radium.

As is well known, crystals richer in radium can be obtained by fractional crystallization of the chloride, bromide or chromate of barium, when it contains radium. In experiments on these lines, carried out by Hahn and Strassmann with their active barium preparations from which disintegration products had been removed, negative results were always obtained, that is, the activity was uniformly distributed amongst the various barium fractions, whereas control experiments with barium containing the radium isotopes ThX and MeTh_1 yielded results conforming to those obtained when the barium contains ordinary radium. In a further experiment, in which ' Ra_{IV} ' and MeTh_1 were mixed with barium and then subjected to fractional crystallization, only the MeTh_1 was concentrated in the process.

The authors conclude from these results that their 'radium' isotopes have the properties of barium, and that, from the chemical point of view, other elements being excluded, these active substances must be regarded as consisting not of radium but of *barium*. This conclusion has been confirmed by further indicator experiments, according to a personal communication from one of the authors (O.H.).

Hahn and Strassmann have also subjected a mixture of their ' Ac_I ' and the actinium isotope MeTh_1 with lanthanum oxalate to fractionation from a nitric acid solution. At the end of the process a gain in concentration of MeTh_1 was achieved, but no increase in the concentration of ' Ac_I ' was noted. From this they conclude that the substances generated by β -ray emission from their alkaline-earth products are not isotopes of actinium, a conclusion which agrees with that of Curie and Savitch for their composite product of half-value period $3\frac{1}{2}$ hours. In all probability they will prove to be isotopes of *lanthanum*. The products designated 'Th' in the above scheme of disintegration, which constitute the final members of the series

derived from the 'Ac-La' preparations, have not yet been tested for their identity with cerium.

On the strength of the chemical evidence, it is difficult to avoid the conclusion that the elements denoted by the symbol 'Ba' in the above-mentioned disintegration scheme should in reality be designated 'Ba', and so far as the evidence has gone it seems

probable that the succeeding elements 'Ac' and 'Th' will prove to be 'La' and 'Ce' respectively. It is as though, at some stage in the process resulting from the bombardment of uranium by neutrons, a 'collapse' of the nucleus occurs, giving rise to the four active isomeric alkaline-earth elements and the succeeding 'lanthanum' and 'cerium' products. The investigations are being continued. R. W. L.

Subspecies and Varieties

A DISCUSSION dealing with subspecies and varieties was held at the meeting of the Linnean Society on February 2. This discussion had been arranged at the request of the Association for the Study of Systematics in Relation to General Biology in order to obtain information as to the views and principles governing the practice of systematists in various groups of animals and plants. It was apparent from the discussion that systematists are generally dissatisfied with the existing state of affairs. As was to be expected, little or no attention is paid to infra-specific categories in the less-known groups of both plant and animal kingdoms; but where the broader taxonomic outlines are well understood there is considerable divergence in systematic practices according to the amount of genetical, cytological and ecological work that has been done. In vertebrates, only a single infra-specific category, the 'subspecies', is generally recognized, but in entomology and botany there are others. How many there may be and their status in the taxonomic scheme are matters of dispute, and there is a disturbing confusion in the terminology applied to them. In this connexion, it may be mentioned that the Association is compiling a list of the various terms which have been used. Almost all the speakers stressed the need for more experimental work from the genetical, cytological, physiological and ecological aspects.

In opening the discussion, Mr. M. A. C. Hinton described the practice of mammalogists, who, in recent years, have used the term 'subspecies' to express stages or trends in geographical variation; they are sections of what Dr. Julian Huxley has called 'clines' (NATURE, 142, 219; 1938). One principle generally accepted is that no two races of the same species can ever be found on the same ground, though exceptionally two such forms may meet after very different histories and journeys and continue to exist side by side without fusing. The principle that, unless intergradation can be demonstrated, differences, however trivial, indicate specific separation, has some theoretical support. In practice, however, it has disadvantages, especially in dealing with insular forms, and tends to mask that most interesting and instructive phenomenon, discontinuous distribution.

The definition of subspecies is an essential part of any intensive analysis of the facts of variation and distribution, and is particularly valuable in paleontology, by preventing loose identifications and consequent faulty geological deductions. It is hoped soon to commence large-scale experiments to test the values and permanence of subspecific characters and to obtain more definite information on subjects concerning which surmise alone is at present possible.

Dr. W. B. Turrill emphasized that all taxonomic categories are matters of scientific convenience based on abstractions from a continuous evolution. He recognizes that for little-known floras it is undesirable to analyse below the species level; but urged that in relatively well-studied floras the need is for intensive studies of infra-specific variation from every angle. His own researches have led him to the conclusion that taxonomic categories intergrade completely. He suggested that the term 'variety' should be used for every phenotype which is the expression of a different genotype, and that the term subspecies should be used only when a species is in process of breaking up into new ones. Names should be given to infra-specific groups only to serve some definite purpose, and in highly polymorphic species symbols might be used instead. Apomicts should receive distinct treatment.

Mr. A. J. Wilmott pointed out that confusion results from using the words species, subspecies and variety both for categories of variation in Nature and groups of different rank in the nomenclatural system. He suggested that the terms 'binome' and 'trinome' might be substituted for species and subspecies in the nomenclatural sense, leaving the latter free for application to categories of variation. True subspecies are parts of the present time section of a lineage which has become branched by isolation, but the branches of which are not yet completely separated. Varieties, on the other hand, are in a different category, being merely the observed phenotypic effects of separate genes, and not different *kinds* of organisms; they should not be given names under the same system as species and subspecies, but might be designated by symbols.

Mr. J. S. L. Gilmour dealt with the philosophical aspect of the subject and drew a distinction between taxonomic and non-taxonomic infra-specific categories. The former, which might be limited to subspecies, variety, and form, should be based so far as possible on the total attributes of the individuals concerned, while the latter should be based on a selection of attributes chosen for special purposes. Examples of such non-taxonomic categories are Dancer's 'commisum', 'comparium', and 'convivium', based on interfertility data, and useful for investigating the relationship between such data and other attributes, such as morphological differentiation. He urged that this distinction is essential for the proper classification of infra-specific variability.

Mr. H. W. Parker showed that the practice of herpetologists is essentially similar to that of mammalogists. He believes, however, that owing to lack of other data, systematists have laid undue emphasis on geographical considerations, with invidious results. Recognition by trinomials of certain forms to the

exclusion of others equally important, and the inclusion of different grades of infra-specific rank, in the same category is misleading. The traditional methods employed in taxonomy must be supplemented for the study of infra-specific variations, and not until we know more of the categories to be dealt with can a satisfactory scheme of nomenclature be devised.

Dr. B. P. Uvarov expressed his belief that the recognition by entomologists of subspecies, in the sense of geographical races, has been of great practical convenience; it has enabled taxonomists to unite numerous minor forms into large species without losing sight of their individuality. Recent physiological, ecological and genetical work has revealed the existence of races which are indistinguishable by external characters. Between these incipient, deeply seated, internal changes and the appearance of external morphological characters there is probably a time lag; consequently even the smallest external differences, if not irregular and obviously casual, deserve the closest attention as representing quite an advanced stage in variation.

Prof. McClung remarked that the perfect taxonomy has been described as the summation of all biological knowledge; we have obviously not yet reached perfection and the present discontent shows a striving in the right direction.

Mr. C. E. Hubbard said that the terms subspecies and variety are used by systematic botanists to cover every grade from a slight variation in one character to a well-defined species. In the floras of large tropical areas there occur numerous polymorphic species which, in the absence of detailed knowledge, it seems best to lump together and note the polymorphism. Where variations are of economic importance, those that are well defined can

be given binary names with the view of making reference easier.

Prof. F. E. Weiss agreed with the previous speakers that investigations of the taxonomic categories need further biological knowledge, especially genetical. Frequently genetical analysis can establish the status of a taxonomic group when the systematist is in doubt. A good example is seen in the pimpinels; of the two blue forms, one has proved to be a genetically stable species and the other, scarcely distinguishable by any other criteria, merely a mutation of the red species.

Dr. Julian Huxley emphasized that taxonomy deals with natural groups having a real existence. Discussing infra-specific variability, he pointed out that in the gradation between varieties, subspecies and species, the points of stability are more frequent than the intergrading zones. He dealt with various causes of discontinuity and mentioned especially isolation leading to non-adaptive variation, and the production of partial discontinuity by the formation of internally stable gene-complexes. For the description of more or less continuous variation he suggested the use of his 'cline' concept.

Dr. R. Melville pointed out that hybridization is much commoner in plants than in animals and that in certain groups the species can be arranged on an intergrading series corresponding to a 'cline' in Huxley's sense, but with no geographical basis. He suggested that new terminology should be used for forms constituting these series.

Prof. W. Garstang commented on the difficulties of genetical research on animals, and directed attention to the existence of 'clines' in fishes, particularly herrings and mackerel. In some instances, the 'clines' can be correlated with gradual environmental changes.

Interstellar Space

ON May 13, 1938, Prof. Charles Fabry delivered the George Darwin Lecture at the Royal Astronomical Society and dealt with the problem of the nature of the matter which exists in interstellar space (*Mon. Not. Roy. Astro. Soc.*, 98, 9, Supp. No., October 1938). The subject is so vast that it was possible for Prof. Fabry only to review briefly the different methods of investigation and the interpretation which has been placed upon what they reveal. As is well known, the Doppler effect has enabled the interstellar lines to be detected. The displacement of the lines in stellar spectra gives the radial velocity and this should be the same for all lines. If a line gives a velocity which differs from that derived from the displacements of other lines, the discrepancy must be due to matter situated between the star and ourselves—in other words, interstellar matter. In 1904, Hartmann observed the spectrum of δ Orionis, a star of variable radial velocity, and found that the velocity, measured on the hydrogen lines, varied between +133 and -66 km./sec., but the lines of ionized calcium showed a constant velocity of +16 km./sec. This supplied the evidence for the existence of a cloud of ionized calcium between the star and ourselves. It seems remarkable that for fifteen years these

ionized calcium lines were the only ones which were known with any certainty. In 1919, however, Miss Heger established without doubt the existence of neutral lines of sodium, and with improvements in spectroscopic methods more interstellar lines have been discovered. It is interesting to notice that the exploration of the ultra-violet lines of sodium by Adams and Dunham has been rendered possible by the use of aluminized mirrors and of gratings ruled on an aluminized layer. The discovery of other lines which cannot be identified has caused some speculation regarding their origin, and Prof. Fabry conjectures that microscopic crystals, perhaps giving absorption bands at the very low temperature, may be responsible for some of them.

Among some of the interesting results accomplished may be mentioned the estimate of the mean radial velocity of the interstellar matter between the star and ourselves, and it seems that the interstellar gas has the same mean rotation as the galaxy. Quite recently, however, Beals has shown that in some cases it is possible to detect masses of interposed gas which have different velocities. Important developments may be expected in this particular sphere.

It is impossible in the limited space to refer to more than a few of the points dealt with in the lecture.

One matter of some interest may be mentioned in conclusion. Cabannes and Dufay found in the light of the night sky a yellow line which they suspected to be sodium, and during the present year they have been able to show conclusively that sodium lines are present. Bernard showed that this sodium doublet is emitted by the very high layers of the atmosphere, the line being greatly intensified at twilight when the upper atmosphere is illuminated by the sun. What is the origin of this sodium? Does it come from the earth where small crystals of sodium chloride exist

in abundance, or is it interstellar sodium which the earth has picked up in its journey through space? How are the sodium atoms excited? Perhaps solar radiation may be able to produce this excitation, but this, like the other points, cannot be answered at the moment, and we must await future research for light on the subject.

Non-astronomers will find much of the lecture readable and they will be amply repaid for the time spent on studying the numerous matters of interest dealt with by Prof. Fabry.

H. T. de la Beche: Geologist and Business Man

By Dr. F. J. North, National Museum of Wales

FEBRUARY 16, 1839, was an important date in the history of the Geological Survey, for on that day Mr. (as he was then) H. T. de la Beche wrote a letter which eventually resulted in the Survey being changed from a one-man affair, with no settled headquarters, to a great organization with an office in London*. It was something to have persuaded the Government to make a grant of £300 for the purpose of colouring geologically a few sheets of the Ordnance Survey map, but a geological survey of the whole of England and Wales was quite another matter, and, like *Oliver Twist*, de la Beche was continually asking for more—money for instruments, a travelling allowance, and permission to extend the survey into other parts of the country. He was not only able to envisage a National Geological Survey but he had also the courage and perseverance to overcome official inertia in order to establish it.

It is the object of this note to illustrate, by reference to one of his campaigns for the expansion of his work, the kind of man he was and the debt which geology owes to him. It is based upon de la Beche manuscripts deposited by the late Colonel J. I. D. Nicholl in the Geological Department of the National Museum of Wales, and upon some old letter books of the Ordnance Survey, to which, by kind permission of the Director, I was given access.

When the geological mapping which de la Beche had been allowed to undertake in Devon, Cornwall and Somerset was nearing completion, he obtained permission to continue the survey in South Wales, where he found a willing voluntary collaborator in W. E. Logan, then a young man engaged in the copper smelting business, and also received help in the field from one of the Ordnance surveyors, Henry McLauchlan. This help was, however, local and occasional, and arguing that, on the basis of his work in Devon, he could not hope to cover the whole of England and Wales in less than twenty-one years, de la Beche decided to seek permission to secure constant assistance with the view of completing the map in about ten years, and in a letter to Colonel Colby, the director of the Ordnance Survey (February 16, 1839), he wrote:

"It being an object of importance that the Geological Survey should be rendered as efficient as the

money granted for the service will permit, . . . I would respectfully suggest for the consideration of the Honourable Board of Ordnance that I should be permitted to hire such Geological Assistants as I may consider requisite for the proper execution of the work . . . such geological assistants to be chosen by myself and discharged by myself as may in my judgment appear reasonable and proper. . . . I would propose that I should not award any rates of pay exceeding ten shillings per day without special authority from the Honourable Board, and that I should send a quarterly return for the Honourable Board's information, showing the names and rates of pay of the persons so employed."

During the previous five years many letters concerning finance had passed between de la Beche and his employers, and his new application shows that he had profited by his experience. His opening remarks related to efficiency and economy, in his conclusion he disarmed criticism by offering to lay all his cards upon the table, whilst a condition that he knew from experience would be one of vital importance was inconspicuously inserted in the middle.

As usual, the Inspector General of Fortifications was cautious, and he endorsed the application as follows: "I know of no authority for the extensive view here taken of extending the Geological Research beyond the eight sheets of the Ordnance Survey authorized by the Master General's and Board's order of the 2nd May, 1832, and I should beg to submit the expediency of not proceeding . . . until something like an approximate estimate of the whole intended outlay be submitted to Parliament in the usual way."

The result of this endorsement was a letter to Colby stating that "The Master General and the Board are decidedly of opinion that it will never do to go on with this Geological Survey without some distinct rules by which the expense is to be governed. They are desirous of affording Mr. de la Beche every facility, but it must be on some express understanding as to the extent of work to be executed, and the length of time to be occupied. By reference to the original arrangement it will be seen that a most material departure has already taken place from what was then proposed, and . . . what is now asked for will lead to an unlimited expenditure of time and money."

De la Beche was asked to indicate how long the whole work would take, and how much it would cost,

* A brief account of the early history of the Geological Survey was given by Sir John Fleet in "The First Hundred Years of the Geological Survey of Great Britain" (1937), which was reviewed in NATURE of November 27, 1937.

and in reply he explained that it was not possible to estimate "the cost of Geological Surveys and the time necessary for their completion, as until some examination of a given area has been effected no correct idea of the whole expenditure can be formed". The region then under consideration was South Wales, and, he continued, "The coal and iron districts require great care both in scientific and economic points of view, and hence far more time has to be bestowed upon them, than upon most other portions of the country . . . but perhaps thrown in with South Wales generally the whole may be taken at about £1 per square mile".

Colby also replied to the Board, pointing out that the letter which he had received "contains no reply whatever to the original question of Mr. De la Beche being permitted to hire assistants", and stating that he (Colby) had realized the necessity for hiring assistants during the progress of the work in Devonshire.

Careful handling of the situation eventually resulted in an official acknowledgment that it was not possible to foresee and to legislate for every contingency that was likely to arise during the course of a geological survey, and on March 15 it was reported that, "The Master General and Board consider the explanation given to be so far satisfactory as that it limits his labours to the completion of certain parts of the Survey for which the authority of the Treasury has been obtained, and to this he must be confined until the Master General and Board receive further instructions on the subject. With respect to the

expenditure, the only plan . . . will be, from year to year, to take such a sum as may be deemed advisable, upon which point the Master General and Board would from time to time avail themselves of your opinion and so check any extraordinary expense that may be proposed".

De la Beche was quick to act upon the recommendation, for in April he wrote, in a letter to Colby: "I have picked up one very clever hand as an assistant at 7s. per day, a regular good one he is, and I am now on the look out for others". The "regular good one" was David Hiram Williams, who after rendering useful service in South Wales joined the Indian Survey, and his name was given in the "Return of Geological Assistants employed on the Geological Survey of England and Wales", which de la Beche made in June 1839. It will be noted that he wrote of the "Survey of England and Wales", although at the time he had only had authority to work in South Wales.

The "Return" for September 1839 contained two names, for Josiah Rees had been appointed at a salary of five shillings a day, and in December, when de la Beche submitted his estimates for the coming year, he budgeted for four assistants and a total expenditure of £1,400, while in the following year he budgeted for six, and a total expenditure of £1,900—but the question of the possible limit to the duration of the Survey was not raised again, and before the work in South Wales was completed de la Beche was seeking permission to extend his operations into the Forest of Dean!

Hydrogenation of Oils by the Continuous Process

V. T. Athavale and S. K. K. Jatkari have recently carried out a detailed study of hydrogenation of ethyl oleate using nickel-carbonate kieselguhr catalyst (*J. Indian Inst. Sci.*, 21, A, Part 25, 1938) and show a definite advance on previously recorded results. Iodine values, refractive indices and dispersions were determined on a number of samples of hydrogenated ethyl oleate, and results are recorded graphically. Contrary to expectation, iodine values did not vary linearly with refractive index in the initial stages of hydrogenation, but only after the iodine value had fallen by about twenty-five per cent. Comparison of refractive index and dispersion values of samples hydrogenated at different temperatures and with different rates of flow of ethyl oleate over the catalyst showed that dispersions of samples having almost identical refractive indices vary considerably. Similarly, it was found that samples having the same iodine value had dissimilar dispersions, thus indicating the formation of oleic acid during the reaction. A study of the effect of temperature on the velocity of hydrogenation at a fixed rate of flow of ethyl oleate over the catalyst further revealed a marked difference in dispersion values of samples hydrogenated at low temperatures and the conclusion was, therefore, reached that the isomers of oleic acid are formed because of the low activity for hydrogenation of the catalyst at low temperatures.

Interconnected with this research a further series

of experiments were undertaken by the same authors (*J. Indian Inst. Sci.*, 21, A, Part 26, 1938). Earlier work had pointed to the possibility that variations in velocity coefficients of hydrogenation of oils might be due not only to differences in composition of the oils, but equally to differences in the heterogeneity of the catalyst surface. Consequently, a study was undertaken of the velocity coefficients for the hydrogenation of ground-nut oil in the presence of nickel-carbonate-kieselguhr, unsupported nickel-carbonate, nickel-hydroxide-silica gel and nickel-peroxide-kieselguhr catalysts. A comparison was then made with the velocity coefficients of hydrogenation of the same oil over a nickel-wire catalyst. Velocity coefficients (K) were calculated from the equation:

$$K = \frac{2.8}{t} \log \frac{a}{(a-x)};$$

where x is the percentage conversion at a given rate and t is the time of contact. This velocity coefficient was further corrected for the effect of absorption expressed as $K = K^1 (\text{rate})^{\frac{1}{2}}$, where K^1 is the corrected velocity coefficient. By plotting the value K^1 for different samples of oil against temperature, curves showing a maximum at 150° were obtained. This appeared to depend upon the percentage of olein in the oil and its selective hydrogenation at that temperature.

Science News a Century Ago

Researches on the Chemical Equivalents

ON February 14, 1839, Richard Phillips (1778-1851) who from 1839 until his death was chemist and curator of the Museum of Practical Geology, read a paper to the Royal Society entitled "Researches on the Chemical Equivalents of Certain Bodies". The paper was the result of a series of experiments made to test the truth of the theory of Dr. Prout and Dr. Thomson "that all atomic weights are simple multiples of hydrogen", a theory which the late Dr. Turner said was untenable. Turner having adopted the number 108 as the equivalent of silver, Phillips had selected this element as the basis for his inquiry into the equivalent numbers of chlorine and some other elementary gases. From his experiments, the author concluded that no material, and even scarcely any appreciable, error, could arise from considering the equivalent numbers of hydrogen, oxygen, nitrogen and chlorine as being 1, 8, 14 and 36 respectively.

Ehrenberg awarded the Wollaston Medal

AT the anniversary meeting of the Geological Society on February 15, 1839, the Wollaston Medal was handed to the Chevalier Bunsen for transmission to Prof. Christian Gottfried Ehrenberg, of Berlin, to whom it had been awarded for his discoveries respecting fossil Infusoria. "These discoveries," said Dr. Whewell, when handing the medal to Bunsen, "eminently striking and curious to all intelligent persons, are full of the most lively interests for geologists." They were, he added, a just reward of Prof. Ehrenberg's merits, "since he had prepared himself for this success by a profound study of natural history, by practical and scrutinising researches, and by extensive and enterprising travels". In his reply, Bunsen said that the honour accorded "will be deeply felt by the whole literary public of Germany; it will, I trust, form a new link in that intellectual union between the two great and enlightened nations, which have so many objects of warm and deep sympathy; a union which must become every day more and more intimate, and prove productive of the most beneficial consequences, not only for the progress of science in the whole range of human intellect, but for the welfare of humanity at large".

Steel-making in India

DURING the discussion of a paper "On the Differences between the European and Indian Methods of Making Steel", at a meeting of the Asiatic Society on February 16, 1839, Mr. Heath, who had lately returned from the East, described the operations of the natives of India in manufacturing iron and steel. The ore used, he said, was the magnetic oxide of iron combined with quartz in the proportion of fifty-two of oxide to forty-eight of quartz, which occurred in the district of Salem. The ore was prepared by stamping and washing. The furnace was built of clay, charcoal was used as fuel, and the bellows were made of goat skins. The melting took about four hours and the product was hammered into bars. To convert the iron to steel, it was cut into small pieces and placed in crucibles with the dried wood of *Cassia auriculata* and a few green leaves of *Azadirachta indica*.

Societies and Academies

Paris

Academy of Sciences (C.R., 208, 133-236, Jan. 16, 1939).

E. BORREL: A continuous problem analogous to a card game.

M. MOLLIARD and R. BOHEVIN: Does the nature of the food affect the reserves [of plants]? Radish and viper's grass grown aseptically produce the same reserves whether levulose or glucose be applied to their roots.

A. GOSSET, R. JAHIEL and MM. S. DELAUNAY: Study of the evolutionary cycle of pneumonic illness in the rabbit, by local anaphylaxis, starting with endogenous proteins.

O. E. DIEULEVAULT: Moments of hypergeometric probabilities.

P. LÉVY: Division of a segment by a point chosen at random.

E. J. GUMBEL: Values of position of an aleatory variable.

P. VINCENTINI: A transformation of angle congruences of constant focal planes.

O. EHRENMANN: Paratactic congruences and parallelisms in projective spaces.

D. S. MITRINOVICH: Theorem on Ricci's equation.

J. MARCINKIEWICZ: Remark on M. Besikowitch's spaces.

C.-T. CHUANG: Holomorphic functions in the *corolla* unit.

B. KWAL: Some relativistic generalizations of the fundamental equations of analytical mechanics.

R. GOUDRY: Measurements of the intensity of gravity in France during the year 1938.

G. PETIAU: Electromagnetic equations of the theory of the photon.

J. BASSOT: Determination, under pressures of 1-11,000 kgm./cm², of an isotherm of naphthalene tetrahydride passing from the liquid to the solid state.

A. RASKIN: Construction of a high-tension generator with large output. An output of 800 microamp. can be obtained; the voltage, which is limited by local conditions, is 400,000.

G. REMBOUL and F. PERRIER: A peculiarity of air ionized by X-rays. An effect can be detected several hours after the exciting rays are cut off, due apparently to 'large' ions which in number are about a million times fewer than those produced by the same X-rays.

N. KÜRTI, P. LAJTHA and F. SIMON: Adiabatic demagnetization starting from temperatures obtained with solid hydrogen. Using the great magnet of the Academy of Sciences, with a field of 29 kilograms, a temperature of 0.36° K. was obtained in one stage with iron alum. Thus it is possible to dispense with liquid helium for work below 1° K. and hence the equipment required is simplified.

R. FORRER: Relations between the Curie point, orbital moment and crystal lattice.

L. NÉEL: Specific heat and fluctuations of the molecular field.

E. RENCORER: Properties of vitreous phenol phthalein.

L. GROVEN: Contribution to the study of the X-rays emitted in the discharge between external electrodes with maintained waves [of potential].

MILLS, M.-L. DELWAULLE, F. FRANÇOIS and J. WIEMANN: Study of the constitution of solutions of cadmium iodide; complete Raman spectrum of cadmium tetraiodide.

J. CATHALA and J. OLUXEL: Continuation of the spectrophotometric study of the slow hydrolysis of ferric salts.

P. BASTIEN: Influence of pH of acid solutions on the evolution as a function of time of the 'pickle' brittleness of extra soft annealed steel.

J. FARINHAU: Electronic structure of certain copper-aluminium alloys.

J. BOUGAULT, E. CATTELAINE and P. CHARRIER: Nickel amalgams. Nickel can be amalgamated in the presence of nascent hydrogen, which seems to act as a catalyst.

R. CHAUVENET: Combinations of beryllium nitrate and the alkali nitrates.

MILÉ, J. BRIGANDO: Study of ferricyanic, cobalticyanic and chromocyanic acids.

G. COURTOIS: Fusibility of mixtures of pure anhydrous sodium sulphide and sodium sulphate.

A.-A. SANFOURCHE: Magnesium hydroxy-apatite.

G. VAYON, J. CALIN and J. FOUBCHIER: Action of halogen derivatives on magnesium couples.

R. JOUAN: A new method of production of crystals on which physical measurements can be made. A 'seed' crystal is supported in a supersaturated solution on artificial silk gauze carried on an oscillating glass frame.

L. BERTHOIS: Remarks on the origin of tourmaline in sedimentary rocks.

G. CHOUBERT: The Cretaceous of eastern Morocco.

M. THORAL and B. GHEZ: Structure of the western region of the southern slope of the Black Mountains (Aude-Hérault).

R. HUMBERY: Piezometric surface of a sheet of water feeding any number whatever of artesian wells. A theoretical investigation.

J. MOUSSIGOT: Measurements of the conductivity and ionization of the atmosphere in the Alps (work of the Sanatorium des Étudiants de France, and of the chair of therapeutic hydrology and climatology of the Faculty of Medicine of Lyons).

G. GREENET and MME. P. QUENNY: Comparison of electromagnetic seismographs.

H. HUMBERT: An archaic genus of Cucurbitaceae of Madagascar.

G. MANGENOT: Action of colchicine on plant cells. Colchicine immediately prevents cell proliferation though growth continues. This occurs before the appearance of giant nuclei.

A. MICHALSKI and F.-X. SKUPIŃSKI: Ecological researches on *Physarum didermoides* Rost, an endospore myxomycete.

R. SOUBGES: Embryogeny of the Cucurbitaceae; development of the embryo of *Bryonia dioica* Jacq.

J. RIBOUL: General theory of the action of X-rays on biological elements. A revision of Crowther's formula is proposed.

M. PIÉRY, J. ENSELME, C. PESCHIERA and MILÉ, M.-A. NOVA: Effect of the oxygen saturation of arterial blood on the production of lactic acid by striated muscle.

A. BEBEDZKA: Antidiphtheric serotherapy by the cutaneous route. Antidiphtheric serum on the scarified skin of the rabbit is effective, even if applied several hours after penetration of the toxin.

P. LEPESME: Influence of temperature and humidity on the pathogeny of the aspergillosis of Acridians.

Geneva

Physical and Natural History Society (November 17, 1938).

A. PIOTET: Geographical distribution of organisms and the problem of transformism. Studies in the field and laboratory suggest that there is a relationship between geographical separation and racial chromosomal constitution, separation having created germinal differences. This view puts the process of transformism back to early geological times before the continents were separated.

M. PÉREOT: The chromosomes of *Archelix* and of *Alabastrina Alabastrites* Michaud. The chromosome number of *A. Alabastrites* is different from that in the three other species of *Archelix*. It is concluded that the genus *Alabastrina* of Kobelt is artificial, since it contains species related to *Archelix* and others which should be placed in another group.

J.-L. PÉREOT and M. PÉREOT: Chromosomes of five species of *Limnaea*. Chromosome number of *L. auricularia*, *ovata* and *peregra* is 17; that of *L. palustris* and *stagnalis* is 18. This confirms the classical arrangement of the first three species in the subgenus *Radix*. The parallelism between the chromosomal homogeneity and the great resemblance of conchological and anatomical characters is also emphasized.

J.-L. PÉREOT: Is self-fertilization possible in *Eulota fruticosa* Müller? In contrast to a nearly related species, *E. similis simpsoni*, self-fertilization is not possible.

M. L. MISCH and A. J. A. VAN DER WYK: Structure of oxamide. X-ray study of crystallized oxamide shows that it belongs to the triclinic system. Cohesion in the *ac* plane is very great; this accounts for the special physical properties of oxamide.

December 1, 1938.

A. PIOTET: Localization of physiological races of Lepidoptera in the Swiss National Park as a function of altitude and of the flora. The topography and diversity of soils and flora of the Park have localized individuals (of *Nemophila plantaginifolia*) in autonomous stations, where they retain their own physiological and genetic characteristics from year to year.

H. BRANDT and W. SCHUSSEL: Researches on vitamin C during athletic effort. Vitamin C, or more strictly the reducing power of the urine in the dihalophenol-indophenol reaction, may increase or decrease after exertion. The same subject always gives the same reaction, which appears to be a constitutional factor.

December 15, 1938

B. SUZ and E. BRINER: Absorption by benzoic aldehyde in the violet and the near ultra-violet. The coefficient of extinction between 3820 Å. and 4060 Å. has been measured, after elimination by extrapolation of the effect of the benzoic acid always present in small concentration.

P. ROSSIER: Choice of the resistance of the induced circuit in measurements with the ballistic galvanometer. Case of critical damping when the galvanometer deflection is a maximum.

F. CHODAT: Study of chloroplasts by the method of formation of starch *in vivo*. Transformation of starch formed by the chloroplasts, by warming, permits the demonstration of the heterogeneous structure of the chloroplasts; after this treatment they show a series of granulations.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Monday, February 13

UNIVERSITY OF LONDON, at 5.15.—Prof. J. E. Littlewood: "Results in the Theory of Prime Numbers".*

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 5.30.—Heath Clark Lectures on "Europe and West Africa: Some Problems of Adjustment" to be given by various lectures (succeeding lectures on February 15, 17, 20, 22 and 24).*

ROYAL SOCIETY OF ARTS, at 8.—Sir Gilbert Morgan, F.R.S.: "Achievements of British Chemical Industry in the last Twenty-five Years" (Cantor Lectures. Succeeding lectures on February 20 and 27).

Tuesday, February 14

UNIVERSITY COLLEGE, LONDON, at 5.15.—Prof. S. R. K. Ghosh: "The Use of Museums. (2) The Archaeological Museum".*

Thursday, February 16

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE, at 7.45.—Dr. C. Wilcocks: "Tuberculosis in Natives of Tropical and Sub-Tropical Regions."

Friday, February 17

INSTITUTION OF CHEMICAL ENGINEERS (at the Hotel Victoria, London), at 11.—Annual Corporate Meeting. Dr. William Oullen: "My Fifty Years of the Explosives Industry" (Presidential Address).

UNIVERSITY OF LONDON INSTITUTE OF EDUCATION (in association with the SOCIETY FOR THE PROTECTION OF SCIENCE AND LEARNING), at 5.30.—Prof. J. B. S. Haldane, F.R.S.: "Race in Fact and Theory".*

INSTITUTION OF MECHANICAL ENGINEERS, at 5.30.—Annual General Meeting.

W. H. Orr: "The Modern Paper-making Machine".

INSTITUTION OF CIVIL ENGINEERS (GLASGOW SECTION), at 7.30.—W. A. Tooke: "Dugald Clerk and the Gas Engine: His Life and Work" (Dugald Clerk Lecture).

ROYAL INSTITUTION, at 9.—Prof. G. T. R. Hill: "Aeroplane Controls".

Appointments Vacant

APPOINTMENTS are invited for the following appointments, on or before the dates mentioned:

DEMONSTRATOR in the Engineering Test Laboratory in the Royal Naval Engineering College, Devonport—The Director, Education Department, Admiralty, London, S.W.1 (February 11).

ASSISTANT (grade III) in the External Ballistic Department of the Ordnance Board, Woolwich—The Secretary, Ordnance Board, Royal Arsenal, Woolwich, S.E.18 (February 14).

JUNIOR LECTURER in CIVIL ENGINEERING in the University of the Witwatersrand—The Secretary, High Commissioner, South Africa House, Trafalgar Square, W.C.2 (February 22).

SENIOR TECHNICAL OFFICER in the Radio Department of the Royal Aircraft Establishment, South Farnborough, Hants—(February 25).

DIRECTOR OF SUGAR BEET RESEARCH—The Secretary, Sugar Commission, Queen Anne's Chambers, 41, Tothill Street, London, S.W.1 (February 28).

LECTURER in MATHEMATICS in the University of Aberdeen—The Secretary (March 7).

JUNIOR TECHNICAL ASSISTANT (electrical engineering) in the Royal Mint—The Secretary, Civil Service Commission, Burlington Gardens, London, W.1 (March 9).

READER in CHEMICAL ENGINEERING in the University of Bombay—The High Commissioner for India, Aldwych, London, W.C.2.

ASSISTANT MYCOLOGIST at the Imperial Mycological Institute, Ferry Lane, Kew, Surrey—The Director.

Reports and other Publications

(not included in the monthly Books Supplement)

Other Countries

Canada: Department of Mines and Resources, Mines and Geology Branch: National Museum of Canada. Bulletin No. 90 (Anthropological Series, No. 28): The Barren Indians of Alberta. By Diamond Jenness. Pp. vii+93. 25 cents. Bulletin No. 91: Annual Report of the National Museum for the Fiscal Year 1937-38. Pp. 20. 10 cents. (Ottawa: King's Printer.) [231]

Canada: Department of Mines and Resources, Mines and Geology Branch: Bureau of Geology and Topography. Geological Survey Memoir 210: Rice Lake-Gold Lake Area, Southeastern Manitoba. By C. H. Brockwell. (No. 2444.) Pp. 79+8 plates. 25 cents. Geological Survey Memoir 214: Geology and Mineral Deposits of Troopold Mountain, Carleton Place, Yukon. By J. B. Johnston. (No. 2445.) Pp. 11+21. 10 cents. Geological Survey Memoir 217: Laberge Map Area, Yukon. By H. S. Bostock and M. J. Lees. (No. 2449.) Pp. 11+23+3 plates. 25 cents. (Ottawa: King's Printer.) [231]

Annual Report of the All-India Institute of Hygiene and Public Health, Calcutta, 1937. Pp. 64. (Calcutta: Government of India Press.) [231]

Middelseer fra Kommissionen for Danmarks Fiske- og Havundersøgelse. Serie Fiskeri, Bind 10, Nr. 6: 125 Salmon from West Jutland. By O. V. Otterstrøm. Pp. 28. (København: G. A. Reitzels Forlag.) 1.25 kr. [231]

Journal of the Indian Institute of Science. Vol. 22A, Part 1. Supersonic Velocity in Gases and Vapours. Part 4: Measurement of the Absolute Frequency of Piezoelectric Quartz Oscillators. By S. K. Kulikarni and J. K. P. P. 18. (Bangalore: Indian Institute of Science.) 1.4 rupees. [231]

Michigan State College of Agriculture and Applied Science. Agricultural Experiment Station Report, Two Years ended June 30, 1938. Pp. 48. (East Lansing, Mich.: Michigan State College of Agriculture and Applied Science.) [231]

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 123: The Establishment of Pastures on Deep Sands in the Upper South-East of South Australia. By Dr. H. O. Trumble, G. M. Donald and C. A. Neal Smith; with an Appendix on the Role of Seed Inoculation, by T. H. Strong. Pp. 24+4 plates. Pamphlet No. 86: A Chemical Study of some Australian Fish. By W. G. Jowett and Dr. W. Davies. Pp. 40. Pamphlet No. 89: A Study of the Pulping Properties of Three Trees of *N. eichlamii*, using the Sulphate Process. By J. G. Cavanagh, H. M. Dadds, A. W. Mackay and Dr. T. M. Reynolds. (Division of Forest Products: Technical Paper No. 20.) Pp. 23+1 plate. Pamphlet No. 87: The Mechanical Properties of South Australian Plantation-Grown *Pinus radiata* D. Don. By Ian Langlands. (Division of Forest Products: Technical Paper No. 20.) Pp. 53+2 plates. (Melbourne: Government Printer.) [231]

Carnegie Institution of Washington. Publication No. 504: The American Species of *Crepis*; their Interrelationships and Distribution as affected by Polyploidy and Apomixis. By H. B. Babcock and G. L. Stebbins, Jr. Pp. iii+190+3 plates. (Washington, D.C.: Carnegie Institution.) [231]

U.S. Department of Agriculture. Circular No. 494: The Texas Leaf-Cutting Ant and its Control. By M. V. Walter, Lee Beaton and A. A. Mathewson. Pp. 19. (Washington, D.C.: Government Printing Office.) 5 cents. [231]

U.S. Treasury Department: Public Health Service. Studies on Drug Addiction; with Special Reference to Chemical Structure of Opium Derivatives and Allied Synthetic Substances and their Physiological Action. By Lyndon F. Small, Nathan B. Bddy, Ulrich Moestig and O. K. Himmelsbach. (Supplement No. 138 to the Public Health Reports.) Pp. viii+143. (Washington, D.C.: Government Printing Office.) 60 cents. [231]

Madras Fisheries Department. Administration Report for the Year 1936-37. By Diwan Bahadur Dr. B. Sundara Raj. Pp. iii+66. 8 annas. The Fishing Methods of the Madras Presidency. Part 2: The Malabar Coast. By James Hornell. (Report No. 1 of 1937, Madras Fisheries Bulletin, Vol. No. 27.) Pp. 69+11 plates. (Madras: Government Press.) 1.2 rupees. [231]

Annuaire pour l'an 1939 publié par le Bureau des Longitudes. Pp. viii+584+A26+B23+C64. (Paris: Gauthier-Villars.) 25 francs. [231]

Comité National français et Comité National marocain de Géodésie et Géophysique. Années 1933, 1934, 1935, 1936. Compte rendu publié par le Secrétaire général du Comité français, G. Perrier. Pp. 408. (Paris: Secrétaire général du Comité français.) [231]

Commonwealth of Australia. Report of the Ninth Australian Cancer Conference held at Sydney, 5th-9th April 1938. Pp. 56. (Canberra: Government Printer.) [231]

Smithsonian Miscellaneous Collections. Vol. 97, No. 8: Drawings by George Gibbs in the Far Northwest, 1846-1851. By David I. Bushnell, Jr. (Publication 2486.) Pp. iii+28+18 plates. Vol. 97, No. 11: An Assay Method for Growth-Promoting Substances utilizing Straight Growth of the *Avena coleoptile*. By Robert L. Weismann. (Publication 2488.) Pp. ii+10+1 plate. (Washington, D.C.: Smithsonian Institution.) [231]

Institut International de Coopération Intellectuelle. Études et recherches sur les phytohormones. Première réunion organisée en collaboration avec l'Union Internationale des Sciences biologiques, Paris, 1 et 2 octobre 1937. Pp. xiv+126. 35 francs. Les déterminations physico-chimiques des poids moléculaires et atomiques des gaz. Réunion organisée en collaboration avec l'Union Internationale de Chimie et l'Union Internationale de Physique, Neuchâtel, 17 et 18 décembre 1938. Pp. xiii+192. 45 francs. (Paris: Institut International de Coopération Intellectuelle.) [231]

Archivos de la Escuela de Farmacia de la Facultad de Ciencias médicas de Córdoba. No. 5: Muecos de la República Argentina; Contribución al conocimiento de los Muecos de la Provincia de Córdoba. 1. Por el Dr. Carlos Curt Homoc. Pp. 42. No. 7: Contribución al conocimiento de la flora Brionita del sur de Ofite. (a) Parte sistemática, por T. Herzog; (b) Parte fisiográfica, por Carlos Curt Homoc. Pp. 66. No. 8: Muecos de la República Argentina; Contribución al conocimiento de los Muecos de la Provincia de Córdoba. 2. Por el Dr. Carlos Curt Homoc. Pp. 58. (Córdoba: Facultad de Ciencias médicas.) [231]

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series B, No. 25: The Changing Power of Single Cotton Fibres in relation to their Physical Properties. By Dr. K. B. Sen and Dr. N. Ahmad. Pp. 24. (Bombay: Indian Central Cotton Committee.) 8 annas. [241]

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Science in Secondary Schools

SOCIAL organization is passing through a dynamic era. To-day the rate of change is higher, and, what is more important, we are more aware of it. For this reason the Spens report* is to be welcomed as a compendium of suggestions for meeting these changes, and above all as a clear statement that the duty of citizenship in a democracy renders it essential that all should be taught to understand and to think to the best of their ability. The report, the general trends of which were outlined in *NATURE* of January 21, p. 103, though of far-reaching importance, is perhaps not so revolutionary as was expected, which is all to the good ; for revolutionary changes, especially in such a highly organized system as that of education, would only result in confusion and counter-revolution. There is, after all, only a difference of degree between the pronouncements of Arnold and Sanderson, and those of such present-day educationists as Sir Richard Gregory, who once defined education as "the deliberate adjustment of a growing human organism to its environment". Furthermore, several of even the more important suggestions set forth in the Spens report are not new, but have already been made by other authoritative bodies. This illustrates the broad outlook and the democratic spirit adopted by the Spens Committee and the large body of witnesses which helped it in its deliberations.

Though the curriculum, it is considered, should have more regard to the vocational future of pupils rather than give so much time to training potential university students, a good general education is recommended. Thus does the report re-emphasize

the recommendations made earlier by the Hadow, Malcolm and Goodenough Committees. It is not suggested, however, that education has been virtually at a standstill since these recommendations were made. Much progress has indeed been made.

The teaching of science in secondary schools is subjected to much constructive criticism in the report. A plea is put forward for a more intimate alliance between subjects, provided the essential autonomy of each is preserved. It is clear, too, that certain scientific subjects are needlessly subdivided. Advantage should also be taken of the inherent curiosity of children about the practical concerns and activities of the world to bring their studies into closer contact with the practical affairs of life. This is best done by making the curriculum more general and freer, and most will agree with Dr. H. A. L. Fisher that is all to the good. The Spens Committee is thus led to urge strongly the claims of general science to a place in secondary school education.

The Committee considers that the teaching of science has lost touch with life itself, and for this reason has often failed either to give knowledge required or to stimulate the pupils' interest. This supports the pleas made by Sir William Bragg, in his presidential address to the Science Masters' Association in 1936, for the teaching of science in ways that will facilitate co-operation in dealing with national and international affairs—a strong plea in face of the present-day challenge to democracy.

There can be little doubt that in the early educative period more generalized science teaching is required. This was agreed so far back as 1934 at a conference arranged by the Science Masters'

* Report of the Consultative Committee on Secondary Education with Special Reference to Grammar Schools and Technical High Schools. Pp. xxviii+478. (London: H.M. Stationery Office, 1934.) 2s. 6d. net.

Association and the Institute of Education of the University of London. There the inclusion of biology in the syllabus was urged, which led Prof. E. N. da C. Andrade to admit that such a wider syllabus might lead to some superficiality of treatment, but he could see no particular harm in that—a statement of greater significance perhaps now than then. The interim report of the sub-committee appointed by the Science Masters' Association to consider the question of general science was much in favour of teaching the subject, and we commented (see *NATURE*, 138, 1030; 1936) on the efforts being made to change school science from its traditional, intensive and formal habit to a broader and more human shape. The addition of biology to a curriculum hitherto containing physics and chemistry only must of necessity broaden the cultural aims of science teaching. A general syllabus containing all three subjects aims, as no narrower syllabus can, at helping the pupil towards an intelligent understanding of his immediate environment, and thus forms a sounder basis for widening his interests and understanding in later life.

The Spens report emphasizes all this very thoroughly, and goes so far as to say that, in boys' schools especially, science teaching is too often restricted to the physical sciences, and in girls' schools too much botany is taught at the expense of biology. It is, therefore, of interest to compare the number of candidates in England and Wales offering these subjects in the School Certificate examinations in 1933 with those of 1937. In 1933, 27,007 candidates offered chemistry; in 1937, the number was 27,246—a negligible increase; physics has shown an increase from 18,860 to 20,826; botany a decrease from 13,094 to 8,487; biology an increase from 6,171 to 15,119; and general science an increase from 2,560 to 4,779. Although the period taken is comparatively short, it seems, therefore, that the recommendations made by various bodies in the past few years are bearing fruit. So this augurs well for the Spens report.

The report goes still further, however, in its recommendation that science should be more generalized. It suggests that astronomy and possibly some geology should be included; while in chemistry, a certain amount of attention should be given to organic studies. There seems no sound argument against such recommendations, which should have the whole-hearted support of every educationist and man of science. It is

interesting to note, too, that the final report of the sub-committee of the Science Masters' Association*, recently issued, puts forward similar views.

The Spens report gives special consideration to the peculiar problems of the country secondary schools, asserting that full advantage should be taken of their rural environment. The report recommends the teaching of more biology, agriculture, gardening and so forth, and the application of local surveys and farm statistics to geography and mathematics. The special position of a rural school is so obvious that to take advantage of the resources of the countryside seems a natural sequence. As optional subjects, the final report of the Science Masters' Association also recommends more biology, ecology, gardening and agriculture. While agreeing in principle with these conclusions, we suggest that they be treated with a certain amount of caution. The immediate environment of the rural school is naturally an advantage and convenience for the teacher. But more important than this is consideration for the future of the taught. Carried to ill-considered extremes, these recommendations would involve a 'rural population' receiving a rural education, and an 'urban population' a non-rural education. But there are children in the country more talented in the physical sciences, and the reverse applies to certain town children. Physics, chemistry and astronomy can and should be taught equally in both types of school; and in the town school, experimental biology can be taught, though of course not with such a wealth of material at hand as in the rural school. Few town children of to-day are absolutely unfamiliar with country life, or at any rate with plant and animal life, including man. While supporting the suggestion, therefore, that the school should take advantage of its environment, we would plead for a certain balance and plasticity in the individual school curriculum, in order to prevent the production of a certain number of 'square pegs in round holes'.

As we have stated over and over again, the narrowness of school science is due in no mean measure to the stranglehold of examinations. This applies especially to the School Certificate examination, which is the subject of criticism in the Spens and Science Masters' Association reports. At present, it tends to enforce an undesirable

* "The Teaching of General Science". Part 2. The Science Masters' Association. (London: John Murray, 1938). 2s. 6d.

uniformity in the curriculum, especially through its group system. The abolition of this grouping was recommended by the Secondary Schools Examination Council (Circular 1463, H.M. Stationery Office). This is now endorsed by the Spens Committee, and certain examining bodies have decided to adopt the recommendation. Such a recommendation will relieve the pupil from forced issues and encourage him more to follow his own bent. It is, for this reason, to be hoped that the recommendation will eventually be adopted by all examining bodies. Furthermore, both reports plead for a consideration of school records supplied by those who have taught the candidates. We welcome this suggestion, since it would relieve the examiners of what is tantamount to absolute authority in assessing educational merit, for which everyone, and especially the examiners themselves, would feel grateful.

It is gratifying to note that in the House of Commons on February 2, the Parliamentary Secretary to the Board of Education stated, in reply to a question, that the Spens report is being examined departmentally, and that "no time will be lost in getting into touch with local education authorities and other interested parties for the purpose of a full discussion of the important and constructive recommendations on such matters, among others, as technical high schools, the curriculum of grammar schools, the school certificate examination, and the inspection of private schools".

The recommendations enumerated above, even if only adopted in part, are bound to have their repercussions on the teacher as well as on the pupil. This is an important aspect of the problem which the Science Masters' Association report seems to have taken more to heart than has the Spens report. It is axiomatic that the right kind of teacher is required—one with a 'generous' training in science rather than the narrow specialist. Many teachers in secondary schools are university graduates who have specialized in one or two subjects. They would naturally feel embarrassed on being asked to teach subjects with which they are not familiar. In fact, according to the Science Masters' Association report, some of them are not in favour of general science for this reason. But that is merely shelving the problem. In any event, there is, as stated in this report, a tendency to exaggerate the difficulty, and the same report offers suggestions to such specialized teachers. There are, for example, Board of Education studentships to enable

teachers to improve their qualifications, university diplomas in certain subjects, evening courses in universities and colleges, vacation courses and so forth. There are also other facilities; for example, the Educational Advisory Board of the British Social Hygiene Council is offering a course for teachers in biology.

But these, at their best, can only help present-day teachers, and not even all those. It is the teacher of the future who will have to face the problem in its entirety. It is, therefore, the responsibility of the authorities to see that the most suitable teachers are available to deal with changes in educational curricula and methods. Most committees dealing with the problem look solely to the universities for aid and inspiration. But it is not the main function of a university to produce school teachers, although one cannot justifiably accuse them of being blind to the needs of the teaching profession. Much could be done before the future teacher makes his final choice of degree work. It is difficult, for example, to see the necessity for so many honours graduates in schools. A teacher with a general degree has, at any rate, sufficient actual knowledge of his subjects for school-teaching purposes, and more of them.

It is, we think, to the training colleges and education departments of the universities from which help might also be expected. Certain of them are already making efforts to produce the kind of teacher required to meet the changes in educational method. The education department of the University of Reading, for example, already offers a course on the teaching of rural science to graduates in science, agriculture and horticulture (see p. 305). This policy could, we think, with advantage be extended in such training institutions to the teaching of general science. Many student teachers enter their period of teacher-training either concurrently with their reading for a degree or after having graduated. They have already, therefore, a certain knowledge of scientific method and outlook, and should be easy material for elementary instruction in other scientific subjects and in general scientific methods. In this way, teachers with the requisite knowledge of general science could be supplied to the schools—teachers infinitely better equipped to teach general science than the first-class honours man who, in order to teach it competently, is forced to devote his spare time to extra courses of instruction after his period of training.

Science in the Modern World

The Social Function of Science

By J. D. Bernal. Pp. xvi+482. (London: George Routledge and Sons, Ltd., 1939.) 2s. 6d. net.

FOUR years ago a series of essays under the title "The Frustration of Science", to which Prof. J. D. Bernal himself contributed one on "Science and Industry", bore witness to the sense of social responsibility of individual scientific men at least, and to their concern at tendencies or forces which are preventing science from bringing its full benefits to mankind. Somewhat earlier, in "Scientific Research and Social Needs", Prof. Julian Huxley gave a popular picture of the extent to which scientific advance is influencing every aspect of everyday life and a brief forecast of some of the further possibilities if we can lessen or close the wide gap still existing between scientific knowledge and its application to the needs of humanity. In the interval, Lord Stamp in "The Science of Social Adjustment" has outlined something of a programme for research on some of the urgent problems arising from the impact of science on society. The events in the year or more since the publication of the present volume was first announced have made it, if anything, even more timely. Besides the more widespread interest in the reaction of science on society and the social consequences of scientific discoveries, scientific workers have become aware that, for the first time since the Renaissance, science itself is in danger, and that political forces are threatening not merely the direction but even the existence of science.

"The Social Function of Science" is fundamentally an elaboration of the books mentioned above. Addressed primarily to scientific workers in general, it ranges over the whole field of science, and indicates broadly its present position and structure, and the way in which the advance or the application of science is being delayed. It gives also some idea of the possibilities if the limitations or impediments to that advance or application can be removed, and like Lord Stamp, from whose book he quotes extensively, Prof. Bernal makes a number of specific proposals for investigation with the view of eliminating existing handicaps or obstacles.

The task Prof. Bernal has set himself is encyclopaedic; but he is to be congratulated alike on the width and balance of his survey. Important as detail may be, he has not allowed it to obscure his main theme, which is to give a comprehensive

picture of the whole situation. This he considers is the first condition of real progress. The present unsatisfactory position is largely due to lack of such a comprehensive view, and to the pursuit of short-range or sectional policies which may hinder the general advance. One of the main points in Prof. Bernal's argument is indeed the intricacy or complexity of the situation. Scientific advance in a particular field is determined not merely by the ability and number of the workers in that field, the way they are organized and the resources at their disposal, but also by their relations with the general body of men of science as well as by their whole social, industrial and political environment. He argues that attention to the social functions of science is required in the interests of scientific advance as well as in the interests of society.

Nor is this a new point of view. The social function of science is something which has grown up imperceptibly with science itself and in the same haphazard and unco-ordinated manner. This forms the theme of the second chapter of the book, which gives a concise but adequate historical approach. From this, the author proceeds to discuss the main structure of science at the present time. The existing organization of scientific research in Great Britain, both academic and industrial, the place of science in education and the training of the scientific worker, factors which limit the efficiency of research at the present time are reviewed, as well as the very topical questions of science and war and international relations of science.

Prof. Bernal makes many shrewd comments on present-day weaknesses and causes of inefficiency which individual scientific workers will be able to endorse from their own experience, if the author himself is limited rather to generalities. Moreover, while Prof. Bernal is a keen critic of many conditions for which scientific workers themselves have at most only an indirect responsibility, he leaves no room for doubt that there are many problems to which they could give their immediate attention, and that if science is to be of full use to society it must first set its own house in order.

The second part of the book gives Prof. Bernal's view of the possibilities which science offers if these limitations on its efficiency and utilization were removed. A series of chapters which are largely the counterpart of those in the

first part of the book, contain his own constructive suggestions in such matters as the training of the man of science, the reorganization of research, scientific communications, or publications, the finance of science and the strategy of scientific advance, and finally a picture of how science would be utilized in a beneficent transformation of human economy.

It is impossible in the space of a short review even to mention the main topics upon which Prof. Bernal touches. His chapters are calculated to stimulate thought and discussion, and if the plan of the book necessitates those interested in one particular topic, such as education or scientific publications, turning from one chapter to another widely separated in the second part of the book, instead of being able to follow it continuously, the arrangement undoubtedly serves the main purpose of the book. Whether in discussing such particular topics or in dealing with the general situation, Prof. Bernal rarely fails to touch on the fundamental problems. Even to scientific workers in their own particular field he often suggests new possibilities or points of view; but the treatment is never allowed to degenerate into disconnected discussions which are unrelated to the main problem of the future of science and its ability to serve society.

Prof. Bernal regards the present social disorders as primarily due to science progressing beyond the social forms in which during the last five hundred years it has developed. The future of science depends on the creation of a new social form and demands the intelligent management of science by society as a whole. Accordingly he argues that scientific workers cannot be indifferent to politics and must avoid becoming pawns of the major social forces, although he does not believe that as men of science they should join any particular party.

Some minor criticisms may be offered. The book bears some evidence of hasty writing. Some quotations are repeated *in extenso* where a reference might easily have served. The appendix on expenditure on industrial research might well have been omitted. A table which omits the names of firms pre-eminent in industrial research at the present time and representing a total expenditure of less than £120,000 per annum on research in Great Britain is too misleading to give even a rough idea of the situation. Again, the account of Soviet science and the development of a scientific outlook in the U.S.S.R. would have gained in value by some indication as to whether or not the greater use of science under that regime is accompanied by any greater freedom of direction and content of scientific investigation than under Fascism. The section on associations of scientific workers is rather unbalanced and is strangely free from Prof. Bernal's usual pertinent and constructive criticism. He omits all reference to A. M. Carr-Saunders and P. A. Wilson's fine study of this problem, and one is inclined to suspect that Prof. Bernal himself is among the many scientific workers who have overlooked the significance of that study.

These and other points, however, are minor matters. Some may well be rectified in a later edition, and meanwhile, at a time when the personal security which has formerly been one of the chief triumphs of civilization has diminished almost to vanishing point, scientific workers may well be grateful for this well-balanced analysis of the intricate relations between science and contemporary life and its constructive proposals to remedy the mistakes and failures of the past. At least, it is to be hoped this book will not, like so many other constructive and suggestive works in recent years, be ignored by their professional associations.

R. BRIGHTMAN.

Nutritional Science

Science and Nutrition

By A. L. Bacharach, with a Preface by Prof. J. C. Drummond. (Changing World Library, No. 11.) Pp. xiv+154. (London: C. A. Watts and Co., Ltd., 1938.) 2s. 6d. net.

THIS is a book with a flavour all its own. The author himself modestly defines his aim as being to "put before the reader the kind of methods used in the laboratory study of nutritional problems and the kind of knowledge obtained thereby". That he has succeeded admirably in this there can

be no doubt. But he has done a good deal more as well. The book resembles neither the ordinary 'elementary science primer' on one hand nor the usual type of 'popular science for the layman' on the other. It puts one in mind rather of a series of essays, discursive, stimulating, witty, such as one might expect to find in one of the weekly literary or political reviews. With no sacrifice of accuracy, the text is enlivened by the catholic tastes as well as by the stylistic gifts of the author. It is for this reason that Mr. Bacharach's little book will be read with so much entertainment and

profit not only by the man in the street to whom, as he tells us, it is principally addressed, but also by the specialist.

In the introduction a justification is given for the predominantly chemical treatment which the subject is accorded :

"Walter Pater said that all art aspires towards the nature of music ; is it not also true to say that all biology aspires towards interpretation in terms of atomic physics ? It will probably be conceded that chemical interpretations are a little nearer to the physical asymptote than are physiological. If so, the urgent need to guide the layman away from the mists of obscurantism—naturalism, vitalism, and what not—in his application of scientific knowledge to ordinary human and social problems, must surely justify the presentation to him of biological facts in terms as far removed as possible from the dangers of mystification. I honestly believe that there is a better chance of doing this on the chemical than on the physiological plane."

It might be argued that this reasoning is somewhat stiff going for the 'man in the street' aforementioned, as are also for example such technical points as the chemical equation for the esterification of mixed glycerides (p. 31), or the statement (p. 142) that "the requirements of the population as a whole will presumably be distributed about M/N , in accordance with the normal frequency distribution curve, though nothing at all is known about the breadth or steepness of the curve that indicates the normal variations in need for this or for any other dietary essential". But this objection cannot be sustained, because it is explained (p. ix) that it is for the "interested and educated layman" that the book has been written ; and its author has also assumed (p. 11) that—

"the reader may well be already acquainted with the general features of human nutrition—the broad chemistry of carbohydrates, fats, and protein, the kinds of food in which they occur and their relative amounts, the processes of breaking down—catabolism—to simpler constituents and building up again—anabolism—to the more complex substances of the living body, the two processes together constituting the *metabolism* of the organism."

Incidentally, another justification offered for the essentially chemical approach is that the lay reader is more likely to be acquainted with chemistry than with biology. "The chances, alas, that he will ever have been instructed even in the earliest rudiments of animal physiology are still to-day so small as to be negligible." Fortunately, biology is to-day being given increasing recognition in the average school syllabus, and it may be that

in a few years time this reproach will no longer be valid.

As Mr. Bacharach is largely concerned with describing the results of investigations in the laboratory, "particularly with experiments on small animals", it was a happy touch to dedicate his book (in impeccable Latin phrases) to the albino rat. An introductory chapter is devoted to a justification, and a very persuasive one, of the use of laboratory animals—not as a substitute for clinical studies, but as "biological reagents".

Following on this introduction, the second section of the book deals with "Classical Nutritional Science", that is, with carbohydrates, fats and proteins. Next is a treatment of the mineral elements, "major" as well as "trace", and of hormones. After this we are given an account of the vitamins. In this portion the author makes no pretence to deal even in outline with the whole field, but wisely contents himself with a series of illustrative examples—vitamin A serves to show how vitamins are detected, vitamin C how they are measured, and D how they have been identified.

The final portion of the book deals with diet and human health, first with "the necessity for the optimal", and then—coming down to earth—with the "absence of the optimal". This last aspect of the problem could not be better summed up than as it is by Prof. J. O. Drummond in his most attractively written preface :

"The survival of democracy or its annihilation during the next few years may easily be determined by the measure of attention given in the various countries to what have come to be called the problems of human nutrition. . . . The great majority of the 'problems of nutrition', about which one hears so much nowadays, have been solved by the scientist, and they are now translated into problems of economics or political science. . . . The incidence of pellagra in the 'corn-belt' of the United States still sharply reflects the rise and fall of poverty and unemployment. It is not a question of nicotinic acid ; it is simply one of £. s. d. The only real problem of nutrition in England to-day is the task of making available to the poorest person the 'protective foods', such as milk, butter, fresh salads, and fruit, which are essential for health."

Referring to so-called 'minimal' diets, Mr. Bacharach adds a much-needed corollary. "When a constructional firm is asked to tender for a railway bridge, it is asked to tender for a railway bridge that will do its job as well as possible, and not for one that will be just 'safe' or 'minimal' within the financial ability of the customer to pay. It seems unfortunate that, in matters of human construction, a different principle should be adopted."

LESLIE J. HARRIS.

The Air Almanac

The Air Almanac, 1939, January-March (Air Publication 1602.) Prepared by H.M. Nautical Almanac Office on behalf of the Air Ministry. Pp. 188+xii. (H.M. Stationery Office, 1938.) 5s. net.

THE British "Air Almanac", an almanac specially adapted to the requirements of air navigation, was published for the first time for the last quarter of the year 1937. A review of this publication appeared in these pages. Experience with the almanac in its original form showed the desirability of certain changes. These changes were required, in the first place, in order to shorten the time occupied in working out the results, and, in the second place, to reduce the amount of turning over of pages, because the air navigator often has very cold fingers. Another consideration was the numbing effect on the brain of a long flight; in order to reduce the possibility of error, it was desirable to make the working out of the results so far as possible a matter of pure routine. To meet these requirements, the "Air Almanac" has been completely remodelled. As compared with the original almanac, in the remodelled edition the amount of interpolation has been reduced to a minimum: the number of separate tables that have to be referred to has been reduced, so avoiding turning over pages; and the way of extracting the required information has been standardized.

It may be recalled that the quantities tabulated in the "Air Almanac" are the Greenwich hour angle expressed in arc (that is, the hour angle measured from the meridian of Greenwich) and the declination. These are the two quantities that are required for drawing a position line. For the stars the simplification is introduced of tabulating the Greenwich hour angle of the First Point of Aries. To obtain the Greenwich hour angle of a star, the sidereal hour angle of the star (the hour angle measured westwards from the First Point of Aries) must be added to the Greenwich hour angle of the First Point of Aries. The sidereal hour angle of a star is a quantity that varies slowly through the year and, to the degree of accuracy of tabulation employed in the "Air Almanac", can be taken as constant for the period of three months covered by each issue of the Almanac in its new form.

In the new issue of the Almanac, the intervals of tabulation have been reduced for the sun, moon and planets. The data for the sun and moon, formerly given at hourly intervals, are now given at intervals of ten minutes; the data for the planets, formerly given at intervals of six hours,

are now given at hourly intervals. The interpolations required for the extraction of the data for a given instant of time are accordingly much reduced and simplified. The original publication consisted of a permanent portion containing interpolation and other tables, together with explanation and description, and ephemeral loose-leaf sheets, each one of which contained the data for two days, the stars on one side and the sun, moon and planets on the other. These two portions have now been combined, so that each quarterly issue in the new form is self-contained.

The reduction in the intervals of tabulation has necessitated doubling the number of pages, so that each sheet now caters for one day only. The sheets are perforated and can be torn off in succession as they cease to be required. The increase in size of the Almanac has made possible the tabulation of sunrise, sunset, twilight, moonrise and moonset for each day. The parallax in altitude of the moon is tabulated for each day in the form of a critical table and the phase of the moon is also given. The planetary data are restricted to the three planets that are most favourably placed for observation. The arrangement of the data has been considered very carefully and the maximum possible information has been given in the space available, but without any appearance of undue crowding.

The introduction and explanation of the use of the tables is given after the daily sheets. The list of stars (fifty in all), together with magnitudes, sidereal hour angles and declinations, and an interpolation table for the interpolation of the Greenwich hour angles of the First Point of Aries and of the sun, are given inside the front cover. Space is provided also for a table of dome refractions, for use when observations are made through a dome. A flap is provided which gives the interpolation tables for the Greenwich hour angle of the moon and of the planets and for moonrise and moonset, as well as the Pole Star table and a table for the conversion of arc into time.

Of the various Air Almanacs that have been published, this Almanac in its remodelled form is undoubtedly the most convenient and compact. The Nautical Almanac Office, which has undertaken the computation of the Almanac for the Air Ministry, by agreement with the Admiralty, is to be congratulated on an excellent production, and the Stationery Office deserves to be complimented on a clearly printed and well-bound volume.

It may be added that the tabulated data, given to the nearest minute of arc, are sufficiently accurate for most requirements of surface navigation.

Man in a Chemical World :

the Service of Chemical Industry. By A. Cressy Morrison. Pp. xii+292. (London: Scientific Book Club, n.d.) 2s. 6d.

THIS volume is an interesting example of the publications of the Scientific Book Club, which are available to members at the uniform price of half-a-crown. Described as "a straight-from-the-shoulder account of the activities of chemical industry in converting the discoveries of science into day-to-day necessities of Everyman", it was originally produced under the auspices of the Executive Committee of the American Chemical Industries Tercentenary, in connexion with the celebration in 1935 of the three-hundredth anniversary of the birth of chemical industry in the United States. Its object, as explained in a foreword, "is to impress the man in the street with the fact that the chemical industries of the United States render a service that touches practically every activity in which he engages". This object is amply attained in a simple and able account of the multifarious achievements of chemistry in industry and everyday life, set out under such headings as "Nature Points the Way", "Chemistry in Overalls", "Keeping Well", "Feeding Millions", "From Papyrus to Television", etc.

A remarkable amount of interesting information has been packed, in an attractive form, into this low-priced volume. The language is plain, and there are no chemical formulae to puzzle the lay reader. The text is well printed in a bold type by the Scribner Press in the United States. There are a few ingenious pictorial diagrams; but some of the illustrations are neither instructive nor decorative. J. R.

Die tierischen Parasiten des Menschen

Von Prof. Walter Stenpell. Pp. viii+226. (Jena: Gustav Fischer, 1938.) 12 gold marks.

IN a more convenient and compact form than has hitherto appeared in Germany, this work essays the description of the parasitic fauna of man. Morphological characters are summarized clearly and briefly, but with sufficient detail for identification of all the common parasites. But the rarer forms are also represented (more briefly and in small type) as may be judged by the inclusion of the python parasite *Armillifer moniliformis*, with five cases recorded from man, and of several insects the connexion of which with human disease is slight; in all, 192 parasites are described. A special feature is the illustration of the text by original schematic figures, which are often accompanied by corresponding photographs.

Since the book is intended to be of service to general zoologists rather than to specialists, morphology takes precedence over physiological, biological, medical and epidemiological aspects, and these are seriously touched upon only in the case of prominent forms, like *Plasmodium*, *Trypanosoma*, the tapeworms and a few arthropods. The publishers are to be congratulated on the clearness of the printing and reproduction of illustrations. *Wuchereria* (pp. 134, 135 and index) should be *Wuchereria*.

Insects of Citrus and other Subtropical Fruits

By Prof. Henry J. Quayle. Pp. x+588. (Ithaca, N.Y.: Comstock Publishing Co., 1938.) 5 dollars.

THE field covered by this work is an extensive one which has not been previously dealt with in a comprehensive book form. Its author has had wide experience of citrus fruit cultivation, and its insect enemies, not only in California but also in other lands. While the book deals with all the main citrus-affecting insects, other subtropical fruit insects are also included, notably those affecting avocado, Persian walnut, vinifera grape, fig, almond, olive, date and some others. The life-histories of the chief pests are described and usually figured. Their natural enemies, where noteworthy, are discussed, and artificial methods of control are fully entered into. The subject matter of this book is up-to-date while the illustrations are often new and original. It is a work that is to be recommended to all concerned with citrus cultivation and more particularly to growers in the United States.

Japanese Minerals in Pictures

By T. Ito. In 4 vols. Vol. 1. Pp. xiv+152+27 plates. (Tokyo: The Author, Tokyo Imperial University, 1937.) 12 yen.

A VERY handsomely illustrated mineralogy with the text in Japanese is Prof. Takeo Ito's "Japanese Minerals in Pictures", of which the first of the four volumes was published in Tokyo in 1937. In 152 pages with 96 crystal drawings the elements, sulphides, and fluorides are described. A fourteen-page key in English gives a brief account of the 38 minerals depicted in the 27 plates, with brief notes on the chief occurrences of the minerals in Japan. Twenty of the plates are reproduced in colour and some of these are among the best coloured representations of minerals printed hitherto. The specimens illustrated are picked specimens and will be the envy of mineral collectors. These plates are the special features of the book and will earn it a place on the shelves of mineralogical libraries all over the world.

Useful Trees and Shrubs :

Being a Card File of Data on approximately 500 Hardy Woody Plants in Common Use as Ornamentals. Compiled and prepared by Prof. Florence Bell Robinson. 494 Cards. 6 in. x 4 in. (Champaign, Ill.: The Garrard Press, 1938.) 4.50 dollars.

THIS card index will be useful to those interested in hardy shrubs and trees, though it is difficult to see that it has any advantage over the available books as a reference work. Certain blank spaces on the cards are said to be an invitation to the user to add his own observations and sketches; if used in this way there is no doubt that much benefit would accrue to the user, and in this case the card index scheme admits of profitable expansion of the record. Notes on the cards refer to habitat; form; colour; bark; season of foliage; flower and fruit; 'cleanliness' (that is, susceptibility to pest and disease); pruning; aspect and value.

Fluorescence and Phosphorescence

By Dr. E. Hirschlaff. (Methuen's Monographs on Physical Subjects.) Pp. vi+130. (London: Methuen and Co., Ltd., 1938.) 3s. 6d. net.

THIS new addition to Methuen's series of monographs on physical subjects makes a valiant attempt to cope with the whole of the subject of luminescence, a task particularly difficult at the present time in view of the rapid advances taking place. The book may, on the whole, be recommended to the general reader. Those already familiar with the subject are likely to discover a number of inadequacies. One feels that the directions of most rapid progress at the present time have not been sufficiently emphasized, and it might have been a good deal wiser to confine the book to one of the more important aspects of the subject. In the result there are twelve chapters, of which the first and last are the worst. Chapter i, subtitled "The Experiments", is almost meaningless in its narrow limits of three pages. Such "experiments" as are here mentioned could easily have been brought naturally into line in the later sections of the book. Chapter xii is concerned with technical applications. The most important application of luminescent solids is in discharge devices, and Dr. Hirschlaff's treatment of this aspect cannot be considered as more than sketchy.

The emphasis of the book may be gathered from the fact that seven of the chapters are given up to the problems of fluorescence in gases, liquids and solutions. Two chapters deal specifically with luminescence in solids, and there is also an account of 'cathodo-luminescence'. It is a pity that the references to original papers given at the foot of each chapter are almost entirely confined to Continental workers.

J. T. R.

Hydroids of the Pacific Coast of Canada and the United States

By C. McLean Fraser. Pp. 208+44 plates. (Toronto: University of Toronto Press, 1937). 2.50 dollars.

TO open this book is to be at once reminded of Hincks' "Hydroid Zoophytes", now seventy years old, or of Dr. George Johnston's book of a generation before, both of them beloved by innumerable naturalists. Here, in like manner, Prof. McLean Fraser has produced, in handy form and copiously illustrated, an account of the rich hydroid fauna of the Pacific Coast, from California all the way to Bering Sea. We are struck, at first sight, by the curious likeness of this fauna to the British fauna; many species are identical, such as Linnaeus's *Obelia geniculata* and *Sertularella polyzonias*, or Ellis and Solander's *Halecium muricatum*. Others, not so familiar as these, such as the various species of *Selaginopsis*, carry an Arctic fauna round the world from the Murman Coast and the Siberian Sea. But there are not wanting many others, strange to our European seas. The book is an interesting one to the naturalist at home, and will become an indispensable one to the many naturalists out west by the Pacific.

D. W. T.

A Hand through Time:

Memories—Romantic and Geological; Studies in the Arts and Religion; and the Grounds of Confidence in Immortality. By Dr. Edward Greenly. Vol. 1. Pp. xvi+378+60 plates. Vol. 2. Pp. viii+379+774+15 plates. (London: Thomas Murby and Co., 1938.) 18s. net.

DR. EDWARD GREENLY is best known as the author of a comprehensive memoir on the geology of Anglesey and of a geological map of that island, both published by the Geological Survey. Practically the whole of his long life has been devoted to geological research and, during his wife's lifetime, he owed much to her helpful co-operation. A large part of his book is devoted to a character study of Mrs. Greenly, with which is interwoven the author's autobiography. This account of a long life's companionship will interest especially Greenly's wide circle of friends and acquaintances.

The book is somewhat discursive, but it includes a chronicle of its author's scientific activities, and there are many interesting geological reminiscences. Dr. Greenly's career as a geologist commenced in Scotland in 1889, where he was attached to the Geological Survey for a few years. There he came into contact with Peach, Horne, Clough and other geologists of the period, and he gives an interesting account of survey work in Scotland at that time. On leaving the Survey he proceeded to Anglesey, where he spent twenty years unravelling the complex geology of that island. The account of this masterly piece of research should prove of interest to all geologists, whether or not they are acquainted with its author.

Physical Geography for Indian Students:

being a completely revised and enlarged edition of Simmons and Stenhouse's "Class-Book of Physical Geography". By Dr. Cyril S. Fox. Pp. xii+564+5 plates. (London: Macmillan and Co., Ltd., 1938.) 7s. 6d.

ALTHOUGH primarily intended for Indian students, this revised edition of a well-known text-book makes a wider appeal. The coloured maps which illustrate various aspects of map reading have been chosen from the Survey of India, and many of the examples of physical processes have been chosen from India, but the book as a whole covers all the groundwork of physical geography, including the distribution of climate, plants and animals, and should be useful in all English-speaking lands as an introduction to geography. One of the greatest difficulties confronting the writers of an elementary book on these subjects is the avoidance of over-simplification in the discussion on problems of climate. It is easy to generalize and difficult to avoid complexity. On the whole these pitfalls have been well avoided, but a little revision would not be amiss on the subjects of cyclones, world distribution of atmospheric pressure and ocean currents. On the whole, however, the book is admirable and the many exercises are a valuable feature.

R. N. R. B.

Natural Philosophy and Human Cultures*

By Prof. Niels Bohr, For. Mem. R.S.

IT is only with great hesitation that I have accepted a kind invitation to address this assembly of distinguished representatives of the anthropological and ethnographical sciences of which I, as a physicist, have of course no first-hand knowledge. Still, on this special occasion, when even the historical surroundings speak to everyone of us about aspects of life other than those discussed at the regular congress proceedings, it might perhaps be of interest to try with a few words to direct attention to the epistemological aspect of the latest development of natural philosophy and its bearing on general human problems. Notwithstanding the great separation between our different branches of knowledge, the new lesson which has been impressed upon physicists regarding the caution with which all usual conventions must be applied as soon as we are not concerned with everyday experience, may, indeed, be suited to remind us in a novel way of the dangers, well known to humanists, of judging from our own point of view cultures developed within other societies.

Of course it is impossible to distinguish sharply between natural philosophy and human culture. The physical sciences are, in fact, an integral part of our civilization, not only because our ever increasing mastery of the forces of Nature has so completely changed the material conditions of life, but also because the study of these sciences has contributed so much to clarify the background of our own existence. What has it not meant in this respect, that we no more consider ourselves as privileged in living at the centre of the universe, surrounded by less fortunate societies inhabiting the edges of the abyss, but that through the development of astronomy and geography we have realized that we are all sharing a small spherical planet of the solar system, which again is only a small part of still larger systems. How forceful an admonition about the relativity of all human judgements have we not also in our days received through the renewed revision of the presuppositions underlying the unambiguous use of even our most elementary concepts such as space and time, which, in disclosing the essential dependence of every physical phenomenon on the point of view of the observer, has contributed so largely to the unity and beauty of our whole world-picture.

While the importance of these great achievements

for our general outlook is commonly realized, it is scarcely yet so as regards the unsuspected epistemological lesson which the opening of quite new realms of physical research has given us in the most recent years. Our penetration into the world of atoms, hitherto closed to the eyes of man, is indeed an adventure which may be compared with the great journeys of discovery of the circumnavigators and the bold explorations of astronomers into the depths of celestial space. As is well known, the marvellous development of the art of physical experimentation has not only removed the last traces of the old belief that the coarseness of our senses would for ever prevent us from obtaining direct information about individual atoms, but has even shown us that the atoms themselves consist of still smaller corpuscles which can be isolated and the properties of which can be investigated separately. At the same time we have, however, in this fascinating field of experience been taught that the laws of Nature hitherto known, which constitute the grand edifice of classical physics, are only valid when dealing with bodies consisting of practically infinite numbers of atoms. The new knowledge concerning the behaviour of single atoms and atomic corpuscles has, in fact, revealed an unexpected limit for the subdivision of all physical actions extending far beyond the old doctrine of the limited divisibility of matter, and giving every atomic process a peculiar individual character. This discovery has, in fact, yielded a quite new basis for the understanding of the intrinsic stability of atomic structures, which, in the last resort, conditions the regularities of all ordinary experience.

How radical a change in our attitude towards the description of Nature this development of atomic physics has brought about is perhaps most clearly illustrated by the fact that even the principle of causality, so far considered as the unquestioned foundation for all interpretation of natural phenomena, has proved too narrow a frame to embrace the peculiar regularities governing individual atomic processes. Certainly everyone will understand that physicists have needed very cogent reasons to renounce the ideal of causality itself; but in the study of atomic phenomena we have repeatedly been taught that questions which were believed to have received long ago their final answers had most unexpected surprises in store for us. You will surely all have heard about the riddles regarding the most elementary

* Address given at Kronborg Castle during the excursion to Elanore of the International Congress of Anthropological and Ethnological Sciences, Copenhagen, August, 1938.

properties of light and matter which have puzzled physicists so much in recent years. The apparent contradictions which we have met in this respect are, in fact, as acute as those which gave rise to the development of the theory of relativity in the beginning of this century, and have, just as the latter, only found their explanation by a closer examination of the limitation imposed by the new experiences themselves on the unambiguous use of the concepts entering into the description of the phenomena. While in relativity theory the decisive point was the recognition of the essentially different ways in which observers moving relatively to each other will describe the behaviour of given objects, the elucidation of the paradoxes of atomic physics has disclosed the fact that the unavoidable interaction between the objects and the measuring instruments sets an absolute limit to the possibility of speaking of a behaviour of atomic objects which is independent of the means of observation.

We are here faced with an epistemological problem quite new in natural philosophy, where all description of experiences has so far been based upon the assumption, already inherent in ordinary conventions of language, that it is possible to distinguish sharply between the behaviour of objects and the means of observation. This assumption is not only fully justified by all everyday experience, but even constitutes the whole basis of classical physics, which, just through the theory of relativity, has received such a wonderful completion. As soon as we begin to deal, however, with phenomena like individual atomic processes which, due to their very nature, are essentially determined by the interaction between the objects in question and the measuring instruments necessary for the definition of the experimental arrangements, we are forced to examine more closely the question of what kind of knowledge can be obtained concerning these objects. In this respect we must, on one hand, realize that the aim of every physical experiment—to gain knowledge under reproducible and communicable conditions—leaves us no choice but to use everyday concepts, eventually refined by the terminology of classical physics, not only in all accounts of the construction and manipulation of the measuring instruments but also in the description of the actual experimental results. On the other hand, it is equally important to understand that just this circumstance implies that no result of an experiment concerning a phenomenon which, in principle, lies outside the range of classical physics, can be interpreted as giving information about independent properties of the object; but is inherently connected with a definite situation in the description of which the measuring instruments

interacting with the objects also enter essentially. This last fact gives the straightforward explanation of the apparent contradictions which appear when results about atomic objects obtained by different experimental arrangements are tentatively combined into a self-contained picture of the object.

Information regarding the behaviour of an atomic object obtained under definite experimental conditions, may, however, according to a terminology often used in atomic physics, be adequately characterized as *complementary* to any information about the same object obtained by some other experimental arrangement excluding the fulfilment of the first conditions. Although such kinds of information cannot be combined into a single picture by means of ordinary concepts, they represent indeed equally essential aspects of any knowledge of the object in question which can be obtained in this domain. It is the recognition of such a complementary character of the mechanical analogies by which one has tried to visualize the individual radiative effects which has, in fact, led to an entirely satisfactory solution of the riddles of the properties of light alluded to above. In the same way, it is only by taking into consideration the complementary relationship between the different experiences concerning the behaviour of atomic corpuscles, that it has been possible to obtain a clue to the understanding of the striking contrast between the properties of ordinary mechanical models and the peculiar laws of stability governing atomic structures which form the basis for every closer explanation of the specific physical and chemical properties of matter.

Of course I have no intention, on this occasion, of entering more closely into such details, but I hope that I have been able to give a sufficiently clear impression of the fact that we are here in no way concerned with an arbitrary renunciation as regards the detailed analysis of the almost overwhelming richness of our rapidly increasing experience in the realm of atoms. On the contrary, we have to do with a rational development of our means of classifying and comprehending new experience which, due to its very character, finds no place within the frame of causal description suited only to account for the behaviour of objects so long as this behaviour is independent of the means of observation. Far from containing any mysticism contrary to the spirit of science, the viewpoint of 'complementarity' forms indeed a consistent generalization of the ideal of causality.

However unexpected this development may appear in the domain of physics, I am sure that many of you will have recognized the close analogy between the situation as regards the analysis of atomic phenomena, which I have described, and characteristic features of the problem of observation

in human psychology. Indeed, we may say that the trend of modern psychology can be characterized as a reaction against the attempt at analysing psychical experience into elements which can be associated in the same way as are the results of measurements in classical physics. In introspection, it is clearly impossible to distinguish sharply between the phenomena themselves and their conscious perception, and although we may often speak of lending our attention to some particular aspect of a psychical experience, it will appear on closer examination that we really have to do, in such cases, with mutually exclusive situations. We all know the old saying that, if we try to analyse our own emotions, we scarcely possess them any longer, and in that sense we recognize between psychical experiences, for the description of which words such as 'thoughts' and 'feelings' are adequately used, a complementary relationship similar to that between the experiences regarding the behaviour of atoms obtained under different experimental arrangements and described by means of different analogies taken from our usual ideas. By such a comparison it is, of course, in no way intended to suggest any closer relation between atomic physics and psychology, but merely to stress an epistemological argument common to both fields, and thus to encourage us to see how far the solution of the relatively simple physical problems may be helpful in clarifying the more intricate psychological questions with which human life confronts us, and which anthropologists and ethnologists so often meet in their investigations.

Coming now closer to our subject of the bearing of such viewpoints on the comparison of different human cultures, we shall first stress the typical complementary relationship between the modes of behaviour of living beings characterized by the words 'instinct' and 'reason'. It is true that these words are used in very different senses; thus instinct may mean motive power or inherited behaviour, and reason may denote deeper sense as well as conscious argumentation. What we are concerned with is, however, only the practical way in which these words are used to discriminate between the different situations in which animals and men find themselves. Of course, nobody will deny our belonging to the animal world, and it would even be very difficult to find an exhaustive definition characterizing man among the other animals. Indeed, the latent possibilities in any living organism are not easily estimated, and I think that there is none of us who has not sometimes been deeply impressed by the extent to which circus animals can be drilled. Not even with respect to the conveyance of information from one individual to another would it be possible

to draw a sharp separation between animals and man; but of course our power of speech places us in this respect in an essentially different situation, not only as regards the exchange of practical experience, but also and above all as regards the possibility of transmitting through education to children the traditions concerning behaviour and reasoning which form the basis of any human culture.

As regards reason compared with instinct, it is, above all, essential to realize that no proper human thinking is imaginable without the use of concepts framed in some language which every generation has to learn anew. This use of concepts is, in fact, not only to a large extent suppressing instinctive life, but stands even largely in an exclusive relationship of complementarity to the display of inherited instincts. The astonishing superiority of lower animals compared with man in utilizing the possibilities of Nature for the maintenance and propagation of life has certainly often its true explanation in the fact that, for such animals, we cannot speak of any conscious thinking in our sense of the word. At the same time, the amazing capacity of so-called primitive people to orientate themselves in forests or deserts, which, though apparently lost in more civilized societies, may on occasion be revived in any of us, might justify the conclusion that such feats are only possible when no recourse is taken to conceptual thinking, which on its side is adapted to far more varied purposes of primary importance for the development of civilization. Just because it is not yet awake to the use of concepts, a new-born child can scarcely be reckoned as a human being; but belonging to the species of man, it has, of course, though more helpless a creature than most young animals, the organic possibilities of receiving through education a culture which enables it to take its place in some human society.

Such considerations confront us at once with the question whether the widespread belief that every child is born with a predisposition for the adoption of a specific human culture is really well-founded, or whether one has not rather to assume that any culture can be implanted and thrive on quite different physical backgrounds. Here we are of course touching a subject of still unsettled controversies between geneticists, who pursue most interesting studies on the inheritance of physical characters. In connexion with such discussions, however, we must above all bear in mind that the distinction between the concepts genotype and phenotype, so fruitful for the clarification of heredity in plants and animals, essentially presupposes the subordinate influence of the external conditions of life on the characteristic properties of the species. In the case of the specific cultural

characters of human societies the problem is, however, reversed in the sense that the basis for the classification is here the traditional habits shaped by the histories of the societies and their natural environments. These habits, as well as their inherent presuppositions, must therefore be analysed in detail before any possible influence of inherited biological differences on the development and maintenance of the cultures concerned can be estimated. Indeed, in characterizing different nations and even different families within a nation, we may to a large extent consider anthropological traits and spiritual traditions as independent of each other, and it would even be tempting to reserve by definition the adjective 'human' for just those characters which are not directly bound to bodily inheritance.

At first sight, it might perhaps appear that such an attitude would mean unduly stressing merely dialectic points. But the lesson which we have received from the whole growth of the physical sciences is that the germ of fruitful development often lies just in the proper choice of definitions. When we think, for example, of the clarification brought about in various branches of science by the argumentation of relativity theory, we see indeed what advance may lie in such formal refinements. As I have already hinted earlier in this address, relativistic viewpoints are certainly also helpful in promoting a more objective attitude as to relationships between human cultures, the traditional differences of which in many ways resemble the different equivalent modes in which physical experience can be described. Still, this analogy between physical and humanistic problems is of limited scope and its exaggeration has even led to misunderstandings of the essence of the theory of relativity itself. The unity of the relativistic world picture, in fact, implies the possibility for any one observer to predict within his own conceptual frame how any other observer will co-ordinate experience within the frame natural to him. The main obstacle to an unprejudiced attitude towards the relation between various human cultures is, however, the deep-rooted differences of the traditional backgrounds on which the cultural harmony in different human societies is based and which exclude any simple comparison between such cultures.

It is above all in this connexion that the viewpoint of complementarity offers itself as a means of coping with the situation. In fact, when studying human cultures different from our own, we have to deal with a particular problem of observation which on closer consideration shows many features in common with atomic or psychological problems, where the interaction between objects and measuring tools, or the

inseparability of objective content and observing subject, prevents an immediate application of the conventions suited to accounting for experiences of daily life. Especially in the study of cultures of primitive peoples, ethnologists are, indeed, not only aware of the risk of corrupting such cultures by the necessary contact, but are even confronted with the problem of the reaction of such studies on their own human attitude. What I here allude to is the experience, well known to explorers, of the shaking of their hitherto unrealized prejudices through the experience of the unsuspected inner harmony human life can present even under conventions and traditions most radically different from their own. As a specially drastic example I may perhaps here recall the extent to which in certain societies the roles of men and women are reversed, not only regarding domestic and social duties but also regarding behaviour and mentality. Even if many of us, in such a situation, might perhaps at first shrink from admitting the possibility that it is entirely a caprice of fate that the people concerned have their specific culture and not ours, and we not theirs instead of our own, it is clear that even the slightest suspicion in this respect implies a betrayal of the national complacency inherent in any human culture resting in itself.

Using the word much as it is used, in atomic physics, to characterize the relationship between experiences obtained by different experimental arrangements and capable of visualization only by mutually exclusive ideas, we may truly say that different human cultures are complementary to each other. Indeed, each such culture represents a harmonious balance of traditional conventions by means of which latent potentialities of human life can unfold themselves in a way which reveals to us new aspects of its unlimited richness and variety. Of course, there cannot, in this domain, be any question of such absolutely exclusive relationships as those between complementary experiences about the behaviour of well-defined atomic objects, since scarcely any culture exists which could be said to be fully self-contained. On the contrary, it is well known from numerous examples how a more or less intimate contact between different human societies can lead to a gradual fusion of traditions, giving birth to a quite new culture. The importance in this respect of the mixing of populations through emigration or conquest for the advancement of human civilization need scarcely be recalled. It is, indeed, perhaps the greatest prospect of humanistic studies, to contribute through an increasing knowledge of the history of cultural development to that gradual removal of prejudices which is the common aim of all science.

As I stressed in the beginning of this address, it is, of course, far beyond my capacities to contribute in any direct way to the solution of the problems discussed among the experts at this congress. My only purpose has been to give an impression of a general epistemological attitude which we have been forced to adopt in a field as far from human passions as the analysis of simple physical experiments. I do not know, however, whether I have found the right words to convey this impression, and before I conclude, I may perhaps be allowed to relate an experience which once most vividly reminded me of my deficiencies in this respect. In order to explain to an audience that I did not use the word 'prejudice' to imply any condemnation of other cultures, but merely to characterize our necessarily prejudiced con-

ceptual frame, I referred jokingly to the traditional prejudices which the Danes cherish with regard to their Swedish brothers on the other side of the beautiful Sound outside these windows, with whom we have fought through centuries even within the walls of this castle, and from contact with whom we have, through the ages, received so much fruitful inspiration. Now you will realize what a shock I got when, after my address, a member of the audience came up to me and said that he could not understand why I hated the Swedes. Obviously I must have expressed myself most confusingly on that occasion, and I am afraid that also to-day I have talked in a very obscure way. Still, I hope that I have not spoken so obscurely as to give rise to any such misunderstandings of the trend of my argument.

Modern Trends in Air Transport*

MOST modern air transport is by means of the aeroplane, a body heavier than air, depending upon forward movement for sustentation. For purposes of this examination it can be considered to consist of four fundamentally different systems: (1) the lifting system, that is, the wings; (2) the non-lifting system, principally the body, a structure with space for the load, a girder carrying the tail control units, and often the power plant; (3) the propulsive system comprising the engines and airscrews; (4) the control system, including all devices by which the pilot governs the movements of his aircraft. The trend in development of each of these is examined from the point of view of its approach towards air transport ideals of carrying capacity, speed, range, economy, comfort and safety.

The lift of a wing increases with its area, the square of the speed, and, in general, its angle of attack. Increase of lift therefore demands some combination of larger values of these. It must be remembered that carrying capacity is not gross lift; but rather the surplus of the total lift over that necessary to sustain the weight of the structure, engines, etc. Assuming wing structures carrying the same load per unit area, with the same geometry of structure and materials of construction, while the lift will increase as the square of the dimensions, the volume, and consequently the weight, of the wing will increase as

the cube of these. This relationship, known as the square/cube law, implies that with weight increasing at a greater rate than lift, the carrying capacity of any wing system will ultimately be reduced to zero. The functioning of this law is being defeated by designers by the more efficient distribution of the materials in the structure, the use of specifically stronger (strength/weight) materials, and improved aerodynamic design allowing increased speed for the same power, and consequently extra lift from the same wing area. This is further helped by the fact that the power required is a factor of the wing area, and its weight is only increasing as the square of the linear dimensions of the machine. Increase in angle of attack, as a method of obtaining additional lift, results in an increase in drag of the wing at such a rate that the weight of the extra power plant necessary to overcome it soon cancels out its extra lift. As an example, early post-War commercial aeroplanes weighed from three to five thousand pounds with a wing loading of eight to twelve pounds per square foot, and there was evidence that the optimum size under the square/cube law was already approaching. A new Boeing flying boat, now building, will weigh 82,000 lb. with a carrying capacity of 10,000 lb. while some projected designs for trans-ocean services are of 200,000 lb. total weight and expected to carry a pay load of 25,000 lb., with wing loading of 30-40 lb. per square foot.

The question of speeds is one of commercial requirements. They have risen from 50-80 mile per hour to 150-200 miles per hour normal cruising

* Based on a lecture by Prof. W. F. Durand, emeritus professor of mechanical engineering in Stanford University, given at the recent meeting of the American Association for the Advancement of Science, Richmond, Virginia.

speeds, with much higher top speeds when necessary. The probable highest possible speed of flight that can be visualized at present is about 500 miles per hour, assuming a machine with its various characteristics combined in an optimum manner for this alone, a quite impractical proposition in many other respects. Excluding commercial stratosphere flight—as yet unproved—300 miles per hour appears to be about the practicable limit for commercial aircraft.

Range, the distance flown without alighting or refuelling, obviously depends upon an arbitrary balance between paying load and fuel carried. The theoretically maximum range, with no pay load, and neglecting the effect of weather conditions, assuming a machine designed specially for maximum performance in this respect, appears to be of the order of 8,000–9,000 miles. The present record is about 7,000 miles, and it is not unfair to say that the reduction in this figure is largely due to adverse weather conditions and the limitations of the human element in the control of the machine. Economic considerations bring this figure down considerably; the China Clipper flying boats on the Pacific service, making flights necessarily 2,000 miles in length, are not considered to be a paying proposition to-day. It is anticipated that the new 82,500-lb. flying boat, already mentioned, will have an economic range of 2,400 miles at a cruising speed of 150 miles per hour. It is interesting to note that the cost of operating these long-range commercial flights is curiously stable at an average of 2 cents per passenger seat per mile. These performances may also be modified by taking advantage of the reduced resistance of the more rarefied air at high altitudes. Here again record flights on special machines (52,937 ft.) have no commercial significance; but it appears that more economical flight should be possible in the sub-stratosphere between the altitudes of 20,000 ft. and 30,000 ft. Experimental flights at between 15,000 ft. and 20,000 ft. are already being arranged. The two essentials, that of supplying the engine with the necessary oxygen by supercharging it, and providing the air conditions required for the passengers' comfort by enclosing them in a pressure-tight cabin, have already been accomplished. A Boeing No. 307 is being built for sub-stratosphere flight, with a range of 1,000 miles at 180 miles per hour, carrying a pay load of 9,200 lb.

Comfort for passengers is also an economic question, being principally one of the extra size of the body, with its additional drag and weight, the weight of furnishings of the cabin, the number of crew carried, provision of meals en route and more solid walls for sound- and weather-proofing. All of these are being met in a spirit of competition nowadays.

Safety, principally a matter of allowing for certain adverse weather conditions, can best be studied by considering those conditions in groups that affect an aeroplane differently. Structural breakages due to bad design are practically unknown, and failures of the power plant are being rapidly reduced to a negligible quantity. The Diesel type of engine with its simpler carburation, ignition, and less inflammable fuel, is the more attractive from this point of view, although its performance is inferior in some respects. Flying and navigational instruments are available for all needs, including blind flying and landing in fog, although the human element has to be considered in the limitation of the number of operations that any one person can carry out at the same time. Among more recent developments in this respect are an 'echo' altimeter giving the height of the machine above the ground in the immediate vicinity, a static suppressor that eliminates interference in radio communication, and an automatic radio direction finder working with a gyro-pilot. 'Stall' warning devices of various kinds, coupled with aerodynamic improvements in the control of a machine when flying slowly, have done much to reduce the hazards of taking-off and landing.

The autogyro—a rotating-wing aeroplane—and the helicopter—a flying propeller—are two developments that may have special applications because of some peculiarity that they possess; but their inferior performance in competition with the more conventional aeroplane would appear to limit their use for general air transport.

The position with regard to lighter-than-air craft is not so clear at the present time. Experience dictates that some inert gas, of which helium appears to be the only practicable one, must be used, for reducing fire danger. The restricted supply of this, limited to certain parts of the world, is likely to be a serious factor in the development of airships.

Structural failures in airships of the past have been serious, but lessons have been learned from their investigation, and it is claimed that airships could be built to-day with a structural margin of safety at least equal to a modern aeroplane. Airships are also immune from two possible dangers present in heavier-than-air craft: forced landing due to engine failure, and loss of control resulting in a spinning dive.

In conclusion, it is claimed that although practical flight, which came into being with the success of the Wright brothers in 1903, has presented the transport world with new problems by reason of the fact that it functions in an additional third dimension, they have not proved impossible of solution in both the technical and economic point of view.

Pope Pius XI and His Scientific Interests

WITH the lamented death of His Holiness Pope Pius XI on Friday, February 10, the Christian world at large, and the Catholic body in particular, have lost a spiritual leader who will go down in history as a saintly man of courage and character, of kindness and tolerance, of piety and science.

The duties and interests of a Roman Pontiff are manifold in character. As religious head of the Church, he has to keep, to interpret and to defend the doctrinal and moral teachings of Catholicism. The task of the late Pope in this respect was a difficult one, in view of the social theories and practices of certain totalitarian States. Pius XI placed the whole weight of his authority against individual, social and racial persecution.

As temporal sovereign, the Pope has to consider the political and administrative duties of his exalted position. But in spite of the heavy burden these duties involved, Pius XI never failed to show an active interest in science and its advancement; as a student, he was soon to realize the importance of science not only in a world which is obviously actuated by it, but also for the final shaping of one's philosophical and religious knowledge. As a young scholar, as a curator of the Ambrosian, and afterwards of the Vatican Libraries, as a prelate and finally as a Pope, Pius XI was always assisting the peaceful development of the positive sciences in their various fields of application. For he was convinced that there could be no real incompatibility between science and faith.

The Lateran Treaties, which sealed the peace between the Vatican and the Italian State in 1929, gave the Pope the opportunity of showing in a conclusive manner that he was not only the Pope of peace, but also the Pope of scientific progress. Pius XI took a personal interest in the planning, building and reconstruction of the scientific institutions of his miniature but model State. In November 1930 was opened the new central telephone exchange of the Vatican City; in the following February, the new electric power station and the new wireless station were inaugurated.

The Pontiff was particularly proud of the powerful wireless station at Castelgondolfo, his summer residence, in which the late Senator Marconi embodied the latest devices. The experiments, the tests and the first messages transmitted from Castelgondolfo in April 1932, were followed with the greatest interest by the scientific world. In fact, special receiving apparatus had to be supplied to authorities abroad to suit the requirements of

the ultra-short wave station of Castelgondolfo. Catholics in all parts of the world were thus able to hear in their homes the voice of the Pope himself.

The head of the Church was always ready to co-operate with international scientific organizations. A notable event was the official participation of Vatican delegates to the International Congress of Aeronautics in September 1931 at Budapest. The Pope himself was always ready when his other duties allowed him the time to do so, to receive representatives of learned or technical congresses held in Rome.

The work of the Pontifical institutions in Rome proper was followed with active interest by Pius XI. The inauguration of the new buildings of the Gregorian University in November 1930, of the College of the Propagation of Faith in April 1931, of the Art Gallery in October 1932, the collapse of the roof of the Vatican Library and its subsequent reconstruction, and other similar events, gave the Pope many occasions to confirm his support for the achievements of science. The Pope was informed also of the scientific results obtained by the scholars personally in the Pontifical institutions, not only in Rome, but also in the Catholic University of Milan, which has a world-famous school of experimental psychology under Father Gemelli, and in similar institutions abroad.

The crowning example of the Pope's interest in pure science was the reconstitution in 1936 of the Pontifical Academy of Sciences, which is now housed in the Casina Pio IV in the Vatican gardens, through the generosity of Pius XI himself. The Academy, which was known in the past as the Pontificia Accademia dei Nuovi Lincei, now consists of seventy members chosen from among the most distinguished men of science, irrespective of nationality and of religious profession. The British members are Sir Charles Sherrington and Prof. E. T. Whittaker; the late Lord Rutherford was also a member. His Holiness was present himself at the opening of the new Academy in June 1937:

At the inaugural meeting of the Pontifical Academy last year, Pope Pius XI paid a personal tribute to the benefits conferred on mankind by the labours of Marconi, whom he honoured with his friendship, and of Hertz, to whose widow now living in exile at Cambridge His Holiness made a personal gift of £250. Their work, said the Pope, was accompanied by Divine blessing and recalled the words of Schiller: "Soll das Werk den Meister loben, doch der Segen kommt von oben."

T. GREENWOOD.

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LETTERS TO THE EDITOR

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 290.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

PHYSICAL SCIENCES

Radioactivity of Sea Water

THERE still exists considerable uncertainty regarding the amount of radioactive elements present in sea water, the values found by different investigators varying between very wide limits. In general, a few units of 10^{-12} gm. radium per litre is considered a fair average, although occasionally much higher values have been reported. As regards thorium, the estimates are still more uncertain, generally upper limits only of the content being given, whereas with uranium no sufficiently sensitive method for measuring this element existed until quite recently¹.

Since 1934, through collaboration between this Institute, the Institut für Radiumforschung in Vienna and the Kjemisk Institut in Oslo, we have tried to develop accurate methods for measuring the content of the three elements mentioned in sea water.

Uranium has been measured (by its fluorescence in beads of sodium fluoride excited with ultra-violet radiation) in a considerable number of water samples, taken in coastal as well as in mid-ocean waters and at various depths down to several thousand metres. The results show that uranium is a constant component of sea water, varying in proportion with the total salinity. Ocean water of 35 per thousand salinity holds about 2×10^{-6} gm. uranium per litre, or 2×10^{-8} gm. uranium per gm.

Radium measurements have proved much more difficult, since the amount present is only a small fraction of the anticipated value mentioned above. Success was first achieved in 1936, when we started using a *Mitrisreaktion*, precipitating the radium as sulphate together with barium sulphate by adding small quantities of chloride of barium, of a low and accurately measured radium content, to large quantities of sea water. Working on volumes of 25–200 litres of water from the Baltic, the Kattegat, the Skagerrak and the fjords of Bohuslän, taken at depths from the surface down to 600 metres, we found the radium content to vary between 0.03 and 0.2×10^{-12} gm. radium per litre. We are not yet able to state

with certainty to what extent these variations are due to differences in the radium content with locality, depth, salinity and time.

Separate measurements on the radium concentrated in plankton cells, diatoms extracted from about 6,000 cubic metres of surface water during the spring increase, appear to negative the assumption that particulate matter suspended in the water may be responsible for sensible variations in its radium content.

The average value found from these measurements, namely, 0.07×10^{-12} gm. radium per litre, receives further support from measurements on the radium contained in mollusc shells, *Mytilus edulis* and *Ostrea edulis*. The radium-calcium ratio was found to be about 0.2×10^{-12} , which corresponds to a radium content in the water of rather less than 0.1×10^{-12} gm. radium per litre. It seems significant that this radium content is only about one tenth of the equilibrium amount corresponding to the uranium content already stated. It has been suggested by one of us² that this apparent deficiency of radium in the sea may be due to a more or less complete removal from sea water of ionium, the parent element of radium and an isotope of thorium, caused by the large-scale precipitation of iron as ferric hydroxide occurring in the sea, especially in coastal waters.

The very low radium content, say less than 10^{-12} gm. radium per gm. water, shows that sea water is several hundred times poorer in radium even than meteoritic iron. If the high radium content in certain samples of red clay and radiolarian ooze were really due to a precipitation of radioactive elements from the superposed column of water, it would appear more likely to assume ionium to be precipitated with iron than either uranium or radium itself. The implications following from this possibility will be tested by us in the near future.

Also, in our thorium measurements we have found it necessary to use a precipitation method, adding ammonia and ferric chloride (purified from thorium)

to large quantities of sea water, to which ammonium chloride had been added beforehand. The thorium content was found to be certainly less than 10^{-4} gm. thorium per litre and probably less than half that amount. If we assume the removal of thorium from sea water through natural precipitation with iron to be as efficient as the removal of ionium, taking the thorium-uranium ratio in the denuded rocks to be 2:1, we should expect the thorium content in sea water (judging from its uranium content) to be reduced from, say, 4×10^{-4} gm. thorium per litre to one tenth that amount, that is, to 4×10^{-5} gm. thorium per litre, or very probably still further.

A detailed report on our measurements will appear in *Meddelanden från Océanografiska Institutet i Göteborg*.

Since writing this account of our work, our attention has been directed to a paper by R. D. Evans, Arthur F. Kip and E. G. Moberg²; working by different methods and using much smaller quantities of sea water, these investigators have found values for the radium content not much different from those we have found with water of quite different origin.

Bornö Station,
Sweden.

ERNST FÖYR.
BERTA KARLÉN.
HANS PETTERSSON.
ELISABETH RONA.

¹ *Medd. Océan. Inst.*, No. 11 (1937).

² *Wiener Akad. d. Wissenschaften*, July 1, 1937.

³ *Amer. J. Science*, Oct. 1938.

Physical Evidence for the Division of Heavy Nuclei under Neutron Bombardment

From chemical evidence, Hahn and Strassmann¹ conclude that radioactive barium nuclei (atomic number $Z = 56$) are produced when uranium ($Z = 92$) is bombarded by neutrons. It has been pointed out² that this might be explained as a result of a 'fission' of the uranium nucleus, similar to the division of a droplet into two. The energy liberated in such processes was estimated to be about 200 Mev., both from mass defect considerations and from the repulsion of the two nuclei resulting from the 'fission' process.

If this picture is correct, one would expect fast-moving nuclei, of atomic number about 40-50 and atomic weight 100-150, and up to 100 Mev. energy, to emerge from a layer of uranium bombarded with neutrons. In spite of their high energy, these nuclei should have a range, in air, of a few millimetres only, on account of their high effective charge (estimated to be about 20), which implies very dense ionization. Each such particle should produce a total of about three million ion pairs.

By means of a uranium-lined ionization chamber, connected to a linear amplifier, I have succeeded in demonstrating the occurrence of such bursts of ionization. The amplifier was connected to a thyatron which was biased so as to count only pulses corresponding to at least 5×10^3 ion pairs. About fifteen particles a minute were recorded when 300 mgm. of radium, mixed with beryllium, was placed one centimetre from the uranium lining. No pulses at all were recorded during repeated check runs of several hours total duration when either the neutron source or the uranium lining was removed. With the neutron source at a distance of four centimetres from the uranium lining, surrounding the source with paraffin wax enhanced the effect by a factor of two.

It was checked that the number of pulses depended linearly on the strength of the neutron source; this was done in order to exclude the possibility that the pulses are produced by accidental summation of smaller pulses. When the amplifier was connected to an oscillograph, the large pulses could be seen very distinctly on the background of much smaller pulses due to the alpha particles of the uranium.

By varying the bias of the thyatron, the maximum size of pulses was found to correspond to at least two million ion pairs, or an energy loss of 70 Mev. of the particle within the chamber. Since the longest path of a particle in the chamber was three centimetres and the chamber was filled with hydrogen at atmospheric pressure, the particles must ionize so heavily, in spite of their energy of at least 70 Mev., that they can make two million ion pairs on a path equivalent to 0.8 cm. of air or less. From this it can be estimated that the ionizing particles must have an atomic weight of at least about seventy, assuming a reasonable connexion between atomic weight and effective charge. This seems to be conclusive physical evidence for the breaking up of uranium nuclei into parts of comparable size, as indicated by the experiments of Hahn and Strassmann.

Experiments with thorium instead of uranium gave quite similar results, except that surrounding the neutron source with paraffin did not enhance, but slightly diminished, the effect. This gives evidence in favour of the suggestion³ that also in the case of thorium, some, if not all, of the activities produced by neutron bombardment⁴ should be ascribed to light elements. It should be remembered that no enhancement by paraffin has been found for the activities produced in thorium⁵ (except for one which is isotopic with thorium and is almost certainly produced by simple capture of the neutron).

Prof. Meitner has suggested another interesting experiment. If a metal plate is placed close to a uranium layer bombarded with neutrons, one would expect an active deposit of the light atoms emitted in the 'fission' of the uranium to form on the plate. We hope to carry out such experiments, using the powerful source of neutrons which our high-tension apparatus will soon be able to provide.

O. R. FRISCH.

Institute of Theoretical Physics,
University,
Copenhagen.
Jan. 18.

¹ Hahn, O., and Strassmann, F., *Naturwiss.*, 27, 11 (1930).

² Meitner, L., and Frisch, O. R., *NATURE* [143, 239 (1939)].

³ See Meitner, L., Strassmann, F., and Hahn, O., *Z. Phys.*, 109, 538 (1938).

The Fundamental Length Introduced by the Theory of the Mesotron (Meson)*

It is well known that the vector theory of the meson¹ contains a fundamental length in the interaction of mesons with protons and neutrons determined by the fact that the mass of the meson appears

* The name 'mesotron' has been suggested by Anderson and Neddermeyer (*NATURE*, 143, 874; 1938) for the new particle found in cosmic radiation with a mass intermediate between that of the electron and proton. It is felt that the 'tr' in this word is redundant, since it does not belong to the Greek root 'meso' for middle; the 'tr' in neutron and electron belong, of course, to the roots 'neutr' and 'electra'. In these circumstances, it seems better to follow the suggestion of Bohr and to use electron to denote particles of electronic mass independently of their charge, and negatron and positron to differentiate between the sign of the charge. It would therefore be more logical and also shorter to call the new particle a meson instead of a mesotron.

explicitly in the denominator of some of the interaction terms. This circumstance has the result that in those elementary processes in which the momentum change is large compared with mc , m being the mass of the meson, the interaction becomes very large, leading to Heisenberg explosions, and to greater divergences in some second-order effects than is the case in radiation theory. This has led Heitler¹ and others to the view that the meson theory in its present form is quite incorrect for meson energies larger than about mc^2 , and Heisenberg² to the position that quantum mechanics is competent to deal accurately with only those elementary processes in which the condition³ due to Wataghin,

$$\left| \left(\frac{E_1 - E_2}{c} \right)^2 - (p_1 - p_2)^2 \right| < \left(\frac{\hbar}{r_0} \right)^2, \quad (1)$$

is satisfied, E and p being the initial and final energy and momenta of a particle concerned in the process, and r_0 a fundamental length of the order $\hbar/mc$. The purpose of this note is to bring forward an argument which, it seems to me, shows first that the limitation of quantum mechanics by the condition (1), if true, cannot be based on the explosions as derivable from the theory of the meson, and secondly, to throw some doubt on (1) itself as a limit to the correctness of quantum mechanics.

The argument runs as follows. Let us consider uncharged mesons⁴ for simplicity, since this changes nothing essential to the argument, and consider the Hamiltonian given in A (49)¹. The interaction (58 a) in this contains terms which become very large when the momentum change of the meson becomes large compared to mc in a suitable Lorenz frame. These terms, which lead to explosions, are due as much to the transverse meson waves as to the longitudinal ones, even in the limit when the proton may be considered to be moving non-relativistically. Further, the critical momentum above which explosions begin to appear becomes lower the smaller m , and becomes vanishingly small when $m \rightarrow 0$.

On the other hand, the exact quantized equations of motion for the meson field derivable from this Hamiltonian (A (14) and (15), with the appropriate simplifications for a neutral meson), namely,

$$G_{\mu\nu} = - \left(\frac{\partial}{\partial x^\mu} U_\nu - \frac{\partial}{\partial x^\nu} U_\mu \right) + \frac{g_2}{\hbar c} \psi + \gamma^\mu \gamma^\nu \tau_3 \psi$$

$$\frac{\partial}{\partial x^\mu} b_\mu = \frac{m^2 c^2}{\hbar^2} U_\nu + \frac{g_1}{\hbar c} \psi + \gamma^\mu \tau_3 \psi$$

go over continuously into the Maxwell equations when $m \rightarrow 0$. But one knows from electrodynamics that although there are circumstances in which the emission of a large number of quanta may be more probable than the emission of a single quantum, as in the so-called 'infra-red catastrophe', this in no way sets a limit to the accuracy of quantum mechanics and does not interfere with the calculation of less probable processes by the methods of perturbation theory. Moreover, it is just those processes where the emission of a large number of quanta is very probable which can be calculated classically.

In view of the above circumstances, we must conclude that the appearance of the fundamental length determined by the mass of the meson in the interaction term in no way sets a limit to the accuracy of quantum mechanics. For example, in the collision of two protons with energy very large compared to mc^2 , the probability becomes large for the simultaneous

emission of a large number of mesons, which is the analogue of the 'infra-red catastrophe' for quanta of finite rest mass, and hence quantum mechanics is none the less competent to deal with it. It can similarly be shown that we can calculate the production of large explosions to a high degree of accuracy by treating the meson field quantities classically, that is, as non-quantized magnitudes, for since mesons satisfy Einstein-Bose statistics, the meson field becomes a classical one just in the case where we are dealing with a large number of mesons.

Hence if a fundamental length r_0 exists which limits the applicability of present quantum mechanics to the cases satisfying (1), this length r_0 has nothing to do with the mass of the meson or the appearance of explosions. Quantum mechanics in its present form cannot be strictly valid since it leads to divergent results connected with the self-energies of point charges; but these limitations are probably due to the fact that it is not the quantization of the correct classical equations for point charges, and not to the existence of a fundamental length r_0 . These equations have only recently been given by Dirac⁵ and their quantization has not yet appeared.

Accordingly, we might expect that very fast protons (or neutrons) would produce explosions consisting of mesons of momenta roughly mc , while mesons with energy much larger than the proton rest-energy would not do so, and their scattering by protons would also decrease with increasing energy, in analogy with the Compton effect.

It can be shown that the classical retarded meson field and potentials due to the world line of a classically moving proton or neutron can be written as the sum of two parts. The first part has exactly the form that the corresponding electromagnetic quantities would have for a point charge and point dipole (represented by a six-vector) moving along a classical world line, and does not contain the mass of the meson. The second part has no singularity at any point of space including the world line of the proton, and goes to zero as the mass of the meson $m \rightarrow 0$. The meson singularities are therefore identical with the electromagnetic singularities, and it is possible to eliminate these to the same degree and in the same way as has been done by Dirac⁶ for the electromagnetic field of a point charge.

The detailed calculations will be published elsewhere.

H. J. BHABHA.

Gonville and Caius College,
Cambridge.
Dec. 17.

¹ Kemmer, *NATURE*, 141, 116 (1938); *Proc. Roy. Soc., A*, 166, 127 (1938). Fröhlich, Heitler and Kemmer, *Proc. Roy. Soc., A*, 166, 154 (1938). Bhabha, *NATURE*, 141, 117 (1938); *Proc. Roy. Soc., A*, 166, 501 (1938), referred to above as A; Yukawa, Sakata, and Taketani, *Proc. Phys. Math. Soc. Japan*, 90, 519 (1938). Stueckelberg, *Helv. phys. Acta*, 11, 229 (1938).

² Heitler, *Proc. Roy. Soc., A*, 165 (1938).

³ Heisenberg, *Z. Phys.*, 110, 251 (1938).

⁴ Wataghin, *Z. Phys.*, 68, 650 (1931); 72, 126 (1931).

⁵ Kemmer, *Proc. Camb. Phil. Soc.*, 34, 354 (1938).

⁶ Dirac, *Proc. Roy. Soc., A*, 187, 148 (1938). See also Pryce, *Proc. Roy. Soc., A*, 163, 389 (1938).

Magnetism and the Maxwellian Theory

I AM glad to see from Mr. Rollo Appleyard's letter in *NATURE* of December 31 that he is satisfied with my reply to his query concerning the place of magnetism in fundamental electrical theory. Of course there can be no question of "annihilating magnetic notions" in view of the existence and properties of

permanent magnets; but, as regards the understanding of fundamental physical phenomena, magnetism appears to have played a part similar to that of money in economics—a useful link for facilitating exchange, but a source of unnecessary complexity and confusion in discussion. Since we can formulate the forces acting on moving electric charges directly from Ampère's experiments without introducing magnetism, and thereby dispense with the two stages of reasoning involved in Maxwell's curl equations, it seems decidedly advantageous to do so; and if a magnetic field is merely a translationally moving electric field, as the flux-cutting principle suggests, it seems superfluous to regard it as a separate entity.

What we have hitherto called an electromagnetic wave is simply a wave of electric force and displacement, or electric wave, corresponding to the pressure and displacement in an acoustic wave; and the dualistic concept of two waves of electric and magnetic force in perpendicular planes is a superfluous complication. The electrostatic forces between stationary charged bodies and the propagation of electric waves can be illustrated satisfactorily by assuming protons and electrons to be connected by contractile tentacles or bonds, and the only phenomenon which seems unexplainable by mechanical principles is the transverse force on a moving charge caused by the proximity of another moving charge. This is perhaps the most important fundamental problem in physics and may seem to justify the vortical concept of a magnetic field; but this concept does not appear to provide a convincing explanation. We do know, however, from Ampère's experiments, what this force is; and the general formula given in my letter in NATURE of December 3 enables us clearly to understand the behaviour even of dynamos and transformers without any consideration of magnetism.

Mr. Appleyard has, however, raised another important fundamental point by directing attention to the fact that this force as given by the second

term in my equation: $E_2 = \frac{e}{c^2} [V' \cdot \nabla \phi]$, has no

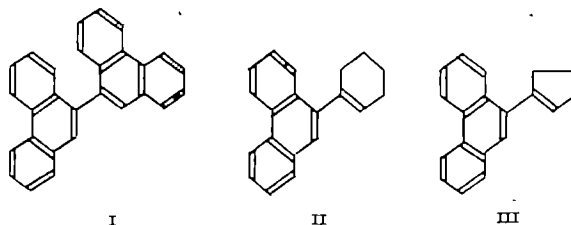
meaning unless the velocities V and V' are defined with respect to a basic framework or medium. This term is in accordance with Maxwell's treatment of moving charged surfaces ("Treatise", 2, xix, § 769); with Ampère's experiments; and with the flux-cutting equations given in my article in NATURE of February 5, 1938. These equations: $E' = [VJ] = \kappa[V \cdot E]$, and $E' = -[VB] = -\mu[VH]$, appear to be the true fundamental equations if the magnetic link is employed, and lead to the relation $E' = \kappa V \cdot E$ for an isotropic dielectric medium if that link is eliminated; but it is evident that they also have no meaning for space unless V is defined relatively to a basic framework or medium; and the physical picture of electric wave propagation which arises from them is so clear and convincing as to leave no room for doubt that electric waves, including light, are undulatory electric displacements in a basic medium or ether which has the properties of a dielectric. I believe that this will be acknowledged in due course, and that the classic theories and concepts of Newton, Faraday and Maxwell will be restored to their rightful eminence.

C. V. DRYSDALE.

The Athenæum.
Jan. 5.

Ultra-violet Absorption Spectrum and Chemical Reactivity of some Substituted 9-Vinyl-Phenanthrenes

THE direct conjugation between two aromatic nuclei or between an aromatic nucleus and an olefinic double bond expresses itself in the spectrum: diffuse bands appear instead of the sharp ones and at higher wave-lengths (diphenyl¹, di- α -naphthyl², styrene³, etc.). It is therefore worth reporting that 9,9'-diphenanthryl (I), although having a system of two conjugated olefinic double bonds, exhibits a spectrum which is practically identical with that of phenanthrene⁴ (two regions of absorption: persistent, diffuse bands between 2700 and 3000 Å., and sharp bands at higher concentrations, between 3000 and 3500 Å.). The same is true for 9-cyclohexenyl-phenanthrene (II), which does not behave spectroscopically analogously to styrene.



It is interesting that the two hydrocarbons, according to E. and F. Bergmann⁵, do not show any 'dienic' activity, for example, towards maleic anhydride. If there really is a parallel between this inactivity and the spectral behaviour, one would expect that for a substance analogous to (II), but having an active conjugation, the spectrum should show the above-quoted characteristic features. This is actually the case: 9-cyclopentenyl-phenanthrene (III), which easily combines with maleic anhydride, has fewer and markedly more diffuse bands than phenanthrene, at the same time shifted towards the visible part of the spectrum.

A detailed description of our results and a report on other cases of such an unusual coincidence will be given elsewhere.

VICTOR HENNEL.

Institute of Physical Chemistry,
University, Liège.

ERNST BERGMANN.

Daniel Sieff Research Institute,
Behovoth, Palestine.
Dec. 25.

¹ Postemer and Mayer-Plesch, *Monatsh.*, 70, 104 (1937). Titelen, *C.R. Acad. Sci.*, 190, 455 (1934).

² Postemer and Cecalsky, *Monatsh.*, 59, 113 (1928). Bruns and Patzelt, *Ber. deutsch. Chem. Ges.*, 70, 1849 (1937).

³ Ley and v. Engelhardt, *S. phys. Chem.*, 74, 31 (1910). Ley and Dirking, *Ber. deutsch. Chem. Ges.*, 67, 1831 (1934). Postemer and Williger, *Monatsh.*, 66, 116 (1935).

⁴ Mayneord and Roe, *Proc. Roy. Soc., A*, 188, 209 (1935). Godart *Bull. Roy. Soc. des Sciences Liège*, No. 3-4 (1938).

⁵ Bergmann, H., and Bergmann, F., *J. Amer. Chem. Soc.*, 59, 1441 (1937).

Atomic Lines in the Auroral Spectrum

PROF. L. VEGARD's recent note¹ on the atomic lines in the auroral spectrum calls for some comments. While it is true that the presence of the Vegard-Kaplan bands in auroral spectra was first observed and interpreted by Vegard, R. Bernarc reported an auroral spectrum in which these bands

and the 3,470 line were unusually strong in comparison with the rest of the spectrum. The remarkable resemblance between this auroral spectrum and the high-pressure afterglow spectrum discovered by me led Bernard to interpret the radiation at 3,470 as a line rather than as the 2 *P.G.* (3-4) band as proposed by Vegard. One must give Bernard credit for an important new observation in recognising this resemblance.

It must be pointed out that Vegard's interpretation of this 3,470 radiation as a nitrogen band is very difficult to understand. As support for this interpretation, Vegard cites the fact that other bands of the progression 2 *P.G.* (3-*n*) appear in the auroral spectrum. These other bands should be much more intense, however, than the band 3469 (3-4), whereas in Vegard's own auroral spectra the 3469 band is the most intense of the three bands 3285 (3-3), 3671 (3-5) and the 3469 band. An examination of any laboratory source of this system will show immediately that this discrepancy will rule out Vegard's explanation and lends support to that proposed by Bernard. Furthermore, the band at 3469 is stronger than the 3500 band in the same sequence. In the large number of afterglow and discharge spectra that have been photographed by me during the last decade, I have never observed such a large enhancement in the intensity of this band as that implied by Vegard. It appears, therefore, that the greater part of the radiation at 3470 is due to the ²*P*-4*S* line, and only a very small fraction to the 3-4 band.

I have also obtained some new spectra which should further help to settle this question. Several years ago¹ I produced the green auroral line in rapidly interrupted weak discharges with remarkably large relative intensity. Accompanying this weak discharge was an afterglow showing an equally remarkable enhancement of the Vegard-Kaplan bands. It was recently possible to duplicate this phenomenon in the high-pressure afterglow. In this case the new nitrogen line (instead of the auroral green line) is so strong that it is at least ten times as intense as the strongest second-positive band. This new experiment leaves no question in my mind as to whether the radiation around 3470 is a band or a new line, and it also adds heavily to the evidence which favours both Bernard's identification as well as my proposal that the line is the transition ²*P*-4*S* in atomic nitrogen.

JOSEPH KAPLAN.

Departments of Physics and Astronomy,
University of California at Los Angeles.

¹ Vegard, L., *NATURE*, 140, 670 (1938).

² Kaplan, J., *Pub. Astr. Soc. Pac.*, 47, 257 (1935).

Photo-sensitive Titanium Dioxide

ATTENTION has already been directed to the reversible darkening in daylight exhibited by some varieties of commercial titanium dioxide¹. Mechanisms for this darkening were suggested and the possibility that the phenomenon is connected with iron present as an impurity in the titania was borne in mind. Titanium dioxide contaminated by iron, which shows rapid reversible darkening in daylight, has been prepared by the following simple process.

Titanium dioxide is mixed with an aqueous solution containing enough iron salts to add 0.2 parts by weight of Fe₂O₃ to 100 parts by weight of TiO₂. The mixture is evaporated to dryness. The residue

is ground for a few minutes and then calcined for three hours to a final temperature of 1,000° C. Calcination is performed in a metallic resistance furnace wherein the titania is freely exposed to air. The resulting readily pulverizable product when ground is ready for study.

The titanium dioxide used in the experiments showed no perceptible darkening in daylight and gave the following spectrographic analysis (prepared by Messrs. Adam Hilger, Ltd.). Ca, trace; Fe, very slight trace; Na, very slight trace, practically 0; P, trace; Pb, minute trace, practically 0; Sb, slight trace; Si, heavy trace; Sn, minute trace. Elements sought with negative result: Ag, Al, As, B, Ba (probably; lines masked), Be, Bi, Cd, Co, Cr, Cu, K, Li, Mg, Mn, Mo, Ni, Sr, Th, Tl, V, W, Zn, Zr.

Iron was added to this oxide as ferrous sulphate or ferric ammonium sulphate, both of analytical reagent quality.

Very precise standardization of quantities or heating schedules is not necessary to obtain striking results. Moreover, there is evidence that certain metals other than iron, used as contaminants, give rise to photo-sensitive preparations.

It is hoped to give a fuller account of the subject of this communication, and of related matters, at a later date in the *Transactions of the British Ceramic Society*.

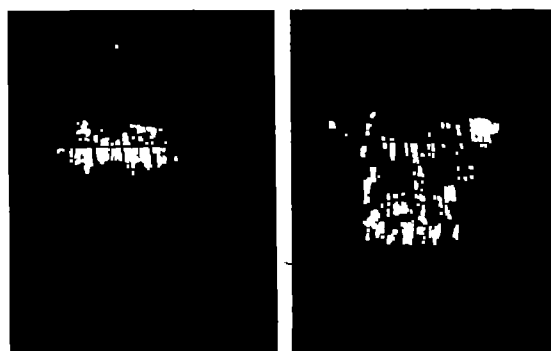
W. O. WILLIAMSON.

Department of Pottery,
North Staffordshire Technical College,
Stoke-on-Trent.
Jan. 16.

¹ Williamson, W. O., *NATURE*, 140, 238 (August 7, 1937).

Migration of Barium on Molybdenum

IN a previous letter¹ we stated that no evidence had been obtained for the surface migration of barium over nickel or tungsten. We have recently published these results² in detail, together with the results of the behaviour of thorium on tungsten.



(a) INITIAL DEPOSIT OF BARIUM OVER PART OF WIRE SURFACE. (b) COMPLETE MIGRATION AROUND WIRE AFTER 20 HOURS AT 1010° K.

The electron microscope described for round wires has been used to study the behaviour of barium on molybdenum. It has been found that over the temperature range of approximately 1,000°-1,050° K., barium migrates uniformly over molybdenum. Below 1,000° K. no movement occurs, and above 1,050° K. evaporation of barium takes place very rapidly.

The two reproductions show the beginning and end of a run at 1,010° K., with barium on molybdenum. It will be noted that the appearance of the migrated layer is similar to that which we have already shown for thorium.

M. BENJAMIN.
R. O. JENKINS.

Research Staff of the M-O. Valve Co., Ltd.
G.E.O. Research Laboratories,
Wembley.
Jan. 11.

¹ NATURE, 140, 153 (1937).

² Phil. Mag., 23, Dec. 1938.

Structure of Proteins

WE have naturally followed with much interest recent developments in the 'cyclol' hypothesis and the structure of the globular proteins¹; but among other things we find difficulty in correlating the following two statements, presumably arrived at by applying the same theory to the same facts: (1) "The properties of proteins shown by our experiments seem to be in accord with the view that the protein monolayer is a two-dimensional network held together by strong elastic springs and are not in accord with a structure consisting of polypeptide chains"²; (2) "This we interpret to mean that, in the formation of monolayers, some or all of the cyclol bonds are opened, few or none of the peptide links being broken, so that protein monolayers consist of polypeptide chains partially or wholly decyclized. . . . This type of structure explains many of their striking characteristics: for example, viscosity, elasticity, etc."²

We ourselves, in view of so much evidence to the contrary, have all along felt that inference (1) was scarcely justified; and in fact we have demonstrated experimentally, by direct measurement and X-ray and optical examination⁴, that egg albumin monolayers deposited by the Blodgett-Langmuir technique do indeed consist of polypeptide chains; but since no references are given and no reason for the change of view from statement (1) to statement (2), it would be helpful to be informed more fully.

W. T. ASTBURY.
FLORENCE O. BELL.

Textile Physics Laboratory,
University of Leeds.
Jan. 21.

¹ Wrinch, D. M., NATURE, 127, 411 (1936), et seq.; Wrinch, D. M., and Langmuir, I., J. Amer. Chem. Soc., 60, 2374 (1938); Langmuir, I., and Wrinch, D. M., NATURE, 140, 551 (1938); Bragg, W. L., NATURE, 143, 73 (1939); Bernal, J. D., NATURE, 143, 74 (1939); Robertson, J. M., NATURE, 143, 75 (1939).

² Langmuir, I., Schaefer, V. J., and Wrinch, D. M., Science, 85, 76 (1937).

³ Langmuir, I., and Wrinch, D. M., NATURE, 143, 49 (1939).

⁴ Astbury, W. T., Bell, F. O., Gorter, H., and Van Ormondt, J., NATURE, 143, 33 (1938).

THE facts, which Astbury and Bell ask for, that have led me to believe that the spreading of a globular protein on water involves the breakdown of a cyclol cage molecule into polypeptide chains without open ends, were given by me in detail in a lecture on July 1, 1938, at the Cold Spring Harbor Symposium on Proteins, in the ensuing discussion, and in the discussion of Dr. Wrinch's paper on June 30. Dr. Astbury attended these lectures. The lectures and discussions have been published in the Cold

Spring Harbor Symposia on Quantitative Biology, vol. 6.

The reasons for the opinion were based upon studies of the viscosities, mechanical properties and solubilities of protein monolayers and a comparison with results obtained with monolayers of several well-recognized long-chain polymers. The fibrous structure that can be developed by shear or by unilateral compression in monolayers of egg albumin, edestin and urease were described and given as additional evidence of the presence of chains in the monolayers. These facts were obtained and the lecture was delivered long after the publication of the "first statement" which Astbury and Bell object to, but before the publication of the paper by Astbury, Bell, Gorter and Van Ormondt.

IRVING LANGMUIR.

Bluffing by Eclipse Prediction

THE communication by Prof. W. A. Osborne¹ has the effect of opening up the question whether the eclipse of the sun mentioned by Anna Comnena may be included in 'historical eclipses'. It is interesting to be able to state that her record seems to be quite sound. There was a total eclipse visible at Constantinople on February 16, 1086.

Most of us have obtained the small amount of knowledge we have about the Emperor and his daughter from the Waverley novel, "Count Robert of Paris". Scott for some reason chooses to describe the lady as being twenty-seven years of age, but he must have known that really her age was only fourteen years, at the time of the story, when the crusaders passed through Constantinople. He gives us a very delightful picture of the daughter reading a newly written chapter of her book to her father for his advice and approval; but here again he must have been equally well informed of the fact that she wrote the work after the emperor's death, when she had taken up her residence in a convent. Now we can all say that she must have had access to reliable records, which enabled her to state with assurance that "the whole [of the sun's] disk was darkened". Usually when a solar eclipse is mentioned by these early writers, the words used are so vague that it is impossible to say whether the eclipse was central or partial at any given locality. In the circumstances, some words of congratulation seem to be due to Anna Comnena and to the authorities who compiled the records from which she derived her information.

The total phase occurred at Constantinople about 4.12 p.m. local mean time. The track of the shadow from the Aegean to the Black Sea seems to be as follows:

Longitude	Latitude
24° 23' E.	39° 54' N.
27° 17' E.	41° 5' N.
30° 17' E.	43° 0' N.
34° 6' E.	45° 8' N.

I obtained the data from the catalogue of eclipses in "L'Art de Vérifier les Dates", vol. 1. The calculations are my own.

C. J. WESTLAND.

116 Western Road,
Christchurch, N.1,
New Zealand.
Dec. 30.

¹ NATURE, 140, 837 (1938).

BIOCHEMISTRY

Coupling between Pyruvic Acid Dehydrogenation and Adenylic Acid Phosphorylation

A new coupling of oxidation-reduction and phosphorylation, with thiamin (vitamin B₁) pyrophosphate as a link of the reaction chain, was found with dry preparations of *Bacterium Delbrückii* (*Acidifactor longissimus*). Phosphorylation of added adenylic acid occurs when pyruvic acid is dehydrogenated, and, as reported previously¹, thiamin pyrophosphate is the prosthetic of the enzyme catalysing the dehydrogenation of pyruvic acid.

When a suspension of certain bacterial preparations, containing very little adenylypyrophosphatase, is shaken with air in the presence of pyruvic and adenylic acid, the oxygen consumption is accompanied by disappearance of inorganic phosphate.

Table 1.

	Initial value	0.125 mol. pyruvate —	0.125 mol. pyruvate 0.03 mol. adenylic acid	— 0.03 mol. adenylic acid
Mgm. inorganic P	0.59	0.53	0.31	0.59
Mgm. ("ml") easily hydrolysed P	0	0.06 (42)	0.23 (200)	0.01
— ml O ₂	—	490	474	58
— P: — O ₂	—	0.04	0.21	—

Aerobic experiment: ca. 25 mgm. dried bacteria, suspended in 0.06 mol. sodium fluoride-phosphate solution, were shaken with air at 37.5° for an hour.

Equation: pyruvate (H₂O) + ½ O₂ = acetate + CO₂ + H₂O.

The organic phosphate compound formed is split by seven minutes hydrolysis with normal hydrochloric acid (see second line of Table 1). Since tests for phosphopyruvic acid were negative, this is taken as evidence for adenosinopolyphosphate synthesis.

As reported elsewhere¹, dismutation is very poor with the dried bacteria, but can be developed by the addition of riboflavin². The analysis showed dismutation to be a fermentation-like reaction with pyruvic acid—pyruvic dehydrogenase as reductant, pyruvic acid—lactic dehydrogenase as oxidant and flavin acting as hydrogen carrier between the two enzymatic systems. The reductant is the same both in aerobic dehydrogenation and in anaerobic dismutation of pyruvic acid. The oxidants, however, are different, being oxygen in the first case and pyruvic acid-lactic dehydrogenase in the second.

It appears from the anaerobic experiment shown in Table 2 that the dismutative reaction also gives rise to phosphorylation.

Table 2.

	Initial value	0.125 mol. pyruvate 0.03 mol. adenylic acid	0.125 mol. pyruvate 0.03 mol. adenylic acid 0.1 mgm. riboflavin
Mgm. inorganic P	0.6	0.59	0.41
Mgm. ("ml") easily hydrolysed P	0	0.01	0.19 (128)
ml CO ₂	—	5	17½
— P: CO ₂	—	—	0.8

Anaerobic experiment: as aerobic experiment, only with nitrogen.
Equation: pyruvate (H₂O) + pyruvate = acetate + CO₂ + lactate.

Since the coupling takes place anaerobically as well as aerobically, it should be independent of the hydrogen acceptor but intimately associated with the dehydrogenation process catalysed by the mediation of thiamin pyrophosphate. In this connexion, it must be considered that inorganic phosphate is an indispensable component of the pyruvic acid dehydrogenation system³. A very close resemblance might exist between the function of the pyridine nucleotide in the coupling reaction in fermentation, analysed by Meyerhof⁴ and by Needham⁵ in detail, and the function of the thiazole derivative in our reaction⁶.

In my opinion, the linkage between the thiamin and adenylic acid systems will prove to be of great importance for the understanding of the metabolic function of thiamin in the living cell. A new source of phosphorylation energy appears which can be utilized both aerobically and possibly anaerobically. The skeletal muscle and to a still greater extent the heart muscle are probably supplied with energy from this source. It is well known that heart failure is one of the most conspicuous symptoms of B₁-avitaminosis⁷ and, according to Birch and Mapeon⁸, the inability of the heart to dispose of free adenylic acid is the cause of the bradycardia of animals deprived of thiamin. Also, the oxidative phosphorylations in kidney and liver, reported by Kalokar⁹, might be linked in part to the thiamin system.

I wish to express my sincere thanks to the Ella Sachs Plotz Foundation for the aid given to this work. The adenylic acid was very kindly supplied to me by Dr. P. Ostern.

Biological Institute,
Carlsberg Foundation,
Copenhagen.
Jan. 7.

FRITZ LIPMANN.

¹ Lipmann, *Enzymologie*, 4, 65 (1937).

² Lipmann, Thirteenth Internat. Physiol. Congress, Zurich, 1938, *Dev.*, 2, 161.

³ Meyerhof, Ohlmeier and Mohle, *Biochem. Z.*, 237, 90 (1933).

⁴ Needham and Lu, *Biochem. J.*, 32, 2040 (1938).

⁵ Lipmann and Peckmann, *J. Amer. Chem. Soc.*, 60, 2575 (1938).

⁶ See review by Williams and Spiess, "Vitamin B₁", New York (1938).

⁷ Birch and Mapeon, *NATURE*, 133, 27 (1933).

⁸ Kalokar, *NATURE*, 140, 871 (1938).

Effect of Nicotinic Acid Deficiency on the Coenzyme Content of Tissues

It is now well recognized, largely through the efforts of the Euler and Warburg laboratories, that nicotinic acid amide is a constituent of both coenzyme I and coenzyme II. Since these coenzymes have such an important role in the metabolic processes of the body, it is of decided importance to acquire more information concerning their physiology. A good deal has been learned from studies with synthetic enzyme systems in which these coenzymes are involved. The *in vivo* approach has been attempted by the Euler group. They have confined themselves to rats as the experimental animals and have encountered many obstacles in their work, since it has been very difficult to demonstrate a clear-cut deficiency in the rat of the coenzymes or of any of their possible precursors. Recently, however, Elvehjem and co-workers¹ have demonstrated a

definite nicotinic acid deficiency in the dog, and Dr. H. Chick *et al.*¹ have made similar observations on the pig. We have thus been enabled to work with two different species in which a definite nicotinic acid deficiency is relatively easy to produce.

Our first approach was an attempt to demonstrate a decrease in the coxymase content of the blood of dogs deficient in nicotinic acid. The coxymase was determined by Euler's method², and every analysis was strictly controlled with blood from a normal animal. In no case were we able to find any differences between the coxymase content of the bloods drawn before and after nicotinic acid therapy. Similar results were obtained by analyses on the blood of deficient pigs.

Our next approach was the coxymase analysis of the brain, liver, kidney and muscle of two pigs and one dog, all showing a definite nicotinic acid deficiency. These analyses were also controlled by using for comparison similar tissues from animals fed the basal diet plus nicotinic acid. The following results were obtained:

(a) There was no decrease in the coxymase contents of either the brain or kidney.

(b) The livers of the deficient animals showed a decrease of about one hundred per cent, while the muscles showed a decrease of so high as one thousand per cent, in their coxymase content.

The accompanying table summarizes the results obtained from the coxymase analyses of normal tissues:

Tissue	Coxymase* (mgm./100 gm. fresh tissue)	Nicotinic acid amide (calc.) (mgm./100 gm. fresh tissue)
Beef muscle	31	5.7
Beef liver	70	12.9
Pig liver	52	9.6

The coxymase values agree with those found by Ochoa³ for rabbit muscle.

The calculated nicotinic acid amide values are of necessity minimal since the coxymase determination includes neither the free acid or amide, nor coenzyme II. The above values for the amide agree in a general way with the nicotinic acid equivalence obtained by bio-assay on the same tissues⁴, and also with those from actual isolation when expected losses are taken into consideration^{5,6}. Karrer⁷, on the other hand, reports values for nicotinic acid amide which are so low that they cannot begin to account for the coxymase alone which is present in the tissues.

It is evident that the coxymase content of the tissues of normal animals remains quite constant, while in a nicotinic acid deficiency there is a decided decrease in the coxymase content of both the liver and the muscle.

A. E. AXELROD.

C. A. ELVEHJEM.

Department of Biochemistry,
University of Wisconsin,
Madison, Wisconsin.
Dec. 15.

* We are indebted to Prof. H. von Euler and Dr. F. Schlenk for a sample of pure coxymase and to Mr. H. A. Campbell for weighing the small amount of coxymase used.

¹ Elvehjem, C. A., Madden, B. J., Strong, F. M., and Woolley, D. W., *J. Biol. Chem.*, **128**, 137 (1938).

² Chick, H., Macrae, T. H., Martin, A. J. P., and Martin, G. J., *Biochem. J.*, **32**, 10 (1938).

³ Euler, H., *Ergeb. Physiol.*, **33**, 1 (1936).

⁴ Ochoa, S., *Biochem. J.*, **303**, 68 (1937).

⁵ Walman, H., Mickelson, O., and Elvehjem, C. A., Unpublished results.

⁶ Kuhn, R., and Vetter, H., *Ber.*, **68**, 2374 (1935).

⁷ Karrer, P., and Keller, H., *Helv. chim. Acta*, **21**, 1170 (1938).

Inactivation of Progesterone in the Organism

SOME years ago, I was able to demonstrate that oestrone which had been administered to the organism very soon became inactive¹. Mature mice or infantile rats were injected subcutaneously with large doses of oestrone (up to 40,000 M.U.). Three to seventy-two hours after the administration of the hormone the animals were killed, cut into small pieces and extracted *in toto* with an organic solvent. It was apparent that even after a very short time, only very insignificant amounts of the hormone (about 1 per cent) could be detected. There remained, indeed, always a certain quantity of active hormone, sufficient to produce oestrus; but the question whether we were considering a hormone which had not become inactive, or one which had become re-activated again, could not be decided. Oestrone is inactivated in the liver, probably by means of an enzymatic process. This inactivation, apparently, is a general biological reaction, since it takes place not only in warm-blooded, but also in cold-blooded animals and in plants as well.

Similar experiments have now been carried out by means of progesterone. For each experiment (progesterone of Organon-Oes was used) two infantile rats were injected subcutaneously with 2.5 mgm. (= 2.5 rabbit units) respectively of progesterone. (An infantile rat tolerates at the most 3.5 mgm. of progesterone.) Forty-eight hours after hormonal treatment the rats were killed, cut into small pieces and ground, including the fur, until a fine mash of tissue resulted. To begin with, this mash was extracted with acetone for some days at room temperature until a fine dry powder was obtained. This was then thoroughly extracted with alcohol and ether for twenty hours in a Soxhlet. All the residue was collected (acetone, ether and alcohol) and only that part which was soluble in absolute alcohol was used. This was dissolved in 10 c.c. of oil (solution A) and tested for its content of progesterone (+) in infantile rabbits. For eight days preliminary treatment with 20 M.U. of oestrone respectively was given, after which the rabbits were given daily 2 c.c. of the oily solution A during the course of five days. On the fourteenth day the animals were killed and the uterus subjected to histological examination. The presence of the decidual transformation of the uterine mucosa proves that at least 1 rabbit unit (= 1 mgm.) must be present in the extract. The experiments having been set up with 5 mgm., the results furnished proof of the fact that 20 per cent of the progesterone which had been administered is still present in the bodies of the rats.

Administration of progesterone	Time elapsed before extraction (hours)	Progesterone transformation is present, that is, 1 mgm. has been detected = 20 per cent
5 mgm.	6	+++
5 mgm.	12	+++
5 mgm.	24	++
5 mgm.	48	—
5 mgm.	96	—

As shown by the accompanying table, the experiments demonstrate: (a) that 6 and 12 hours after the administration of progesterone at least 20 per cent of the hormone could be detected in the organism; (b) that 24 hours after the administration of the hormone the decidual reaction was inadequate, that is, scarcely 20 per cent was still present; (c) that 48 hours after the administration of the hormone the decidual reaction was negative and that there was, therefore, no longer 20 per cent.

Although the progesterone reaction, that is, the decidual transformation of the uterine mucosa, does not occur until about 100 hours have elapsed, even after 48 hours the hormone is no longer present in an active form. In this respect, progesterone is similar qualitatively to oestrone. Inactivation of oestrone, however, occurs much more rapidly and much more intensely than that of progesterone.

Control experiments were set up to prove that, with the help of the extractive method, progesterone which had been added to the mash could again be proved quantitatively.

BERNHARD ZONDEK.

Obstetrical-Gynaecological Department,
Rothschild Hadassah-Hospital,
Jerusalem.
Dec. 8.

¹ Zondek, B. *Lancet*, 227, 355 (1934); *Scandin. Arch. Physiol.*, 70, 133 (1934); "Hormone d. Ovariums und d. Hypophysen-vorderlappens". Second edition (Vienna: Springer, 1935), pp. 124-147.

Determination of rH in Endocrine Extracts of a Protein Nature

We have begun to study systematically extracts of endocrine glands containing hormones of a protein nature, especially extracts of the anterior pituitary lobe (ALH) of cattle. For technical reasons very dilute extracts were used: 1 gm. of the dry powder, previously kept *in vacuo*, was shaken for 4 hours with 20 ml. of a 0.0001 *N* NH_4Cl solution and then filtered. The pH of the filtrate was kept at about 6.2.

Search was made for reducible substances in the solution and their reduction potentials were measured by means of Heyrovsky's polarographic apparatus with the dropping mercury cathode. All measurements were made with a voltage of 3 volts across the potentiometer. Before each experiment a stream of electrolytic hydrogen, thoroughly purified, was bubbled through the solution. The sensitivity used was generally 1/50 and 1/100 of the total sensitivity of the galvanometer.

We show first the current voltage curve obtained with an extract of powdered ALH, showing three steps corresponding with three reducible substances (groups), having well-defined reduction potentials: $rH_1 = -0.23$ volts, $rH_2 = -1.00$ volts, $rH_3 = -1.65$ volts. The second decimal figure has no great significance.

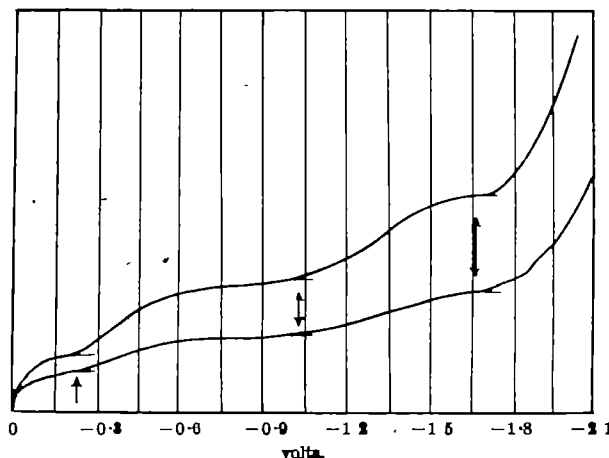
These three steps did not appear when the powder had not been kept *in vacuo*; they disappeared gradually as the extract was made more and more alkaline, and completely at pH 9.9. These substances (groups) are soluble in ether and in acetone. We were able to repeat these results with powders made from different fresh or frozen glands or glands kept for a time under acetone and also with different extracts prepared from the same gland.

Next, we wished to establish whether the three rH values corresponded with different anterior pituitary hormones. We first examined several purified commercial preparations. One of them had, as shown by tests on guinea pigs and rats, a thyreotropic and a gonadotropic action. This preparation, diluted with 0.0001 *N* NH_4Cl , showed reduction potentials at $rH = -0.23$ v. and $rH = -1.65$ v., and therefore corresponds with rH_1 and rH_3 of the total extract of the powdered ALH. Another preparation showed in our own tests a gonadotropic action, but no signs of thyreotropic activity, as determined by the usual guinea pig method. This preparation

showed $rH = -0.23$ v. and sometimes $rH = -1.00$ v. and therefore corresponded with rH_1 and rH_2 of the total extract.

Finally, we ourselves prepared extracts from the powdered ALH. One extract showed a gonadotropic action, but no definite thyreotropic effect or only very little. It had a reduction potential of $rH = -0.23$ v. only.

Another extract prepared by us showed some thyreotropic but no gonadotropic action and a reduction potential of $rH = -1.65$ v.; it therefore corresponded with rH_3 of the total extract.



CURRENT VOLTAGE CURVE OF A TOTAL EXTRACT OF POWDERED ALH. ABSCISSA: VOLTAGE, ONE DIVISION = -0.15 VOLTS. ORDINATE: INTENSITY OF THE CURRENT. UPPER CURVE: SENSITIVITY 1/50 (ORDINATE: 1 MM. = 2×10^{-7} AMP.). LOWER CURVE SENSITIVITY 1/100 (ORDINATE: 1 MM. = 1×10^{-7} AMP.).

We were not able to find these two substances ($rH = -0.23$ v. and $rH = -1.65$ v.) in extracts from other glands. There are, of course, reducible substances in such extracts; thus we found in some extracts from freshly prepared powdered ovaries from cows rH values of -0.17 v. and -1.35 v., but never values of -0.23 v. or -1.65 v.

The substance (or group of substances) characterized by $rH = -1.00$ v., the rH_2 of the total extract of the powdered ALH, described above, was also found in extracts of the pituitary posterior lobe, whether these extracts had both a hypertensive and an oxytocic effect, or only either of these effects alone.

We conclude from these experiments that in extracts from the freshly prepared powdered anterior lobe of the pituitary the gonadotropic hormone is always accompanied by a reducible group of $rH = -0.23$ v. and the thyreotropic hormone by a reducible group of $rH = -1.65$ v. Gonadotropic hormone prepared from urine of pregnant women does not contain this reducible group having an rH of -0.23 v. The physiological significance of these two specific reducible substances (groups) remains still to be investigated.

Pharmacological Department,
University,
Ghent.

L. HAUBS.

Laboratoires Belges
d'applications biologiques,
Brussels.
Dec. 7.

Trimethylamine Formation in Relation to the Viable Bacterial Population of Spoiling Fish Muscle

IN view of the recent communication in *NATURE* on this subject¹, the following comments may be of interest.

Experiments with haddocks stowed in ice² have shown that there is no close correlation between the viable count and the trimethylamine content of the flesh. Indeed, the content of dimethylamine, also produced from trimethylamine oxide, follows the general curve of bacterial growth much more closely³. Whilst it is most probably true that only certain organisms are capable of reducing the oxide, the empirical fact remains that in haddocks stowed in ice—the usual industrial preservative—the increase in content of trimethylamine has always been found to follow the organoleptic phases of spoilage in a sufficiently consistent way to render the amount of this substance present a useful index of the extent of spoilage. It would seem that, as Dr. Tarr suggests may be the case, the proportion of trimethylamine-forming to non-trimethylamine-forming bacteria is fairly constant, at least under the conditions of stowage mentioned above. The content of dimethylamine has similarly been found to be a useful index of spoilage. Indeed, reference to these two indexes together serves satisfactorily to characterize the condition of haddocks at any stage right up to the point of definite staleness.

Finally, whilst it is reasonable to assume, until the contrary is proved, that the flora of the external surfaces of all sea fish is much the same, it has been found that spoilage may pursue different courses in different species. Thus in the dogfish the contents of diamine and triamine never rise during stowage in ice to the extent that might be expected from the much larger amount of oxide present as compared with the haddock. Indeed, diamine is present only in traces during stowage for thirty days; whilst the amount of triamine is only of the same order as that found under similar conditions in the haddock. The explanation of these results may be that the large amount of ammonia formed from urea, present in much larger amounts in the dogfish than in the haddock, causes the trimethylamine oxide reducers to be overgrown by other bacteria. Certainly it has been noticed that after stowage the flora of the dogfish is considerably restricted in types as compared with that of the haddock.

In this connexion, it is of interest that Dr. Tarr's work, as reported¹, was done with smoked fish, since it is probable that the constituents of smoke effect considerable alteration in the original flora of the fish.

JAMES M. SHAWAN.

Torry Research Station,
Aberdeen. Jan. 19.

¹ Tarr, H. L. A., *NATURE*, 140, 1078 (1938).

² Shawan, J. M., Report of the Food Investigation Board (London), Sec. 4, p. 75 (1937).

Determination of Uronic Groups in Polysaccharides

URONIC groupings occurring in polysaccharides are usually determined by measuring the evolution of carbon dioxide on heating with 12 per cent hydrochloric acid. Campbell, Hirst and Young¹ have pointed out that a small amount of carbon dioxide is liberated under these conditions from a number of pure sugars and polysaccharides in which the presence of uronic groups is not presumed, though not necessarily disproved. The evolution of carbon dioxide from certain acids that might be formed by

the degradation of polyuronides was reported by Norman and Martin². In an investigation of plant celluloses carried out two to three years ago at the Rothamsted Experimental Station, it was sought to establish whether the carboxyl groups demonstrably present were of the uronic type. Yields of carbon dioxide of the order of 0.2–0.3 per cent were considered to be unreliable for the reason just given, and accordingly recourse was had to the determination of the rate of evolution of carbon dioxide from such substances under standard conditions in the hope that this might be employed for demonstrating the presence or absence of uronic groups. No absolute value is involved inasmuch as it is the rate of absorption that is measured, and this is in part a characteristic of the size of apparatus in relation to the sample, the air stream, and absorbing device employed. The oil bath temperature was maintained at 140°, and a constant rate of aeration secured. The distillation was not carried out in an atmosphere of nitrogen; nevertheless the total yields of carbon dioxide from pure substances were not higher than those given by Campbell, Hirst and Young¹.

Heating was ordinarily continued for five hours, and the absorbing vessels changed every ten minutes in the first hour, every fifteen minutes in the second hour, and thereafter at thirty-minute intervals.

The rate of evolution of carbon dioxide from substances predominantly of a polyuronic nature, such as pectin, was found to be characteristic. The curve for mgm. carbon dioxide evolved per minute per gram exhibited a sharp peak between 20 and 30 minutes from time of reaching the boil. By the end of the first hour, slightly less than 50 per cent of the total carbon dioxide yield was collected. The only sugars exhibiting a sharp peak in carbon dioxide evolution were fructose and sucrose, and in these the maximum occurred earlier, between 10 and 20 minutes from time of boiling. No such sharp maximum was obtained with glucose, from which carbon dioxide was liberated only slowly. Evolution was higher in the second hour of boiling than the first, and the peak, which was ill-defined, appeared to occur at about 75 minutes. By the end of the first hour only about 15 per cent of the total carbon dioxide yield was obtained. The total yield was, in fact, difficult to establish since small quantities continued to be evolved for many hours.

The curve obtained for rice starch was of the same type as that for glucose, but that for cotton cellulose exhibited a peak in the neighbourhood of 30 minutes followed by a steady but not abrupt fall. This was more marked in a sample of Canadian spruce cellulose (not dried), which showed a second but smaller maximum at about 75 minutes. The nature of the curves was such as to suggest that they combined the effect of the uronic grouping in giving an early peak, and that of the hexose material in providing a longer and more steady evolution of carbon dioxide. Such a procedure may therefore be helpful in pointing to the probable presence of uronic groups in polysaccharides, when small quantities only are present. In addition, the total carbon dioxide evolution from a number of plant celluloses was determined.

PERCENTAGE CARBON DIOXIDE EVOLVED FROM CERTAIN CARBOHYDRATES

		Celluloses from:	
Glucose	0.19	Wheat straw	0.30
Fructose	0.50	Rye grass	0.31
Sucrose	0.54	Oak	0.54
Rice starch	0.30	Canadian spruce	0.41
Potato starch	0.30	Jute	0.78
Cotton oxycellulose	1.29	Hemp	0.30
Barbado cellulose	0.18	Manilla hemp	0.55

In support of the conclusion that the presence of uronic groupings could be inferred from the rate of evolution of carbon dioxide, it was further established that the plant celluloses were not homogeneous with respect to groupings giving rise to carbon dioxide, and that mild acid and alkaline treatments effected a reduction in carbon dioxide yield out of all proportion to loss of weight. The following figures were obtained for Canadian spruce cellulose (carbon dioxide yield = 0.41 per cent).

(1) Residue after extraction with hot 5 per cent sulphuric acid for 1 hour, 87.34 per cent; carbon dioxide yield, 0.26 per cent.

(2) Residue after extraction with cold 4 per cent caustic soda for 2 hours, 86.40 per cent; carbon dioxide yield, 0.23 per cent.

Carbon dioxide yield on original basis from (1) = 0.22 per cent. Carbon dioxide yield on original basis from (2) = 0.20 per cent.

While no quantitative significance in terms of uronic content can be attached to very small yields of carbon dioxide from polysaccharides, the development of the procedure outlined above may permit of the demonstration of the presence of uronic groupings with a reasonable degree of certainty.

Agronomy Department,
Iowa State College,
Ames, Iowa.
Dec. 30.

A. G. NORMAN.

¹ Campbell, W. G., Hirst, M. L., and Young, G. T., *NATURE*, **142**, 913 (1938).

² Norman, A. G., and Martin, J. T., *Biochem. J.*, **24**, 649 (1930).

A Rapid Visual Test for Vitamin A Deficiency

A RAPID visual test for vitamin A deficiency has been described by Gridgeman and Wilkinson¹, by Haines², and recently by Pett³. In this method the patient is first asked to view a strong light (of intensity I), for a standard time T . Then this light is suddenly switched off and the time t required to see a dim light of intensity i is noted. An excessively high value of t is taken to indicate abnormality.

For the past six months I have been studying this method with the view of finding a standard method which will: (a) give maximum discrimination between normals and abnormals; (b) be applicable to uneducated people and children; (c) be capable of being rapidly carried out by an unskilled observer.

The most important difficulty is due to the fact that the time t can be largely influenced by factors such as intelligence, education and nervousness, as well as by vitamin A deficiency.

From my results it appears that: (a) if the intensity I is greater than about 100 foot-candles, the patient closes the eyes or is troubled with after-image; (b) to bring the eye to a definite state and to give maximum discrimination, T must be at least 150 seconds.

Since some time must be spent in making the patient accustomed to the apparatus, I do not think that a reliable indication can be obtained in less than five minutes. At present I make three tests with values of T at 30, 60, 150 sec. respectively, the total time being 7 minutes. The first two serve to make the patient accustomed to the apparatus. Also an abnormal, in addition to showing a long time (t) on the last test, usually shows a considerable difference between the second and third tests. Unintelligent or nervous normals, on the other hand, may improve between the second and third tests.

The patient has to say which of four letters he sees (N , Z , T , X). The letters are about two inches high and are viewed from 18 inches. Objects of similar size are used for children and illiterates, so that ordinary errors of vision do not affect the result.

This work is being continued by Miss E. J. Power-Steele, by whom the detailed results will be published.

Trinity College,
Dublin.

R. W. DITCHBURN.

¹ *Lancet*, **i**, 905 (April 16, 1938).

² *Trans. Ophth. Soc.*, **57**, Part 1 (1938).

³ *NATURE*, **142**, 23 (1939).

A Specific Factor in Extracts of the Choroid Plexus Influencing the Permeability of the Myelencephalic Roof

WE have shown in earlier experiments that in chick embryos the spread of cerebrospinal fluid from the neural canal to the periaxial spaces is coincident with the development of the choroid plexuses¹, and that in rabbit, rat and guinea pig embryos, extra-cerebral spread of cerebrospinal fluid can be induced when a hypertonic saline solution is injected into the blood stream only after the choroid plexuses are differentiated².

In recent experiments we have shown that extracts of the choroid plexus of the rabbit, dog, cow, sheep and guinea pig contain a factor which has the following properties:

(1) It increases the intradermal spread of dyes to a degree commensurate with that of the spreading factor isolated from mammalian testis by McClean³ and investigated by Hoffman and Duran-Reynals, Claude and Duran-Reynals and others.

(2) It is species specific, that is, the choroid plexus extract of rabbit gives in the rabbit a much wider dermal spread than the choroid plexus extracts of cow, sheep and dog; the choroid plexus extract of the dog produces its most extensive spread in the dog.

(3) Stale extracts are usually less potent than fresh extracts.

(4) By injecting chicken choroid plexus extract into the central canal of the nervous system we were able to anticipate the peri-pariaxial spread of cerebrospinal fluid. In non-injected chick embryos, the first extra-cerebral spread of fluid is seen at 7 days through the anterior membranous area of the myelencephalic roof, coincident with the development of the choroid plexus in the lateral and third ventricles. In injected chick embryos there was a quite marked extra-cerebral spread at five days, that is, two days earlier than the appearance of the choroid plexus, and a slight spread was observed in four-day embryos. Cow choroid plexus and rabbit testis extracts increased the permeability of the membranous areas but slightly and at a much later stage (5½ days).

These experiments suggest that a primary function of the glandular epithelium of the choroid plexus is to elaborate a factor which renders permeable the membranous areas of the myelencephalic roof and thus initiates the extra-cerebral escape of the fluid from the central canal.

We have found recently that extracts of the ciliary body contain a similar spreading factor, an observation which might throw light on the etiology of senile glaucoma.

Department of Medicine,
University of Liverpool.
Jan. 10.

HENRY COHEN.
SARAH DAVIES.

¹ Cohen, H., and Davies, S., *J. Anat.*, **68**, 23 (1937).

² Cohen, H., and Davies, S., *J. Anat.*, **68**, 430 (1938).

³ McClean, D., *J. Path. and Bact.*, **33**, 1045 (1930).

BIOLOGY

'Sporangial Drops' in the Mucoraceae

It is remarkable that such a commonplace occurrence as the natural liberation of the spores from a sporangium of *Mucor* seems not yet to have been accurately described.

The text-books either ignore the matter, or state briefly that the sporangial wall bursts, setting free the spores. Many of the figures published^{1,2} show

At this stage the spores may be dispersed by contact with solid objects. Comparison may be made with the 'oidial drops' of *Coprinus* described by Brodia³, but a similar function in relation to dispersal by flies has not been observed in the Mucoraceae. Where the 'sporangial drops' come in contact with aerial hyphae, they tend to run down them and collect as large irregular spore-containing drops at points where a number of hyphae touch. Such sporangial and spore-containing drops occur in every culture in which sporangia develop to maturity; but all those observed by me have dried down into solid masses of spores firmly stuck together (Figs. 4-6). The precise conditions under which spores are distributed into the air have not yet been determined, but there is no evidence that in any of the species examined the spores are so dispersed while the sporangiophore is still turgid.

The expansion and contraction of the liquid contents of the unseptate mycelium in response to variations in temperature cause rapid changes in the size of the sporangial drops and the turgidity of the sporangiophores. Even in a sealed cell containing a water surface, sporangiophores and other aerial hyphae are in constant motion owing to slight temperature changes. Thus the stalk of a mature sporangium collapses, as shown in Fig. 2, after a slight fall in temperature, but regains turgidity, as in Fig. 3, when the temperature rises again. This factor is also of some importance in connexion with the growth and bursting of the sporangia.

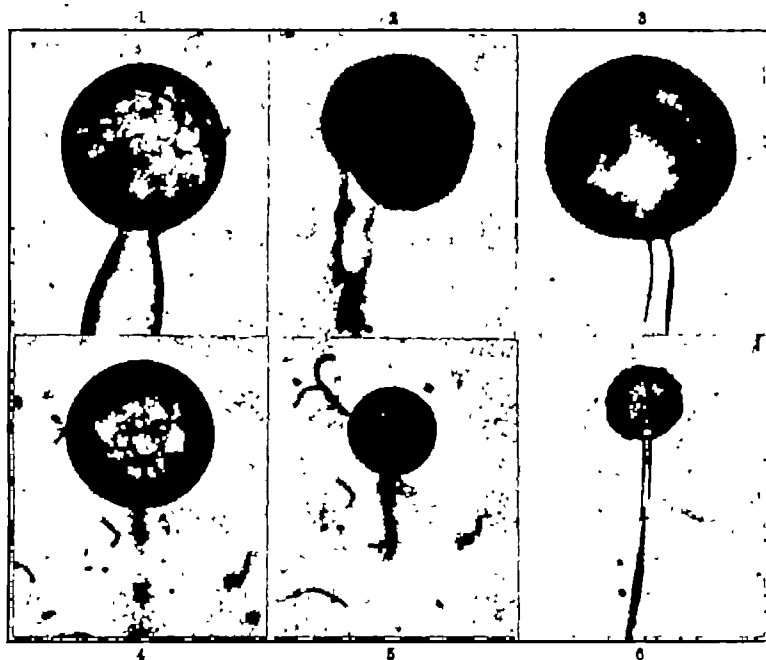


Fig. 1 ($\times 275$).

Diceranophora fulva SCHBÖT., A SPORANGIAL DROP.

Figs. 2-6 ($\times 437$).

Mucor hiemalis WHEIM. 2, 3, MATURE SPORANGIA WITH (2) COLLAPSED, (3) TURGID, STALK; 4-6, A SERIES TAKEN AT 20 MIN. INTERVALS, SHOWING A SPORANGIAL DROP DRYING DOWN TO A SPORE MASS OF IRREGULAR OUTLINE.

spores apparently being liberated into the air from the end of an erect and turgid sporangiophore, and there is one familiar drawing by Brefeld⁴ which has been described, in at least three books^{5,6} which have reprinted it, as of a sporangium shedding its spores. Reference to the original work, however, shows that the drawing is of a sporangium which has been crushed and treated with alcohol.

Normally, sporangia which burst in mid-air can be watched only under a low power of the microscope, as those which are within range of a $\frac{1}{4}$ in. objective almost invariably burst against the coverslip, the spores flowing out and adhering to the glass around the columella somewhat as shown in Brefeld's figure.

The conclusions I have reached after observations on the sporangia of eight species of Mucoraceae are that, when the sporangium bursts in air and away from any solid surface, the spores are not set free when the wall breaks, nor for some time afterwards. The sporangial wall is replaced by a water surface, and the sporangium becomes a 'sporangial drop' of liquid containing the spores and columella (Fig. 1).

Botany Department,
King's College,
London, W.O.2.
Jan. 12.

O. G. DOBBS.

¹ Harshbarger, J. W., "Mycology and Plant Pathology", Fig. 11 (after Conn) (London, 1917).

² "Strasburger's Text-book of Botany", Fig. 335 (London, 6th Eng. ed., 1930).

³ Brefeld, O., "Botan. Untersuch. u. Schimmelpilze", 4, Taf. 2, Fig. 11 (Leipzig, 1891).

⁴ v. Tavel, F., "Vergl. Morphol. der Pilze", Fig. 12, 5 (Jena, 1892).

⁵ "Strasburger's Text-book of Botany", Fig. 387 (1930).

⁶ Bower, F. O., "Botany of the Living Plant", Fig. 313 (London, 1928).

⁷ Brodia, H. J., *Ann. Bot. Lond.*, 45, 315-344 (1931).

Excretion of Nitrogen by Leguminous Plants

THE results of Virtanen¹ and his associates, concerning the possible excretion of nitrogenous compounds from legumes and their absorption by associated non-legumes, have not in general been confirmed. The investigations of Wilson², Bond³ and ourselves⁴ have

on the whole brought forward evidence contrary to that of Virtanen.

It may be generally assumed that the excretion and donation obtained by Virtanen are associated with some environmental factors not readily reproducible elsewhere.

In more recent experiments carried out at the Waite Institute, attempts have been made to grow peas and oats in association under a variety of conditions, which included variations in the amount of daylight and in the moisture content of the soil. It might be assumed that a reduction in the amount of photosynthesis in a well-established leguminous plant might result in an accumulation of nitrogen compounds above the needs of the plant, such excess being excreted and made available for any associated non-legume.

In these experiments in a series of pots, a mixture of oats and inoculated peas and oats alone were grown in pure sand under favourable conditions for a period of six weeks—the peas at the end of this period were vigorous and healthy. A differential treatment was then imposed for a further six weeks on half of the pots. These pots were allowed two hours of daylight only each day, between the hours of noon and 2 p.m. The atmospheric conditions favoured high transpiration.

Each pot contained either two oat plants alone or two oat plants and two pea plants.

TOTAL NITROGEN (MGM.) IN OAT PLANTS PER POT.

Replicate	Normal daylight, approx. 11 hours daily		Reduced daylight 2 hours daily		Mean
	Oats alone	Oats with	Oats alone	Oats with	
1	4.00	3.83	5.01	7.10	5.01
2	3.91	3.14	5.06	6.84	4.99
Mean	4.00	3.48	5.34	6.97	4.95

The standard error of a single observation is ± 0.35 .

The increases in the total nitrogen content of the oats brought about by shading or by association with peas are independently significant, statistically. The legume effect is significant when the effect of shading upon the oats alone is eliminated.

In no circumstances have we ever been able to obtain evidence of donation in controlled pot experiments under the normal growing conditions in Adelaide. It is of interest that we have been able to obtain evidence of apparent donation by some modification of the local environment.

T. H. STRONG.

H. C. TRUMBIE.

Waite Agricultural Research Institute,
Adelaide.
Dec. 24.

¹ Virtanen, A. I., and Laine, T., *J. Agric. Sci.*, **27**, 332 (1937), etc.

² Wilson, P. W., *NATURE*, **149**, 155 (1937).

³ Bond, G., *Ann. Bot.*, n.s., **2**, 61 (1938).

⁴ Trumble, H. O., and Strong, T. H., *U.S.I.R. (Aust.) Bull.*, **105**, 11-24 (1937).

Respiration Changes following Irradiation with X-rays

In a study of respiratory changes prior to tumour formation after irradiation with X-rays, two disturbances in the oxidation processes of the affected tissues were observed. A group of sixteen mice were given local treatment of X-rays sufficient to produce a burn. At various intervals after irradiation (3 hours-60 days), mice were successively sacrificed and the respiration of the irradiated area compared to the respiration of an

equal control area on the same mouse. It was observed that, after the first day of irradiation, the respiration began to decrease, reaching a maximum depression, after about two weeks, of 60 per cent below the respiration of the control skin. Directly following this period of inhibition was a period of stimulation which brought the oxygen consumption of the irradiated area of skin about 35 per cent above that of the control. This stimulation continued over a period of about five weeks.

It has not been determined at this time whether the initial decrease in oxygen consumption is due to a degeneration and dying of the irradiated cells, and the subsequent stimulation of respiration due to an invasion of leucocytes and new tissue cells, or whether irradiation has more directly altered the respiratory mechanism of the cells.

These results are of particular interest in view of the experiments of Davis¹, which show that the resistance or susceptibility of animals to cancer is dependent upon the respiration of the normal tissues of these animals. There also remains the possibility that a relationship exists between tissue respiration and lymphocytic invasion; for it has been demonstrated by Murphy *et al.*², that when lymphocytosis is prevented by proper dosages of X-rays, the resistant state is abolished. Erythema doses (Murphy³), however, considerably reduce the percentage of 'takes' of autografts.

The fact that X-rays can both stimulate and depress tissue respiration may explain why X-rays can both decrease and increase the resistance of animals to transplantable tumours.

JOHN C. FARDON.

WILLIAM A. SULLIVAN.

Institutum Divi Thomae,
Cincinnati,
Ohio.
Dec. 17.

¹ Davis, J. B., *Canadian Med. Assoc. J.*, **26**, 27-30 (1937).

² Murphy, James B., and Morton, John J., *J. Exp. Med.*, **22**, 204 (1916).

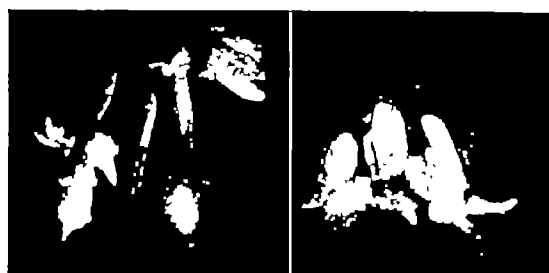
³ Murphy, James B., Malign, Joseph, and Sturm, Ernest, *J. Exp. Med.*, **23**, 645 (1935).

Induction of Polyploidy by Pulp and Disintegrating Tissues from *Colchicum* sp.

INVESTIGATIONS of the active agents in Nature inducing chromosome alterations have shown that the most effective ones are abnormal temperatures¹ and obviously various parasites (cynipid wasps², nematodes³, *Eryophyes*⁴, *Tetranychus*⁵, bacteria⁶, fungi⁷, viruses⁸, etc.). The latter induce abnormalities in the mitotic and meiotic processes chiefly by introducing various substances and partly by wounding, which further give rise to plants with altered chromosome complexes (including polyploidy⁹).

This type of work in connection with the induction of chromosome alterations (chiefly polyploidy) by the alkaloid colchicine⁹ obtained from *Colchicum autumnale* suggested the following experiments: (1) Does pulp from *Colchicum* bulbs induce chromosome alterations? (2) Do disintegrating pieces from the bulbs induce chromosome alterations and particularly polyploidy in seedlings from germinating seeds in the neighbourhood? Experiments performed showed that about two grams of pulp from *Colchicum* sp. bulb induced swellings (like low concentrations from colchicine-induced) in seedlings when seeds from *Triticum*, *Secale* and *Crepis* were germinating on the

pulp, covered with filter paper in Petri dishes. The seedlings that developed at a distance of 1.5–2.5 cm. from the pulp in the dishes showed similar symptoms. Morphologically abnormal seedlings had cells and group of cells with altered chromosome sets (chiefly polyploid) like the seedlings treated with colchicine³. Seeds germinating on disintegrating pieces of bulb from *Colchicum* sp. or near them showed the same morphological abnormalities, namely swelling of the roots and the stems. They also had polyploid cells and tissues. Morphological abnormalities and chromosome alterations (chiefly polyploidy) were also induced when seeds were grown in *Colchicum* pulp



(a) IN THE MIDDLE—A NORMAL (CONTROL) ROOT FROM A WHEAT SEEDLING; ON EACH SIDE, ROOTS FROM SEEDLINGS GROWN (LEFT) ON *Colchicum* PULP AND (RIGHT) AT A DISTANCE OF ABOUT 2 CM. FROM THE PULP IN PETRI DISH WITH FILTER PAPER. (b) RIGHT, A NORMAL WHEAT SEEDLING; THE OTHER TWO, GROWN ON PULP FROM *Colchicum*.

mixed with sand in pots or on disintegrating pieces of various size from *Colchicum* in pots with soil and sand. These observations show that: (1) Pulp from *Colchicum* bulbs can be used for experimental production of polyploid plants. (2) Disintegrating bulbs from *Colchicum* inducing chromosome alterations in laboratory conditions should also cause the same phenomenon in Nature.

The foregoing investigations suggest searching for polyploid forms among the plant species living in Nature together with *Colchicum*.

DONCHIKO KOSTOFF.

Institute of Genetics,
Academy of Sciences of U.S.S.R.,
Moscow.

¹ Extensive literature list, see in Kostoff and Sarana, *J. Genetics* (in the Press).

² Kostoff and Kendall, *Biol. Bull.*, 55, 402–459 (1929).

³ Kostoff and Kendall, *Zentralbl. f. Bakter.*, II Abt., 81, 86–90 (1930).

⁴ Kostoff and Kendall, *J. Genetics*, 21, 113–115 (1929).

⁵ Kostoff and Kendall, *Genetics*, 19, 140–144 (1930).

⁶ Kostoff and Kendall, *Science*, 78, 144 (1923); *Archiv. f. Mikrobiol.*, 4, 457–508 (1933); *Gartenbauwissenschaft*, 8, 20–44 (1934).

⁷ Kostoff, *Ann. Agr. Fak. Sofia Univ.*, 8, 317–324 (1929–30).

⁸ Kostoff, *Genetics*, 15, 103–114 (1928); *Phytopathol. Z.*, 9, 387–405 (1928); *Current Sci.*, 6, 555–556 (1933).

⁹ Kostoff, *NATURE*, 142, 753 (1938).

a culture will die out if it is not provided with fresh tissue by means of subculture. The sarcoma cells infiltrate the added tissue fragment within which they remain for a time embedded. If normal tissue is regularly added, the sarcoma cells can be cultured over an unlimited period and will retain their malignancy.

Since A. Fischer succeeded in culturing sarcoma tissue by the addition of dead tissue (kept in 'Tyrode' in the refrigerator for a month), it might be assumed that the added tissue has a mechanical and perhaps nutritive function in the cultivation of sarcoma, and that the growth of sarcoma *in vitro* depends solely on the continuous multiplication of the original malignant cells. On the other hand, the early experiments of A. Carrel¹ and those recently published by Ludford² show that the Rous sarcoma agent as such is capable of 'infecting' normal cells *in vitro*. We therefore felt justified in assuming that in *in vitro* cultivation of sarcoma according to the methods described above, some process may be taking place in addition to the multiplication of the original sarcoma cells. It may be assumed that the normal cell material which is added is influenced by the agent present in the original sarcoma culture and as a result there is, in addition to a multiplication of sarcoma cells, a constant process of 'cancerization' of the newly added normal tissue.

The first essential in the clearing up of this problem experimentally is the definite separation in culture of agent from the multiplying sarcoma cells. We have succeeded in separating agent from living cells *in vitro* by irradiating cultures with radium.

The relationship between the dose needed to kill cells and that needed to destroy the agent in Rous sarcoma cultures was established accurately. It was, therefore, possible to kill the cells without appreciably impairing the activity of the agent.

An eight-year-old Rous culture strain given us by A. Fischer was used for the experiments. A radium plate containing 6 mgm. of radium was employed, the β -rays being used^{3,4}.

The experiments have shown that the addition of a fragment of tissue or of a pure culture of normal fibroblasts to an irradiated culture of Rous sarcoma, which had received double the dose needed to kill the cells (under the conditions of our experiments this involves an irradiation time of seventy-two hours), results in an invasion of the normal cells by the still active agent. On subculture in a hanging-drop, such a cell colony carrying agent acquires all the known morphological and physiological properties of a real Rous sarcoma culture (typical cell forms, autolytic power, typical behaviour with added cell material). Inoculation into a fowl always proves such a culture to be malignant, causing a typical sarcoma. The use of strongly irradiated cultures causes the 'cancerizing' process to last longer, and the transformation of normal cell colonies in Rous sarcoma cultures manifests itself only after 6–8 passages.

Details of our work will shortly appear elsewhere.

Cancer Laboratories, L. HALBESLANDTHER.
Hebrew University, L. DOLJANSKI.
Jerusalem.
Jan. 5.

¹ "Gewebekultur", Munich (1930).

² *J. Exp. Med.*, 43, 647 (1926).

³ *Amer. J. Cancer*, 31, 414 (1937).

⁴ *NATURE*, 120, 841 (1927).

⁵ *Arch. exp. Zellforsch.*, 19, 475 (1937).

Transformation *in vitro* of Cultures of Normal Cells Treated with Rous Sarcoma Agent into Sarcoma Cultures

THE procedure adopted for the cultivation of the Rous sarcoma *in vitro* in accordance with the usual method described by A. Fischer¹ is as follows: A fragment of tumour is incubated in a medium consisting of chicken plasma and dilute embryonic extract. After a time the growing culture begins to digest the surrounding medium and also itself. Such

Epidemiology of Yellow Fever

URBAN outbreaks of yellow fever are brought to an end either by the eradication of the mosquito vector, *Aedes (Stegomyia) aegypti*, or by the immunisation of a high percentage of the human population. Rural outbreaks are less easily controlled, for in yellow fever areas both in Africa and South America 20-25 per cent of wild monkeys are found to possess immune bodies to yellow fever; in South America, in addition, the so-called jungle yellow fever is transmitted by non-domestic forest-living mosquitoes. Although mosquitoes once capable of transmitting yellow fever by bite appear to remain infective, their life span is short and they are unable to transfer the virus to other mosquitoes either by contact or hereditarily through the egg. If the mosquito-man and mosquito-monkey cycle of transmission represents the complete epidemiological picture of yellow fever, it is not easy to account for the persistence of infection in rural areas during dry seasons when adult mosquitoes are either absent or are present only in very small numbers. It has therefore been suggested that other arthropods may possibly harbour the yellow fever virus, such arthropod vectors either having a longer life than seditious mosquitoes or being able to transmit the virus hereditarily. So far, no biting arthropods other than mosquitoes have been found of importance in the epidemiology of yellow fever.

Two recent observations, however, suggest that it may be necessary to consider non-biting arthropods as possible vectors of yellow fever. In the first place, it has been found possible to infect monkeys with yellow fever by the alimentary canal. When yellow fever virus was introduced by means of a soft catheter into the stomachs of Indian monkeys (*Macaca mulatta*) and African monkeys (*Cercopithecus aethiops*), the virus passed into the blood stream and, in the case of Indian monkeys, caused fatal infection. Similar attempts to infect by the alimentary tract failed in man, dog, rabbit, guinea pig, rat, mouse, hen and pigeon. In the second place, it has been shown that when yellow fever virus is injected into the abdomen of the cockroach, *Blattella germanica*, kept at 19° C., the virus retains its activity certainly for fifteen days. Though it is not suggested that the cockroach necessarily plays any part in the epidemiology of yellow fever, it has long been known that both African and South American monkeys supplement their mainly vegetarian diet by grubs and insects. Precise data as to the insects eaten are, however, lacking; but in view of the observations described, it would be of considerable interest to determine what animal foods are actually eaten under natural conditions by monkeys in the yellow fever areas of Africa and South America.

G. M. FINDLAY.

F. O. MACCALLUM.

Wellcome Bureau of Scientific Research,
London, N.W.1. Jan. 2.

Kinetochore or Centromere?

Few questions in cytological terminology can have caused more disagreement and disorder than that of the name to be applied to the portion of the chromosome which determines its movements on the spindle. The names given to this body have been many, and Dr. Schrader's appeal¹ for the general adoption of one term, with the abandonment of all others, must be received sympathetically by cytologists and geneticists. He proposes, however, the

adoption of the term 'kinetochore', saying that it has been employed by Sharp in his text-book². Sharp certainly recommends the term in a footnote, but he has not, so far as I can observe, carried out his own recommendation. Schrader's alternative proposal is to introduce yet another new term.

Where there exist two or more names for an organ, it is generally found that one of them gradually ousts the rest and becomes established as the accepted term. This process of selection may be seen at work in the special case to which Schrader directs attention. Of the innumerable names which have been proposed, only two main forms appear commonly in present-day literature. One of these, the old term 'spindle fibre attachment', with its variants, is clumsy, somewhat misleading and highly inadaptible. Doubtless it will be discarded in time. The other, Darlington's 'centromere', implies a visible particle instead of a dubious relationship, and has many advantages, being intelligible, pronounceable and adaptable. The adjectives 'acentric', 'dicentric', etc., which are so easily derived from the name 'centromere' add materially to its value. There can be little doubt that it is the best term in use to-day. Dr. Schrader would appear to agree with this statement, as of all the terms he wishes to discard, 'centromere' is the only one for the rejection of which he gives detailed reasons. These are two: (1) that the word has been used earlier in a different connexion by Waldayer, and (2) that 'centromere' is likely to be confused with 'centrosome', 'centriole', etc.

Now Wilson's glossary, so long ago as 1925³, gives Waldayer's usage as obsolete, so the first objection can carry little weight. Secondly, the confusion between 'centromere', 'centrosome', etc., is likely to be no greater than that between 'chromomere', 'chromosome', 'chromatin', 'chromatid' and 'chromonema', all of which are in common use to-day and do not, so far as I am aware, cause any serious difficulty. The lack of weight of Schrader's objections is further shown by the growing popularity of the term 'centromere'. Since its inception in 1936, it has come to be used not only by the English authors admitted by Schrader, but also by many others. In recent papers, Muller⁴, Sax⁵, Stone⁶, Kostoff⁷, Geitler⁸, Levan⁹, Sató¹⁰, Klingstedt¹¹, Husted¹², Matthey¹³ and Parthasarathy¹⁴ all employ this name, some for cytological and others for genetical purposes.

Thus it appears that Darlington's term is doing all that Schrader desires. Its use is growing rapidly, and we may look forward with reasonable confidence to the time when, by its own merits, it will have replaced the ten or more other names. To introduce 'kinetochore', or some entirely new word, would be to confound further the present confusion and to delay the achievement of the unanimity which Schrader so reasonably advocates.

John Innes Horticultural Institution, K. MATHER.
Merton, London. Jan. 28.

¹ Schrader, F., *NATURE*, 143, 123 (1939).² Sharp, L. W., "Introduction to Cytology" (3rd ed.) (New York: McGraw-Hill, 1934).³ Wilson, H. B., "The Cell in Development and Heredity" (3rd ed.) (New York: Macmillan, 1925).⁴ Muller, H. J., *Collecting Nat.*, 12, 181-198 (1938).⁵ Sax, K., *Genetics*, 28, 454-516 (1938).⁶ Stone, W. B., and Griffin, A. B., *Genetics*, 23, 173 (1938).⁷ Kostoff, D., *J. Genet.*, 37, 129-208 (1938).⁸ Geitler, L. v., *Z. indukt. Abstamm. u. Vererb. Lehre*, 75, 161-190 (1938).⁹ Levan, A., *Hereditas*, 25, 9-26 (1939).¹⁰ Sató, D., *Oytologie*, Fuj. Jub. Vol., 80-95 (1937).¹¹ Klingstedt, H., *Memor. Soc. Fauna Flor. Fenn.*, 12, 194-209 (1937).¹² Husted, L., *J. Genet.*, 34, 339-338 (1937).¹³ Matthey, R., *J. Genet.*, 36, 73-102 (1938).¹⁴ Parthasarathy, N., *J. Genet.*, 37, 1-40 (1938).

Points from Foregoing Letters

THE radium content of sea water is found by E. Föyn, B. Karlik, Prof. H. Pettersson and E. Rona to vary between 0.03 and 0.2×10^{-12} gm. per litre. Even the larger figure corresponds to only about one fifth the amount to be expected from the uranium present in sea water (2×10^{-4} gm. per litre), and the authors consider that the larger part of the radium (or rather its parent ionium) is precipitated together with iron in clays and other marine deposits. The same occurs to a lesser extent with thorium, of which only half the expected amount is found in the sea water.

By bombarding a uranium-lined ionization chamber, connected to a linear amplifier, with neutrons from a radium-beryllium source, Dr. O. R. Frisch has been able to detect ionizing particles of atomic weight of at least seventy. This indicates a break-up of the uranium nuclei into parts of comparable size, as foreshadowed by the experiments of Hahn and Strassmann.

Dr. H. J. Bhabha argues that the fundamental length determined by the mass of the mesotron (meson) does not set a limit to the accuracy of quantum mechanics and that it is possible to calculate the production of large nuclear explosions, to a high degree of accuracy, by treating the meson field quantities classically.

Prof. V. Henri and Dr. E. Bergmann report that 9-cyclohexenyl-phenanthrene and 9, 9'-diphenanthryl show a spectrum practically identical with that of phenanthrene, while 9-cyclopentenyl-phenanthrene, in spite of its similar structure, has a much more diffuse spectrum. An analogous difference between these compounds is found in their chemical behaviour.

Dr. W. O. Williamson indicates a simple process for obtaining titanium dioxide which shows rapid darkening in daylight.

Photographs obtained with the electron microscope are submitted by Dr. M. Benjamin and R. O. Jenkins showing that within the temperature range of $1,000$ – $1,050^\circ$ K. barium spreads uniformly over the surface of molybdenum wires. Above $1,050^\circ$ K., barium evaporates rapidly.

Vitamin B_1 (thiamin) brings about the combination of inorganic phosphate with adenylic acid, when pyruvic acid is present (both in the presence and absence of air), according to experiments by Prof. F. Lipmann. The dehydrogenation of pyruvic to acetic acid (through the agency of thiamin pyrophosphate) supplies the energy necessary for the phosphorylation of adenylic acid. This newly discovered coupled reaction may be of importance as a source of muscular energy, and may account for the effect of vitamin B_1 on the heart.

A. E. Axelrod and Prof. C. A. Elvehjem state that they have shown a decrease in the coenzyme content of the liver and muscle of pigs and dogs deficient in nicotinic acid.

Experiments with rats carried out by Prof. B. Zondek indicate that when the sex hormone, progesterone, is injected into the organism, it is progressively inactivated; four fifths of the quantity injected disappeared within 24 hours, although the physiological effects of the hormone upon the organism only occur 100 hours after injection.

Polarographic curves (obtained with a dropping mercury electrode) of extracts of anterior pituitary lobe are submitted by Prof. H. Handovsky and L. Hauss, indicating the presence of three reducible substances or groups, with oxidation-reduction potentials of $rH = -0.23$, -1.00 and -1.65 volts respectively. From these and other experiments the authors conclude that in extracts from freshly prepared powdered anterior lobe of the pituitary the gonadotropic hormone is always accompanied by a reducible group of $rH = 0.23$ v. and the thyrotropic hormone by a reducible group of $rH = -1.65$ v.

Commenting on Dr. H. L. A. Tarr's communication on trimethylamine in spoiling fish, Dr. J. M. Shewan states that in haddocks preserved in ice the increase in the amount of trimethylamine may be considered a useful guide of the extent of spoilage.

Although the evolution of small amounts of carbon dioxide from polysaccharides on boiling with 12 per cent hydrochloric acid cannot be taken as evidence of the presence of uronic groupings, according to Prof. A. G. Norman, the determination of the rate of evolution under standard conditions may make it possible to decide their presence or absence. Carbon dioxide is liberated at different rates from polyuronides, and from sugars or polysaccharides not containing uronic groups.

Prof. R. W. Ditchburn discusses a visual method for testing vitamin A deficiency, with special reference to certain precautions necessary to obtain reliable results.

Prof. Henry Cohen and Miss Sarah Davies discuss the properties of extracts of the choroid plexus in different species. They find that in the chick this extract increases the permeability of the myelencephalic roof and they suggest that the secretion of the choroidal epithelium is the factor initiating the periaxial spread of cerebrospinal fluid in the embryo.

Observations by Dr. C. G. Dobbs show that when the sporangia of *Mucors* burst in air they give rise to 'sporangial drops' which dry down into solid spore masses. Spores are not liberated directly into the air, as figured in many text-books.

By reducing the exposure to sunlight of pea-plants previously exposed to the normal amount of daylight, Dr. T. H. Strong and Dr. H. C. Trumble have been able to confirm the excretion of nitrogen by the roots of these leguminous plants, as discovered by Virtanen.

A method is indicated by Dr. L. Halberstaedter and Dr. L. Doljanaki for the separation of virus from living cells in cultures of Rous sarcoma *in vitro* by means of irradiation with radium. It has been possible to transform *in vitro* normal tissue into typical Rous sarcoma colonies through the action of agent freed from living cells by means of radium rays. From this it is concluded that, in the usual method of cultivation of the Rous sarcoma *in vitro*, there takes place a constant transformation of the added normal tissue into Rous sarcoma, in addition to the multiplication of the original Rous sarcoma cells themselves. Fibroblasts in pure culture too, may, under given conditions, undergo transformation into sarcoma cells through the action of agent.

Obituary Notices

Prof. Henry Balfour, F.R.S.

In Spencer's 'Last Journey' (Oxford, Clarendon Press, 1931), Plate II, will be seen the reproduction of a photograph of Moseley's 1884 biology class at Oxford. The strikingly handsome young man at the very back of the group—he may be distinguished by the rabbit that he is holding in his hand—is Henry Balfour; Baldwin Spencer, Bourne, Hickson, Roth, and other contemporaries also figuring there. That was a momentous year for Balfour, because Moseley induced him, together with Spencer, to help to arrange the collections just then bestowed on the University by General P. H. Rivers at the instance of his friend Tylor. Nine years later, Balfour was appointed curator of the Museum that had meanwhile been fitted out to house and display the rapidly increasing array of ethnological material; and for the forty-six years to come presided, more or less despotically, over the destinies of a treasure-house henceforth filled to bursting point with the spoil of the primitive world.

Though he never limited the range of his biological interests, and numbered both ornithology and geographical exploration among his enthusiasms, Balfour stuck indefatigably to his main business of studying the earlier arts and crafts of mankind according to the comparative method. He had indeed inherited from Pitt-Rivers and Tylor a system of classification somewhat apt to suggest that evolution is a unilinear process. Yet Balfour himself was never under any illusion as to the vagaries attending the propagation of culture, whether technologically considered or in general. Thus his numerous papers—would that he had found the time to compose a systematic treatise on the subject—are primarily concerned with problems of distribution. Before origins can be determined, he would argue, and in order to settle once for all the parts severally played by borrowing and by independent invention, let us exhaustively chart the actual positions in time and space that the evidence enables us to assign to each of our hypothetical types.

Though rarities may gladden the heart of the keeper of a museum, the scientific value as such of Balfour's acquisitions consists rather in a well-authenticated *provenance* warranting their inclusion in some homologous series. Thus when from 1908 onwards Oxford maintained a diploma course in anthropology under the direction of a triumvirate of whom Balfour was one, he fully justified as a lecturer his claim that, despite the wide scope of the physical and social branches of the subject, technology should have strict parity; for he could exploit the educational possibilities of this *tertium quid* as well as any man of his time. Though in the matter of prehistoric archaeology his museum had to share honours with the Ashmolean, he controlled enough material to be able to demonstrate the relations between ancient and modern prehistory; and indeed nowhere was

the doctrine of the age-long continuity of human development better supported by ocular proofs.

To speak of Oxford's debt to Balfour is partly a domestic matter, and, in view of the financial aid forthcoming from the University, it is better not to inquire into the extent of his private benefactions, if indeed Alma Mater can blush. But it is public knowledge that his exploration of the implementiferous gravels of the Victoria Falls, or, again, his travels in Australia, Assam, West Africa and elsewhere, whence his friends so willingly consented to have their pockets picked, made his show-cases the envy of rival institutions. For he had that flair which must ever be the supreme gift of the collector, and could tell at a glance the precise worth, in a scientific and no merely commercial sense, of each scattered piece of material evidence which presently would be fitted into some mosaic revealing a distinctive pattern. Extremely critical, he was slow to construct; but in the independent way of the Scot he could be very tenacious of a formed opinion, if only because of the sufficiency of the knowledge on which it rested. Moreover, his mind had a strong ally in his hand; for he drew beautifully, and had a sound working acquaintance with primitive processes of all kinds, from fire-making to flint-knapping. Altogether, he was a master of his trade, and there are not many like him in the world to provide a fit successor. For the rest he was a very gallant gentleman, whose candid and courteous nature endeared him to his many friends.

Balfour died on February 9 at the age of seventy-six years.

R. R. MARSH.

Prof. Gustav Tammann

We regret to announce the death in Göttingen at the age of seventy-eight years of Geheimrat Prof. Gustav Tammann, whose researches in the Universities of Dorpat-Jurjew and Göttingen on metallography and the properties of the crystalline and amorphous states of matter have proved to be of far-reaching importance both to pure science and to the metallurgical and glass industries.

Tammann began his life's work after the main laws of heterogeneous equilibria had been propounded by Willard Gibbs and developed by Roozeboom, and his contribution has been that of providing the systematic experimental knowledge and detailed interpretation of heterogeneous systems necessary to establish the thermodynamical reasoning in men's minds as of some value in everyday affairs. One of his first interests was the study of the discontinuities arising during the changes of state in condensed systems, and he devised experimental technique for following such changes over a wide range of temperatures and up to pressures of 10,000 kgm. One of his noteworthy discoveries in this field was that ice,

under high pressure, could occur in several different crystalline forms.

In his search for generalizations concerning the equilibria between solids and liquids, Tammann carried out investigations on supercooled liquids, and these led to fundamental discoveries on the nature of glasses. He measured the rates of crystallization and rates of appearance of nuclei in supercooled liquids, and correlated these properties with the rate of development of heat and the changes in viscosity that occurred. His work on silicates in the crystalline and amorphous conditions has also been of value in pointing the way for the development of geochemical and geophysical ideas.

Tammann is, perhaps, best known for his work on metallography, for the reason that this branch of his activities has had the more immediate practical application. Combining microscopical investigation with the determination of the melting point curves of metallic systems, he laid bare the secrets of many two- and three-component systems, and many inter-metallic compounds. He investigated the internal structures of metallic alloys, their electrical and magnetic properties and the changes in properties which occur on cold working and during recrystallization. His work on the amorphous state led him to appreciate the significance of order and disorder in the crystalline state, and he was the first to show that the chemical properties of solid solutions were dependent on the arrangement of the atoms in the lattice. His conclusions in this field have formed the basis of much modern theoretical work, and have proved of very great significance in the metallurgical industries.

As a teacher of physical and inorganic chemistry, Tammann's influence has permeated the scientific world. Throughout a very long life, he had a very large research school, in which were represented many students from far afield, and his monographs under the titles "Kristallisieren und Schmelzen", "Metallographie" and "Aggregatzustände" led to many developments in other hands. His interest in chemical industry was shown by the numerous technological discussions in which he took part, and by the trend of his metallographical work. He played a very active part in the development of the *Zeitschrift für physikalische Chemie*, the *Zeitschrift für anorganische Chemie* and the Bunsen Gesellschaft. His work was recognized by numerous honours both at home and abroad, and in his seventy-fifth year he was awarded the Adlerschild of the German Reich, with the inscription "Altmeister der Deutschen Metallurgie". By future generations, he will be remembered by his contributions to the development of the practical arts, and in this respect he deserves to rank with Agricola, the renowned metallurgist of the sixteenth century.

W. E. G.

Dr. J. E. R. Constable

THE sudden death of Dr. J. E. R. Constable on February 3 came as a great shock to his friends. Dr. Constable, who was only thirty-two years old,

was a senior scholar at Trinity College, Cambridge, and obtained first class in both Parts I and II of the Natural Sciences Tripos. Thereafter, he spent three years as a research student at the Cavendish Laboratory, mainly devoting himself to the application of electrical methods of detecting single particles, in the study of the artificial disintegration of the elements, work necessitating much patience and sound judgment. This investigation brought him his Ph.D.

In 1931, Constable joined the staff of the National Physical Laboratory, where he was attached to the Sound Section of the Physics Department. He soon proved himself a valuable member of the team of acoustical workers who were endeavouring to unravel the entangled phenomena associated with building acoustics, more particularly as regards the transmission and abatement of noise, both air-borne and impact.

Constable was an ingenious and all-round physicist with an original and receptive outlook. His energy and enthusiasm were contagious: he had a great aptitude for getting things done, and could speedily improvise effective equipment and demonstrations. He revealed a cheery and agreeable freshness of style when lecturing or expounding a paper. When he died, as he did in full harness, he had a book approaching completion; and some twenty published papers and articles, singly or jointly, stood to his credit, most of them relating to building acoustics. One may perhaps refer to his valuable and eminently practical investigations on the optimum sound insulation of double windows and composite partitions; the influence of the obliquity of an incident sound beam on the insulating value of a solid partition; the vibration patterns of walls when transmitting sound; the flanking conduction of sound from room to room in a building; and the reduction of noise transmitted along water pipes.

There was assuredly a successful career in front of Constable, had he been spared. I write with a sense of keen personal loss, for we had done much together. This loss is shared by all his colleagues, who will long remember with affection his frank and friendly disposition and his very likeable personality. We offer our profound sympathy to his widow who, herself a former research student at the Cavendish Laboratory, actively co-operated in her husband's acoustical interests. There is one young son.

G. W. C. KAYE.

WE regret to announce the following deaths:

Prof. Karl Schröter, emeritus professor of botany in the Federal College of Technology, Zurich, aged eighty-four years.

Prof. A. Smithells, O.M.G., F.R.S., emeritus professor of chemistry in the University of Leeds, director of the Salters' Institute of Industrial Chemistry during 1923-1937, on February 8, aged seventy-eight years.

Prof. S. P. L. Sørensen, director of the Chemical Department of the Carlsberg Laboratory, Copenhagen, honorary fellow of the Chemical Society, aged seventy-one years.

News and Views

Dr. Alfred Harker, F.R.S.

ON February 19, Dr. Alfred Harker, emeritus reader in petrology in the University of Cambridge, attains his eightieth birthday, and petrologists throughout the world will join in offering their congratulations. Graduating from St. John's College in mathematics in 1882, he had already come into contact with Prof. McKenny Hughes, and was shortly appointed to the staff of the Woodwardian Museum. His earliest original work dealt with the development of cleavage in slates; but he soon turned to petrographic work on the igneous rocks of North Wales, with a series of publications culminating in the Sedgwick prize essay on "The Bala Volcanic Series". In the Lake District, he began (with J. E. Marr) a study of the Shap granite and its aureole, and later of Carrock Fell. During this period also appeared the first edition of "Petrology for Students", now in its seventh edition. From 1895, Harker was for ten years attached to the Scottish branch of the Geological Survey of Great Britain, and worked in Skye and the Small Islands of Inverness-shire, collaborating in the production of the official maps and memoirs, and writing a special memoir on "The Tertiary Igneous Rocks of Skye". Much of this work was necessarily descriptive, and the genetic considerations to which it gave rise were brought together in "The Natural History of Igneous Rocks", a pioneer work on petrology in its treatment of rock-magmas as complex solutions. As president of the Geological Society, he expanded further in his address in 1917 the significance of igneous activity as an integral part of the historical geology of Britain. The central themes of his address the following year, that metamorphism is to be conceived as a progressive change, and that Great Britain offers unique opportunities to investigate such changes, find fuller expression in his book, "Metamorphism", published in 1932. Since his retirement, Dr. Harker has remained actively associated with the petrological collections at Cambridge, where the Harker collection of rock-slides now numbers forty thousand sections. He was awarded the Wollaston Medal of the Geological Society of London in 1922 and a Royal Medal of the Royal Society in 1935.

Prof. František Nušl

IN honour of Prof. F. Nušl, director of the National Observatory of Prague and professor in the Charles University, who has entered on his seventieth year, a composite work has been compiled with the title "Práce věnované Dr. Františku Nušlovi". Prof. Nušl's interest in astronomy is well known; he was vice-president of the International Astronomical Union for the Leyden meeting held in 1928. His circum-zenithal instrument for the determination of time was described before the Czech Academy in Prague (see NATURE, 68, 376; 1903) and also in a number

of other papers. Twelve authors have contributed to the volume and their papers embrace a wide range of subjects. Z. Kopal discusses the two-bodies problem where the central body is an oblate spheroid, not homogeneous, and shows that a steady advance of periastron will take place. V. Guth develops a graphical method for determining the heights and paths of meteors, and J. Štěpánek has a most interesting paper showing the results of photographing Comet Finlay (1937 f) from July 18 until August 15, 1937. It is easy to follow the developments of various parts of the head and tail of the comet by examining these photographs, and also the variations of the different luminous rays. J. Procházka explains his method for investigating the stability of the Bouty meridional telescope at Paris by means of two auxiliary telescopes provided with micrometers, and has found that the stability of the instrument is excellent. J. Svoboda supplies a detailed account of his experimental method for finding the personal error in observations with the Nušl-Friš circum-zenithal instrument. Z. Horák deals with Svoboda's method for determining the radiant of a meteor stream with a minimum of error, and towards the end of his paper shows how very satisfactory results can be obtained by a graphical method. These as well as the other papers, with all of which it is impossible to deal in the limited space, form most interesting reading.

Centenary of the Cell Theory

THE centenary of the cell theory is marked by an article from the pen of Prof. William Seifriz, professor of botany in the University of Pennsylvania, in the recent issue of *Chronica Botanica* (4, No. 6, December 1938). The original theory as propounded by Schleiden and Schwann was faulty; but the immediate theory was, like many other theories, of far less value than the truths which it has been instrumental in ultimately bringing to light. The authors advanced the theory that all organisms are aggregations of structural units or cells; but in his cautiously worded article Prof. Seifriz warns biologists that disciples of the theory tend to attach far more meaning to this than perhaps even its originators intended. The theory established a universal principle of development in living matter; to follow the principle slavishly, in the light of modern knowledge, is wrong; but there is, according to Prof. Seifriz, a tendency to do so. Many biologists seem averse to remoulding their speculations with the advancement of knowledge. Another weakness in the theory is that the cell is viewed as an elementary individual with an autonomy all its own. But this conception is very limited, since the cell is invariably influenced by its environment, such as solutions, temperature, and even the proximity of other cells. That is, the cell is far more plastic than the cell theory would

allow. As Prof. Seifriz emphasizes: "The laws of science as formulated by man are to be commended, even the worst of them, because of the influence they have on further speculation, but they are at best but speculations. . . . In this light must we view the cell theory. Flexibility in thinking comes through mellowness in character and greater willingness to view matters philosophically."

In a less critical, though historically more detailed, article, in the recent issue of *Current Science* (7, No. 6, December 1938), Mr. E. W. Melseon, of the Bausch and Lomb Optical Co., Rochester, New York, claims that the cell theory has been followed by such a wealth of confirmation that we are justified to-day in rating it as the most fundamental concept in the whole science of modern biology. He gives interesting facts concerning the aberrations on cells made by Hooke, Swammerdam, Malpighi, Van Leeuwenhoek and Wolff. They, together with others mentioned, collected much data concerning cells. They undoubtedly saw them and probably their nuclei; but the significance escaped them. Dutrochet published in the eighteen twenties much material which showed his clear conception of the anatomical identity of the cell. In fact, it seems that it was Dutrochet's experiments on physiology which made the recognition of the cell as a structural, functional and developmental unit a necessity. But the nucleus was left out. Schleiden's greatest contribution rests on his recognition that increase in the size and number of cells is responsible for growth, and Schwann's his statement that "The elementary parts of all tissues are formed of cells in an analogous, though very diversified manner, so that it may be asserted that there is one universal principle of development for the elementary parts of organisms, however different, and that this principle is the formation of cells. . . ." But we feel, with Prof. Seifriz, that biologists tend to be incautious of the theory, especially in elementary biological teaching, and do not realize sufficiently that neither Schleiden nor Schwann had at their disposal present-day knowledge of nuclear structure, mitotic division and all the modern concepts in genetics and cytology.

Evidential Value of Blood Groups in Litigation

THE debate on the second reading of the Bastardy (Blood Tests) Bill, introduced by Lord Merthyr, which took place in the House of Lords on February 8, was no less noteworthy for the tribute paid by Viscount Dawson of Penn to the work of Mendel in the study of inheritance than for the cogency of the arguments with which his Lordship supported the objects of the legislation proposed. Clause 1 of the Bill states that in applications for affiliation orders a court may, and at the request of either party shall, order a test to be made of the blood of all three parties in the case. Lord Dawson's insistence on the urgent desirability of substituting objective evidence for the human and subjective in this class of legal action, which is peculiarly open to the danger of a miscarriage of justice—a contention in which he was followed with characteristic vigour

by Lord Raglan—will be welcomed by all who concur in the view that the scientifically attested fact is the surest guide to right judgment. At the same time his recapitulation of the scientific evidence, on which confidence in the blood group test is based, will both inform public opinion as to its potentialities, while removing certain popular misconceptions as to its scope by the emphasis laid on its limitations. It was pointed out by both Lord Merthyr and Lord Dawson that the blood test provides no more than negative evidence, that is evidence of non-paternity, to the extent, it is estimated, of 30 per cent of innocent men. In the course of the debate it was pointed out that the application of the test in this connexion had been widely adopted in other countries and its supporters "were culled not from the scientists of one country, but from the whole civilized world". "It was," it was said further, "a slur on the medicine and law of this country that we were so long in adopting something so completely proved". The Bill was referred for inquiry to a Select Committee of the House; but the Lord Chancellor in summing up the arguments, mostly of a practical nature, against adoption of the Bill, accepted Lord Dawson's scientific view as "completely reliable".

New Explanation of the Great Glen Fault

THE powerful dislocation which intersects Scotland in a north-east and south-west direction along the line of the Great Glen has usually been interpreted by geologists as a normal fault with a vertical downthrow on its south-eastern side. In an important paper read before the Geological Society of London on February 8, however, Dr. W. Q. Kennedy brought forward new evidence which leads him to believe the fracture as a strike-slip or wrench fault with a true lateral displacement of approximately 65 miles. It belongs, therefore, to the same class as the San Andreas rift of California and, like the latter, presumably extends downward at least to the base of the earth's granitic shell. This conclusion is supported by several independent lines of evidence. (a) The Great Glen fault belongs to the same system as the Strathconan, Ericht-Laidon and Loch Tay faults, all of which have proved lateral displacements of up to five miles. (b) It possesses characters unlike those of a normal fault but similar to other strike-slip dislocations (for example, singularly smooth, straight outcrop and abnormally wide shatter-belt). (c) It displaces the great north-south injection belt of the Moine Series for a distance of at least sixty miles. (d) It truncates the Strontian granite, the southern portion of which, according to the detailed structural evidence, is missing. The missing half, however, has now been identified in the Foyers granite, which outcrops on the other side of the fault some sixty-five miles to the north-east and is similarly truncated by the fracture. These two intrusions consist of identical rock-types and agree in all details of internal and external structure. This interpretation clarifies certain obscure features of Scottish geology and serves to explain the southern continuation of the Moine Thrust in Islay. The fault is still active but the main lateral movement appears to have been

accomplished in Upper Devonian or Lower Old Red Sandstone times. The dynamical interpretation of the movement, moreover, indicates that the fault must have resulted from a regional compression which acted in a north and south direction. The fracture is, therefore, unrelated to any Caledonian pressure or tension, but formed as a result of early Hercynian pressure.

British Industries Fair

THE British Industries Fair, 1939, will open on February 20. It is divided into two main sections—one at London and the other at Birmingham; and the London section is again divided into two groups—one at Olympia and the other at Earl's Court. The number of overseas buyers who have intimated their intention to come to the Fair is six hundred more than last year and they are coming from no fewer than 66 countries. Holland heads the list, sending 607 compared with 465 last year. Belgium is second, 293 having accepted as against 245. Eire is sending 269 as against 207; Poland, 164 compared with 72; Czechoslovakia, despite recent happenings, 154 as against 37; Hungary, 110 as against 19; from Denmark there is a slight falling off, 105 compared with 112; and from Switzerland 98 are coming, as against 79 last year. The hardware and heavy industries section of the Fair will be held, as heretofore, at Castle Bromwich, Birmingham. At Earl's Court the main exhibits will be those of the textile and furnishing trades, and also an Empire section. At Olympia the trades exhibited will include chemicals (light and heavy), scientific instruments, photographic and cinematographic apparatus, radio apparatus and plastics, in addition to a large number of other industries, such as glass and leather, usually regarded as belonging to the category of light industries. Among the chemical exhibits, that of Imperial Chemical Industries, Ltd., repeats the practice, introduced by this firm last year, of showing only one major product at a time. Last year the subject was soda; this year it will be ammonia. Exhibits will be shown in six main groups: the use of ammonia in its anhydrous form; as ammonia liquor; as ammonium compounds; oxidised to nitric acid; converted to cyanide; and converted to urea.

As in recent years, the scientific instruments section will form a prominent and notable part of the exhibits at Olympia. The national rearmament programme has naturally involved the production on an enormous scale of the scientific instruments needed for the control of the various major weapons of war—such as range finders, periscopes, gun sights, bomb sights and cameras. The latest type of anti-aircraft searchlight will be shown in action, and forms a central feature of the composite stand of this section. It is perhaps not generally realised that the speeds of modern aircraft are such that the anti-aircraft gun may have to be directed as much as two miles ahead to enable the projectile to hit the target. 'Predictors', which automatically calculate this position, are now in general use by anti-aircraft batteries. The War Office has given permission for

an anti-aircraft predictor to be displayed and a staff sergeant will be in attendance to give the public information. A photographic apparatus will be shown, which enables a photographic record to be made of a 500-page book on only 30 ft. of film—an apparatus obviously of great potential use to libraries. Among other apparatus and instruments to be exhibited will be the latest cinematographic projector; a new type of highly efficient loudspeaker of very small dimensions; a projection saccharimeter, which gives an image on the screen showing the percentage of sugar in various foods; and a recent form of dust counter—the 'thermal precipitator'.

Methods in the Study of Man

NUMEROUS questions of general interest, but in their immediate bearing more nearly affecting those concerned with teaching and research in the study of man, were raised by Dr. Henry Balfour in his Fraser Lecture delivered at Liverpool in 1937 and recently issued in pamphlet form (*"Spinners and Weavers in Anthropological Research"*. Oxford: at the Clarendon Press, 1938. Pp. 19). The science of anthropology is a relatively young science; but its progress in recent years has been remarkably rapid. This has been due largely to a vigorous growth of specialisation. So much so, indeed, that not only has it brought about a condition which now renders it unwieldy for the individual, but as Dr. Balfour pointed out, there is a real danger that the major problem, the full comprehension of man's nature and potentialities, may be lost sight of, through increasing individual enthusiasm over one or other branch of the general science of 'anthropology'. Dr. Balfour himself was convinced not merely that there is place for both the 'generalist' and the 'specialist', but in fact that there is a real need for their co-operation as a condition of orderly advance in the future development of the science. Metaphorically their relation is expressed in the title of Dr. Balfour's lecture. Taking as an example the methods employed in one of the departments of his own special branch of study, technology, he expounds how in his conception of the relation of the diverse methods of study, the 'spinner', the specialist, provides the threads of surely grounded data from which the weaver, the 'generalist', fashions the fabric of theory. Among the conclusions which follow from this conception to which Dr. Balfour referred, not the least significant is that which develops its bearing on the organisation of the curriculum for the anthropological student.

Archaeological Interpretation and Modern Analogies

Among other matters upon which Dr. Balfour touched as incidental to the main thesis of his Fraser Lecture, not the least interesting is the interpretation of archaeological data in the light of reference to objects of the material culture and to the practices and beliefs of modern and still-surviving peoples of backward culture. He recalled the opportunity for such a comparison, which was lost irretrievably when the Tasmanians, a people still living the life of paleolithic man, were allowed to die out in the last century and themselves became the subjects of the archaeo-

logical method of research. Although it is widely appreciated that in the archaeological studies of the last generation nothing has contributed more fruitfully to understanding of the culture of the stone age than the interpretation of the palaeolithic cave paintings of southern France and Spain by reference to the magical and religious beliefs of modern 'savages', nevertheless many archaeologists hesitate to press such analogies. They point to the unquestionable fact that the culture of the modern 'primitive' has not been static over a long period, but has itself been the subject of an evolutionary process, even though they may admit with Dr. Balfour that change has been slow, when no extraneous element has been implicated. Yet instances of the prolonged persistence of unchanged tradition do undoubtedly occur. An interesting illustration bearing on the argument is afforded by Mr. S. Casson's study in *Antiquity* of December last of survivals among ceramic types now current in Cyprus and the islands of the Aegean, belonging to a tradition which extends back not only to medieval times, but even in some instances to the bronze age. He points out how the methods of manufacture, marketing and distribution between the islands and to the mainland still followed at the present day may serve, with their Homeric flavour, to throw light on the obscure field of the early industrial and commercial organization of the eastern Mediterranean, about which so little is known in detail.

Research in Mental Disease at Birmingham

ON February 9, a memorial plaque to the memory of the late Sir Frederick Mott was unveiled by Lady Mott in the Medical School of the University of Birmingham at Edgbaston. The plaque, which is the work of Miss Phyllis Mott, the daughter of Sir Frederick, was the gift of Dr. H. A. Pullar Strecker. Sir Gilbert Barling, in an introductory address, said that the Joint Board for Research in Mental Disease has now found its home in the new Medical School of the University, where it has excellent laboratory accommodation. The laboratory was originally opened at Hollymoor in 1923 by the Minister of Health (the present Prime Minister) with Sir Frederick Mott as honorary director of the Joint Board of Research, and Dr. F. A. Pickworth as chief research officer. It was hoped that the mental hospitals in the surrounding counties would join in the research, and this hope is now fulfilled by Staffordshire, Leicestershire, Worcestershire and Shropshire. Sir Gilbert acknowledged the generous help of Sir Charles Hyde both in 1923 and at the present time. Funds are now available for the appointment of another full-time research officer of high standing to study the influence of viruses and hormones as causes of mental disease, and a surplus is to be used to provide the stipend of a research scholar for three or four years.

Roman Road near East Grinstead

A ROMAN road, which is described as "one of the most perfectly preserved of its type in Britain", has been discovered in a field at Holtys near East Grinstead (*The Times*, February 13). It is part of the

old Roman highway which ran from London to Lewes and here crosses a field. The land on which it is situated has been purchased by Mr. I. D. Margary, a Sussex archaeologist, for the purpose of investigation and later preservation. At present a stretch of the road, about 85 yards long and varying in width from 15 to 18 ft., has been uncovered. Wheel marks are plainly visible; but the iron-lag surface has rusted together so solidly as to form a mass almost as hard as concrete, and consequently in an excellent state of preservation. In certain places it has been necessary for the workmen to remove soil to a depth of three feet to reach the surface of the road. The remains of vegetation several inches in depth indicate that at one time a forest grew over the road.

Research in Electrical Industries

LORD STAMP, the new president of the British Electrical and Allied Industries Research Association, when addressing members at a luncheon which followed the annual meeting in London on February 10, laid stress on the value of research in industry. He pointed out that the electrical industry takes a leading place in research because it has no real industrial or commercial history apart from the history of research and invention. Most industries grow out of, and often cling to, primitive operations on raw materials to supply age-old needs. Scientific research, if added to them, complicates them; and many think that these additions are a doubtful advantage if they cannot be confined to benefit those who promote them. They think that it makes competition more keen in various branches of the industry and often, as well, creates unnecessarily rapid obsolescence in plants still working. The whole genesis of the electrical industry has been different; it was born out of research and is meeting the created needs of an advanced civilisation. Continuous research is its natural sustenance. The work of this Association is an excellent example of co-operation between manufacturers and users; it pools their ideas, thus ensuring that both sides get full benefit from them.

Thermal Power Plants for Emergency Service

A MAJOR interruption of the electric supply in a city of any importance is nowadays attended with disastrous consequences. The provision of some reserve source of power, capable of supplying the vital services at least, is therefore imperative when such failures can occur. The main causes of failures are breakdowns of transmission lines, strikes or enemy bombardment. A paper read by Mr. Hvistendahl on November 10 to the Institution of Electrical Engineers distinguishes between the different classes of service to be furnished by stand-by plants. Descriptions are given of automatic and semi-automatic stand-by plants used in towns in Norway and Sweden. Although unthinkable a few years ago, the bomb-proof emergency service station is now a grim reality. Sandbags provide some protection against fragments of stray shells or bombs, but they are little use against repeated attacks from the air,

and a large steam-power station is an easily located target. This has led to the construction in several countries of the Continent of bomb-proof stand-by power plants for the essential services in towns or districts or for supplying the power requirements of munition factories. These plants are either of the surface or of the underground type. The plan of a station for an output of 10,000 kw. is shown located in a tunnel cut into the face of a cliff. The turbo-set, boiler and tanks containing sufficient fuel for 7-10 days' service, and the auxiliary starting set, are accommodated in a gallery about 150 ft. long and of about the section of a normal double-track railway tunnel. When ground conditions are not favourable to such a disposition, or the danger of flooding exists, a station of the surface type is adopted, with roof and walls of reinforced concrete about 4 ft. thick, having the appearance of a block of dwelling houses or made inconspicuous in some other way.

A Naturalists' Directory

WE have recently received a copy of the thirty-first edition of the 'Naturalists' Diary' (Salem, Mass., U.S.A.: The Cassino Press. 3 dollars). It contains the names, addresses and special subjects of professional and amateur naturalists of North and South America, etc. This list will prove very useful to naturalists in the United States, since for that country it seems comprehensive; but in other countries, such as Great Britain, its usefulness is impaired by the sparsity of entries. For example, for the State of New York alone there are about four hundred and fifty entries, while for the whole of Great Britain there are only eleven; for France, six and for Germany, six. The list should prove useful, however, to naturalists outside the United States who wish to get in touch with their American contemporaries. Appended to this directory is a short list of scientific periodicals. While in the compilation of such a list it is naturally essential to be selective, it is difficult to understand what policy was adopted by the compilers, since it is rather inconsistent. Most of the periodicals are American; but even here it is difficult to see why the *Journal of Applied Physics* should be included in a list for naturalists, and the *Botanical Gazette* omitted. Again, among the British journals is included the *Journal of the Chemical Society*, but not the *Aquarist and Pondkeeper* or *Discovery*. Of foreign journals, only *Scientia* and *Electica Physica Acta* are mentioned, whereas journals of international appeal to naturalists, such as *Chronica Botanica*, are omitted. The price for a paper-covered book of about 280 pages is high.

Periodicals for Medical and Scientific Libraries

THE selection of periodicals for medical and scientific libraries is discussed by O. C. Barnard, Librarian of the London School of Hygiene and Tropical Medicine, in a paper in the *Library Association Record* of November, 1938. Mr. Barnard gives a comparison of results obtained by Gross and Gross'

method of arranging periodicals in order of importance as indicated by the frequency of bibliographical reference to them, taking the *Journal of the American Chemical Society* for 1927 instead of the 1926 volume as used by Gross and Gross. Although agreement is satisfactory at the top of the scale, there are considerable variations lower down, and Mr. Barnard points out that, besides the inherent limitations of the method, which does not take account of frequency of publication of the periodicals or of the length of their articles, comparison on the basis of one year's references is too narrow to be trustworthy. Results obtained at the London School of Hygiene and Tropical Medicine for a large number of medical periodicals by marking each volume or part on the table before return to the shelves are tabulated and discussed, particularly as a check upon the personal selection of experts. Mr. Barnard directs attention to the infrequent reference to the earlier volumes of even such periodicals as *Annales de l'Institut Pasteur* and *Zeitschrift für Hygiene*, and suggests that the compilation of similar records by all libraries co-operating in the inter-library loans system might permit recommendations on the basis of a comprehensive survey which would effect appreciable savings in postage and also in time and labour by the redistribution of certain periodicals among the participants.

ASLIB Conference Report

THE report of proceedings of the fifteenth Conference of the Association of Special Libraries and Information Bureaux (price 5s.), which has just been issued, contains the text of papers presented at the Conference together with summaries of some of those presented at the joint session with the International Federation for Documentation on the organisation of information services. An additional paper from Mr. G. Lightfoot, secretary, Council for Scientific and Industrial Research, Commonwealth of Australia, on the establishment of an information service by that Council is also included, as well as summaries of certain papers contributed to the joint session on 'tools' for library co-operation and reports received from the National Central Library and the British Society for International Bibliography.

Air Raid Precautions in Hospitals

A BOOKLET containing advice on the structural and other precautions that can be taken against air raid risks in hospitals has been issued jointly by the Ministry of Health and the Department of Health for Scotland to all local authorities controlling hospitals and also to voluntary hospitals (London: H.M. Stationery Office. 3d. net). Hospital authorities are urged to proceed at once with the precautions recommended, the extent to which they do so depending in some degree on the likelihood of air attack in the area. Measures are described for the adaptation of existing buildings, as well as structural features suggested for new buildings. The Government is prepared to contribute to the cost of these measures under certain conditions.

England-Cape Town Flight

MR. ALERX HENSHAW had made a new record for the round flight between Gravesend and Cape Town when he returned to Gravesend at 1.51 p.m. on February 9. The total journey of nearly 12,000 miles was made in 4 days 10 hours 16 minutes, thus improving by 1 day 6 hours 44 minutes on the previous record set up by Mr. A. E. Clouston and Mrs. Kirby Green. The Percival Mew Gull aeroplane showed no serious signs of damage and the 200-h.p. Gipsy Six engine was still in good condition at the end of the flight. The times for the journey out and that for the return flight, namely, both about thirty-nine hours, are also records.

Vienna Academy of Sciences: Prize Awards

THE following awards have recently been made by the Academy of Sciences in Vienna: Haitinger prize for physics to Dr. H. Haberlandt, for his work on the luminescence of fluorites and other minerals; Rudolf Wegscheider prize for chemistry to Dr. R. Kuhn, for his work on lactoflavine; Fritz Pregl prize for microchemistry to Dr. F. Hecht, for his work on microchemical analysis, particularly of thorium, monazite and uranium minerals; Hanseigir prize for astronomy to Dr. M. Beyer, for his work on the photometry of stars, and in particular for his work on variable stars.

Announcements

THE James Scott Prize (1938) of the Royal Society of Edinburgh was presented to Prof. P. A. M. Dirac, at the ordinary meeting of the Society held on February 6, when he delivered an address entitled "The Relation between Mathematics and Physics".

THE James Alfred Ewing Medal of the Institution of Civil Engineers has been awarded to Prof. A. H. Gibson, professor of engineering in the University of Manchester. This Medal was founded in 1936 in memory of the late Sir Alfred Ewing, and is awarded to a person, whether a member of the Institution or not, for specially meritorious contributions to the science of engineering in the field of research.

PROF. F. G. DONNAN has been elected president of the Association of Scientific Workers, in succession to Sir F. Gowland Hopkins, whose term of office has recently ended.

DR. FABRIS GROSS, lecturer in experimental zoology in the University of Edinburgh, has been elected the first holder of the Jacobson fellowship for research in the new Oceanografiska Institutet of Göteborg, Sweden. The research is in connexion with the inauguration of a new plankton-well, in which the life-histories of plankton may be studied in conditions resembling as closely as possible those in the sea. The University has granted Dr. Gross leave of absence to cover the period of the investigation.

PROF. ADOLF WINDAUS has been awarded the Pasteur Medal for his lectures in Paris on the investigation of vitamins.

SIXTEEN more names have been added to the memorial erected by the German Röntgen Society in commemoration of those roentgenologists and radiologists who sacrificed their lives to science.

M. BERNARD LYOT, who has been awarded the Gold Medal for 1939 of the Royal Astronomical Society, will deliver the George Darwin Lecture at the ordinary meeting of the Society on May 12. The lecture will be illustrated by a film showing the motion of matter in solar prominences and by photographs of the solar corona in the absence of a total eclipse.

At a meeting of the Royal Astronomical Society held on February 10, the following officers were elected: *President*, Prof. H. O. Plummer; *Vice-Presidents*, Prof. S. Chapman, Mr. W. M. H. Greaves, Dr. H. Spencer Jones and Prof. F. J. M. Stratton; *Treasurer*, Mr. J. H. Reynolds; *Secretaries*, Prof. H. H. Plaskett and Mr. D. H. Sadler; *Foreign Secretary*, Sir Arthur Eddington.

THE Division for the Social and International Relations of Science of the British Association is holding a meeting at the University of Reading on March 28 to consider "Milk in its Nutritional Aspects". Further information will shortly be obtainable from the Secretary, British Association, Burlington House, Piccadilly, London, W.1.

THE annual general meeting of the Association of Technical Institutions will be held in London on February 24-25. Three discussions will be held, namely, (1) on the Report of the Consultative Committee; (2) on the Report on Libraries in Technical Institutions; (3) on the Report on Psychological Tests. Further information can be obtained from Dr. H. Schofield, Loughborough College, Loughborough, Leicestershire.

THE Minister of Health has approved an order made by Slough Town Council under the Town and Country Planning Act, 1932, for the preservation of Observatory House, Slough, the residence of Sir William Herschel, where he set up his famous 40-ft. telescope, and also of his son, Sir John Herschel.

THE fifth Elihu Root Lecture entitled "Cultural Contacts of Science" delivered by Sir Richard Gregory on December 8, in the Elihu Root Hall of the Carnegie Institution of Washington, extracts from which were printed in *NATURE* of December 19 p. 1059, has now been issued in book form. The Elihu Root Lectures were founded to deal with the influence of science and research on current thought. Copies may be obtained from the Carnegie Institution of Washington, Washington, D.C.

It was stated in the report received from the British Museum (Natural History) that the diamond presented by Sir Ernest Oppenheimer to the Museum was the first to be taken from the Kimberley diamond mines (*NATURE*, Feb. 4, p. 195). We are informed that this is incorrect. The stone came from the Jagersfontein mine in the Orange Free State.

Research Items

Organization of Labour in Ancient Egypt

It is remarkable that so few records of times taken for ancient enterprise, excepting wars, have been preserved. From one such record, the construction by King Amenophis III of a vast lake of which the site is considered to be a rectangular enclosure near the temple at Medinet Habu, Mr. R. Engelbach and Mr. J. W. Macaldin have endeavoured to arrive at an estimate of the number of workmen employed to have produced this work within the period named (*Bull. de l'Inst. d'Égypte*, 20; 1938). The rectangular enclosure is in size some 2200 metres by 1000 metres. On four commemorative scarabs known, of which one is only a fragment, it is stated that on the sixteenth day the king and his consort sailed on the lake in the royal barge; but it is pointed out by Breasted that the dimensions of the lake differ from those given on the scarabs. Air photographs, however, suggest that although the length-breadth proportions are different, the variant dimensions can be reconciled. Though the lake is generally described as a pleasure lake for Queen Tyi, this is not mentioned on the scarabs; and it is probable that it was intended to serve as a harbour for the numerous boats which would be required by the new palace built by Amenophis. The possibility whether the lake could have been constructed in the time depends upon the number of diggers who could be put to work simultaneously in the space and efficiently served by carriers of the spoil. The only method feasible would be to divide the area into a number of bays, in each of which it is calculated 184 diggers could work while leaving space for the passage of the carriers. This method of excavating is followed in modern Egypt, and on this basis it is calculated that 184 diggers could excavate a bay in 13.96 days. Taking the distance to the still existing mounds of spoil, the calculation gives 50,968 diggers, 50,968 diggers' mates and 675,826 carriers; total, 777,262 men. If, however, the carrying were reduced to temporarily dumping the soil by the side of the lake for later transport to a greater distance, the carriers might be reduced to 140,716.

North American Birds of Prey

THE most complete account of the life-histories of the birds of any country is that now being published by the U.S. National Museum in its series of *Bulletins*. The series began in 1919 and now with Part 2 of the birds of prey has reached its eleventh volume (*Bulletin*, 170; 1938). This part is as thorough as its predecessors, giving as full an account as possible of the life-history of the best-known species of each species, and

as Outram Bangs showed in 1930, has a considerable range in the States. The author, Arthur Cleveland Bent, finally, one hopes, gives the lie to the old fable of the communal life of the burrowing owl with the prairie dogs and rattle-snakes of the western plains. He points out that so comprehensive a work can only be the result of co-operation, and that if any reader fails to find in the volumes anything that he knows about birds, he can blame himself for not having sent in the information. Thus is the critic disarmed.

Nicotine and Bees

In the *Bee World* of January 1939, a short but interesting account is given of the work of F. K. Böttcher, published in *Die Gartenbauwissenschaft* (12, 2; 1938) on the effect of nicotine on bees. It appears that this substance repels bees, and that it is difficult to induce them to take it. When nicotine was added to the drinking water of the bees at any strength over 0.05 per cent, it repelled these insects so much that there was no fear of their imbibing much of it. When a field of mustard was dusted with nicotine in the usual way (2.5 per cent) most forager bees were driven away; only a few became poisoned. Neither dusting nor spraying caused any damage of practical importance to the colonies. It can be concluded, therefore, that when nicotine is used as a dust or as a spray in concentrations of 0.15-2.5 per cent, no damage of practical importance to bees results. This work, if confirmed, is important to bee-keepers and fruit-growers in view of the repeated warnings given about the damage caused by nicotine applications to fruit trees when the blossoms are visited by bees.

Induced Polyploidy by Treatment with Colchicine

A REPORT was presented by A. J. T. Mendes, of the Instituto Agronomico do E. de S. Paulo Campinas, Brazil, at the first South American Botanical Meeting held at Rio de Janeiro, last October, on the preliminary results obtained by treatment of seed and plants of coffee, cotton and tobacco with colchicine. The embryo of the coffee seed is surrounded by a large amount of nutritive matter; the seedlings are grown in solutions as strong as 0.6 per cent. After 35 days did not produce chlorophyll, and no germination. But a 0.1 per cent solution after during 4 days was better. The seedlings were

Pollen Tubes of Cotton

A STUDY of various problems connected with the growth of pollen tubes in cotton has been made by N. K. Iyengar (*J. Genetics*, 37, No. 1). The method found most satisfactory was by direct observation of the pollen tubes in the pistil after suitable treatment. There is a central conducting tissue in the style, and the tubes run for some distance over the placenta before reaching a micropyle. The pollen grains germinate promptly on the stigma, putting forth several tubes which form some branches in the style. Callose plugs are also described. The tetraploid cottons generally have larger pollen grains and wider pollen tubes than the diploids. When the two are present on the same stigma they both germinate, but the self pollen takes part in fertilization. Two to four pollen tubes sometimes enter one micropyle; but there is no evidence that more than one takes part in fertilization. By examining the ovary 25½ hours after pollination, evidence was obtained regarding the order of entry of the pollen tubes into different ovules of the flower. It was found that the first ovules in a locule to receive pollen need not necessarily be the ones nearest the stigma.

Synthesis of Polyploid Types by Hybridization

MÜNTZING's experiments on hybrid incompatibility and the origin of polyploids has brought out the fact that zygotes tend to be more viable if produced by union of gametes with approximately the same chromosome number. M. Skalińska (*Bull. Int. de l'Acad. Polonaise des Sci. et Lett., B, Sci. Nat.* (1) 1938) in carrying out breeding experiments with hyperdiploid *Aquilegia* plants with 15 ($2n + 1$) and 16 ($2n + 2$) chromosomes, obtained a proportion of giant pollen grains by formation at meiosis of restitution nuclei, fusion of spindles in meiosis II or unipolar spindle fusion, giving diploid and extra chromosome types of pollen. It was concluded that such giant grains would compete favourably with haploid or hyperhaploid grains in tetraploid tissues. The results of such crosses fully confirmed Müntzing's observations as pollination of the tetraploid with pollen containing a proportion of giant grains produced, in addition to one triploid ($21 = 3n$) and one hypertriploid ($23 = 3n + 2$), tetraploid (28) and hyper-tetraploid plants with 29 ($4n + 1$) and 30 ($4n + 2$)

no correlation between their shock-frequency curves; but if we assume a hypothetical endogenous cause for all these regional tectonic movements, then this cause must be the connecting link between them and hence between the several earthquake shocks.

Heats of Combustion of Diamond and Graphite, etc.

Three recent papers (*J. Res. Nat. Bur. Stand.*, 21, 457, 475, 491; 1938) by P. H. Dewey, D. R. Harper, R. S. Jessup and F. D. Rossini deal with anthracite cookes, natural and artificial graphites and diamonds from the point of view of heats of combustion and stability, and provide important new data in this interesting field of thermochemistry. In agreement with previous results, it is found that the heat of combustion of 'amorphous' carbon is higher than that of diamond, and that of diamond is higher than that of graphite. The results are expressed in international kilojoules per mol (12.01 gm.) of carbon to form CO, at 25° and 1 atm. pressure without the production of external work. The results do not indicate the existence of different forms of graphite and diamond. The values are: graphite, 393.388 int. k.j. (94,080 gm. cal.); diamond, 395.287 int. k.j. (94,484 gm. cal.); 'amorphous' carbon, 403.03 int. k.j. (extrapolated to zero hydrogen content). The papers contain thermodynamic discussions of the stability of the forms of carbon and deal critically with a large amount of numerical data.

Accuracy of Meteor Data

In a previous paper (*J. Brit. Astro. Assoc.*, 48, 9; July 1938), J. G. Porter discussed the errors in the true paths of doubly observed meteors, and in a recent paper (*J. Brit. Astro. Assoc.*, 49, 3; Jan. 1939) he deals with the accuracy of radiants. Porter utilized thirty-five doubly observed Perseids from 1934 until 1937, and his procedure consisted in determining the true radiant from the elements of Comet 1862 iii which is responsible for the Perseid shower. As the Perseids persist for an unusually long time, computations of radiants were made from July 29 until August 16, and these were compared with the radiants deduced from doubly observed meteors. A very full analysis of the results is made, and, although only thirty-five doubly observed meteors were available, it is highly probable that the deductions are a safe criterion regarding observational errors in general, or at least for the British observers. The probable error of the radiants is $\pm 2.4^\circ$, and this is very small compared with the results found for American observers. Opik accepted a probable error of $\pm 8^\circ$ for the Arizona Meteor Expedition observers, and others have quoted even higher figures. Various other deductions were made from the analysis in this and the previous paper, amongst which the following may be noticed: For the deviations of the flight-paths the probable error was $\pm 2.54^\circ$, and errors of the same order were found in the mean *zenithal* deviation of apparent to *zenithal* by a simple formula suggested

Earthquake Shocks

of the earthquakes with ... in the Philippine ... is of the opinion ... in-

addresses stressing the importance of the meeting. Prof. Gorneth then introduced and explained the subject to be discussed.

At the meetings the following six papers were discussed: "The Significance of the Skolem-Löwenheim Theorem" (Prof. Th. Skolem); "General Analysis of the Question of Fundamentals" (Prof. M. Fréchet); "Logic and the Question of Fundamentals" (Prof. J. Łukasiewicz); "Controversies Regarding the Theory of 'Ensembles' and the Question of Fundamentals" (Prof. H. Lebesgue); "The Role of the Axiom of Choice, and the Hypothesis of

Continuity in Mathematics" (Prof. W. Sierpinski); "The Present Position in regard to Hilbertism" (Prof. Bernays).

At the end of the meeting Prof. Gorneth summed up the general conclusions to be drawn from the discussions, and expressed his thanks to the Institute of Intellectual Co-operation for its help and collaboration.

The texts of the various papers submitted and an account of the discussions will appear in the fourth volume of the new Scientific Series being published by the Institute.

Molecular Structure

A DISCUSSION on molecular structure was held by the London Mathematical Society on January 19 in the lecture room of the Royal Astronomical Society, the president, Prof. E. A. Milne, being in the chair. The discussion was opened by Dr. W. G. Penney; Dr. H. A. Jahn, Dr. C. A. Coulson and Mr. G. J. Kynch made further contributions, and Prof. J. E. Lennard-Jones summarized the discussion.

Dr. W. G. Penney (Imperial College, London) said that the nuclei of a polyatomic molecule in its most stable state are practically at rest and that the electrons move about in a highly complicated, but regular, way. If the nuclei are slightly disturbed, they vibrate, and their motion can be described in terms of a number of normal modes. Such vibrations can be detected in the infra-red spectrum.

to calculate W by perturbation methods. Thus, ψ is expanded in terms of the ψ_a , the Schrödinger functions of the separate atoms. Substituting this in (1), leads to

$$[H^1 - W(x_1, x_2 \dots)] \sum a_a \psi_a = 0.$$

Multiplying by the ψ_a in succession, and integrating over the configurational space, leads to a set of equations in the a_a . Eliminating the a_a gives a determinantal equation for $W(x_1, x_2 \dots)$. Minimizing with respect to $x_1, x_2 \dots$ gives the equilibrium configuration and the heat of formation; expanding about the minimal configuration leads to the frequencies of the normal modes.

Detailed considerations of the function $W(x_1, x_2 \dots)$ show, for example, that if four monovalent atoms are combined with a carbon atom, they are distributed

around the carbon atom in the directions of the corners of a regular tetrahedron. If the carbon atom is linked directly to only three atoms, so that one of the bonds is double, the system is co-planar. When the carbon atom is linked to only two atoms, so that both bonds are double, or one is triple and the other single, the system is linear.

Little progress has been made in calculating the energies of formation and the vibration frequencies of molecules in excited states, and the description of their absorption spectra is therefore at present only qualitative. A similar, but simpler, problem is that of interpreting the absorption spectra of rare earth crystals. The spectrum is that of an inner group of electrons of the metal ion, and the energy levels are very near those of the free ion.

Dr. H. A. Jahn (Davy Faraday Laboratory, Royal Institution) discussed the vibrational potential energy constants of polyatomic molecules. He showed how, starting from a given equilibrium configuration of a polyatomic molecule and making use of the invariance of the vibrational potential energy with respect to all the operations of the group of symmetry of the equilibrium configuration, the most general form of the elastic potential can be determined.

Mathematically, the invariance of the vibrational potential energy is equivalent to the fact that the matrix of its coefficients must commute with all those matrices which show how the normal displacements transform under the symmetry operations of

		Potential energy			
		A_1	E	F_1	F_2
Regular tetrahedron.					
Group T_d .	A_1	k_1			
	E		k_1		
Vibrations:			k_2		
$A_1 + E + 2F_1$.	F_1			k_2	k_3
4 frequencies.				k_3	k_3
				k_3	k_3
5 general force constants.	F_2			k_3	k_4
				k_3	k_4

Let $E(x_1, x_2 \dots)$ be the least energy required to separate a molecule into electrons and nuclei, when the nuclei are stationary at $x_1, x_2 \dots$. Then, in principle, $E(x_1, x_2 \dots)$ may be found as the eigen values of the Schrödinger differential equation

$$(H - E) \psi = 0 \quad (1)$$

The energy of formation of the molecule from atoms is

$$W(x_1, x_2 \dots) = E(x_1, x_2 \dots) - \sum E_a$$

where $\sum E_a$ is the sum of the energies of formation of the separate atoms from nuclei and electrons. The equations for the E_a are similar to (1). Since W is very small compared with $\sum E_a$, it is possible

the group. Consequently, by choosing a complete set of vibrational symmetry co-ordinates which transform according to irreducible representations of the group of symmetry, there may be obtained at once, by application of Schur's Lemma, the most general form of the matrix of the potential energy.

This was illustrated by the example of the methane molecule.

Thus, if the methane molecule is a regular tetrahedron, the potential energy has five general force constants and the molecule has four different vibrational frequencies. Similarly, if the molecule has the form of a square pyramid, the group is C_{4v} , the vibrations are $2A_1 + B_1 + 2B_2 + 2E_1$, there are seven different frequencies and ten general force constants. Experimentally four frequencies are found, and the molecule has the form of a regular tetrahedron.

Dr. C. A. Coulson (University College, Dundee) discussed the theory of the carbon-carbon linkages in some simple polyenes and aromatic molecules. Certain hydrocarbons can be adequately described by a single structural formula. Examples are ethane, where the linkage is a single bond, ethylene, where the linkage is a double bond, and acetylene, where the linkage is a triple bond. Other molecules, such as benzene, naphthalene and butadiene, are more complex, and in these cases the linkages must be considered to be of fractional order. General methods of calculating the orders of these linkages have been discovered. They evaluate the energy of a linkage by the approximation of molecular orbitals or of

electron pairs, in terms of a single parameter which measures the difference of energy of the single and double bonds. Linear interpolation then gives the order.

From the experimental values of certain physical constants of the single, double and triple bonds empirical curves may be constructed. These may be used to predict values for the linkages of intermediate order. Thus, the benzene linkage is of order 1.65, and the internuclear distance should be 1.39 Å. in exact agreement with direct observation. Similarly in naphthalene, there should be four types of linkage. Their orders, beginning at the central link and working outwards, are 1.52, 1.56, 1.76, 1.60. The corresponding lengths are 1.42, 1.40, 1.38, 1.40 Å.

Mr. G. J. Kynch (Imperial College, London) discussed the relations between the magnetic properties, specific heat and absorption spectra of rare earth crystals. The deviations of the principal and mean susceptibilities from Curie's law, $\chi/T = \text{constant}$, are caused by an electric crystalline field which perturbs the magnetic ion. Calculations of the magnetic susceptibilities involve the determination of the lowest energy levels of the magnetic ion. These can be compared with those obtained from the measurements of the absorption spectra and the specific heat. Previously, it was thought that a fourth order cubic field would correlate all the data. This no longer seems possible, because of the considerable magnetic anisotropy of the crystals. A new interpretation of the levels found spectroscopically must be sought.

The British Rhætic Flora

PROF. T. M. HARRIS, with experience of the Greenland Rhætic flora behind him, has now studied the British Rhætic beds and, with the application of new methods, described with considerable detail some of the few plants from these rocks (The British Rhætic Flora, British Museum, 1938.) The main outcrop of Rhætic rocks extends from Dorset to north Yorkshire, and it is from these alone that plant remains have been obtained, though smaller outcrops also occur in Wales, Northern Ireland and Scotland. The conception of the Rhætic formation is that of a shallow sea, dotted with islands, and in this, slight changes in level isolated lagoons, which would soon become brackish or freshwater lakes. It is probably in such lakes that the plants grew. The plant-containing beds occur as strata between those containing fish and other marine remains, suggesting temporary incursions of the sea into the lagoon region. The Bristol locality seems to have supplied most of the specimens.

A new method of examination of surface features by reflected light on specimens moistened with paraffin oil has contributed materially to the success of the investigation. The usual methods of rock sections and cellulose nitrate films have also been used; but are difficult with this material.

A common plant is the alga *Botryococcus braunii*, recognizable as colonies, terra-cotta in colour and with characteristic resistance to $\text{HNO}_3 + \text{KClO}_4$. It is probable that this fossil is the same plant which has been described under various names from Ordo-

vician, Carboniferous, Permian, Rhætic, Jurassic and other rocks up to the present day.

Another alga has close resemblance to *Cosmarium*, but owing to failure to recognize sculpturing of the wall, it is provisionally distinguished as *Stenium cosmarioides*.

Perhaps the most interesting plant and one described in amazing detail is *Naiadites lanceolata*, an undoubted bryophyte. Earlier records of Bryophytes are very scanty and only allow the statement that liverworts, probably belonging to the Jungermanniales, extend back to the Carboniferous, whilst records of mosses are more doubtful.

Naiadites is now described with details of stem and leaf form and structure, rhizoids, gemmæ (free and possibly in gemmæ cups, and development of new plantules from gemmæ), archegonia, sporophytes, perianth and spores. The plant is thus sufficiently known to compare with present-day genera. The radial construction and spiral phyllotaxis (3/8) are moss-like features; but the majority of the characters place it in the Hepaticae, and provisionally as nearest to the Riellaceae of the Spharocarpales.

Prof. Harris discusses the conceptions of evolutionary trend in Bryophyta and regards *Naiadites* as supporting rather the view of a reduction series than an up-grade series.

One other plant, *Hepaticites solenotus*, appears to be a hepatic resembling *Anoura*.

Certain other fossils, previously described as Rhætic, seem more correctly to be Liassic.

Training Teachers of Rural Science

IN 1937 the University of Reading Education Department, under the direction of Prof. H. O. Bernard, decided to pay special attention to training teachers for posts in rural senior, central and secondary schools. Three main considerations seemed to make this undertaking a desirable feature of the training course: (1) there was likely to be a considerable and increasing demand for teachers who could teach science with full reference to the rural environment; (2) the University of Reading has a well-organized faculty of agriculture and horticulture; (3) there are in the surrounding countryside several schools which make a speciality of teaching rural subjects.

In instituting the course at Reading, the principle was adopted that it is undesirable to train teachers so narrowly in one aspect of education that they are partially unfitted to see any other aspect. The course in the teaching of rural science was therefore made one of a number of optional subjects, and at present it includes: (a) a series of lectures on general aspects of rural education; (b) occasional lectures by teachers and others actively engaged in rural education; (c) visits to rural schools; (d) teaching practice in rural schools; (e) practical instruction in horticulture and handicrafts.

The lectures deal with such topics as: the meaning of rural education; comparison of rural and urban schools; Hadow and Spens reorganisation in country areas and their implications; the approach to knowledge through practical activities, for example, how the garden can become the centre of a curriculum which differs from the 'normal' only in the principles on which it is devised and the way in which it is developed; the value and the conduct of school expeditions to farms, etc., and the aims, staffing, equipment and finance of gardening, livestock keeping and handicrafts. Special lectures have been given by the head master of a second-

ary school with a strong 'agricultural bias', by one of His Majesty's inspectors of schools who specialises in rural science and by a horticultural organizer to a county council.

Visits to rural schools, when students have been well prepared in what to look for, have proved to be very valuable, and teaching practice in rural schools has been arranged.

Students receive practical instruction in horticulture at the University Horticultural Station. Their work includes preparation of ground, planting, propagation, pruning, crop rotation, managing a small greenhouse or a frame, grafting, etc. In handicrafts, students are encouraged to make apparatus useful for rural activities, such as model greenhouses, cold frames, etc. A short course in metal-work is being developed, in which students may make such things as gate latches, simple agricultural tools, etc.

The course, as at present constituted, is in its infancy, and is in no way static. Some developments which are contemplated are: contact with a senior school within easy distance of the University; a 'model' garden; instruction in livestock keeping; visits to the University farm; and lectures by farmers.

This then is one way in which Reading is trying to help to forge the rather weak link between education and agriculture.

Students of the University of Reading who have graduated in science or agriculture or horticulture, and who have afterwards spent a year in preparation for the education diploma, including the course on teaching rural science, should be well fitted to teach in a rural school of any type. The University Department of Education already conducts, at the request of the Ministry of Agriculture, a fortnight's course in the "Technique of Teaching" for those who hold posts on the agricultural staff of a county authority or similar positions.

Wave-Action and Shore-Lines

AN article by Mr. W. V. Lewis on the "Evolution of Shore-line Curves" (*Proc. Geol. Ass.*, 49, Pt. 2; 1938) is a valuable contribution to a well-worn subject. The author's position is fundamentally that of Sir Henry de la Beche, founder of the Geological Survey, who a hundred years ago stressed the importance both of the longshore drift of material by prevalent waves and the independent action of storm or dominant waves in piling up embankments of detritus in the direction of the greatest force, sometimes at right angles to the shore. In later years opinions changed, and explanation of the evolution of coastal outline was purely on the action of longshore and eddy currents. Latterly, however, there has been a revival of the wave-action hypothesis due largely to the findings of the Royal Commission on Coast Erosion and Afforestation and the work of Steers, Johnson, and others. Mr. Lewis proceeds to examine in detail various sections of coastline in Britain on the Moray Firth, Cardigan Bay, Bristol Channel, Isle of Purbeck and Chesil Bank, and suggests that shore curves, far from being explicable only by reference to longshore currents, yield in certain cases readily to analysis in terms of the direction of

approach of both dominant and prevalent waves, especially the former.

The case of Weymouth Bay and Chesil Bank is of particular interest. It appears that breakwaters in connexion with the Portland Harbour works have caused a modification in the direction of wave approach, with the result that shingle which used to be driven north from Weymouth is now accumulating in front of the town. This means that the bay has swung slightly round so as to face a more easterly direction. As regards the Chesil Bank, it is pointed out that along its sixteen miles from Chesilton to West Bay we have one of the most perfect examples in the British Isles of a shore moulded into line with both dominant and prevalent waves. This gives stability to the curve of the Beach, which exactly faces the direction of open water just clear of Start Point and Ushant into the Atlantic. The grading of the shingle, which increases steadily in size from West Bay to Chesilton, is held to indicate that there is now no permanent drift of material in either direction. In any case the Beach could not have been formed by simple longshore drift, as this would have first filled up the narrow backwater behind.

Science News a Century Ago

Fox Talbot's Photogenic Drawing

At a meeting of the Royal Society on February 21, 1839, further information on photogenic drawing was given in a letter written by Fox Talbot to S. H. Christie, the secretary, dealing with the preparation of the paper and the means of fixing the design. Having chosen a paper of good firm quality, and smooth surface, said Fox Talbot, it was dipped in a weak solution of common salt and wiped dry. One side was then treated with a solution of nitrate of silver. By alternately washing the paper with salt and silver and drying it in between times, the sensitivity of the paper was increased. With regard to the fixing of the images, the author said, that having tried ammonia and several other reagents, the first which gave him a successful result was potassium iodide, much diluted with water. On a photogenic drawing washed over with this liquid an iodide of silver was formed absolutely unalterably by sunshine.

Lighthouses on Sandbanks

In the February 1839 issue of the *Civil Engineer and Architect's Journal*, was an article on the "Construction of Lighthouses on Sands" by the use of the patent screw piles or screw moorings of Alexander Mitchell. On July 4, 1833, Mitchell had secured a patent (No. 6446) for a dock to facilitate the repairing or building of ships, and in this patent he described caissons held in position by means of piles fitted with broad metal screws or worms. Screws could be fitted also to mooring chains. "It having been brought to the notice of the Corporation of the Trinity House," said the *Architect's Journal*, "that the invention might be utilised for establishing lighthouses on sands, they directed an experiment be made by their engineer James Walker. The spot selected for the experiment was the Maplin Sand twenty miles below the Nore, in the mouth of the Thames." Eight screw piles were driven into the sand forming an octagon 40 ft. in diameter, with one in the centre. The piles were wrought iron tubes of 5 in. diameter, 26 ft. long, and each of them was fitted with a screw 4 ft. in diameter. They were driven into the sand 22 ft. by men working on a raft. Afterwards the tops of the piles were braced together to support the lighthouse structure. In 1839-40 a similar lighthouse was built on a submerged sandbank in the entrance to Morecambe Bay.

Earthquake in Leicestershire

THE issue of the *Gentleman's Magazine* for February 1839 contains the following information: "Dec. 23. About four in the afternoon a smart shock of an earthquake was felt at Woodhouse Eaves in Charnwood Forest, Leicestershire. It was preceded by a loud rumbling noise, as of a wagon on the adjoining road, and the shock was sensibly felt by the numerous congregation then assembled in the new church at Woodhouse Eaves; the vibration was so strong as to loosen pieces of mortar from the roof, which several persons heard falling down the slates to the ground. It appears to have been in the direction from the south-west to the north-east or east, from which former point the wind then blew. . . . It is remarkable that an earthquake was felt at Naples about the same time. It is well known to geologists that an antilinal line of strata is in Charnwood Forest."

University Events

BIRMINGHAM.—The pro-chancellor (Mr. Walter Barrow) and the deputy pro-chancellor (Alderman John Henry Lloyd) have recently resigned their posts. Mr. Edmund Phipson Beale is to be nominated as pro-chancellor. Mr. Beale has been on the University Council since 1923 and became treasurer in 1930. He is a son of the first vice-chancellor, Mr. Charles Gabriel Beale, who was appointed when the University was founded. (The title 'vice-chancellor' was, some years ago, replaced by that of 'pro-chancellor', the former having devolved upon the officer originally called 'principal'.) Alderman Lloyd will still remain on the Council as a representative of the City Council.

CAMBRIDGE.—The Jacksonian professorship of natural philosophy became vacant at the end of January on the resignation of Prof. E. V. Appleton, St. John's College, who has been appointed secretary of the Department of Scientific and Industrial Research. It is recommended that candidature at the next election be limited to candidates whose work is connected with atomic physics. It is further proposed that the Jacksonian professor's duties of residence and lecturing shall no longer be specially prescribed.

Prof. P. M. S. Blackett, Langworthy professor of physics in the University of Manchester, has been appointed Scott Lecturer for the year 1939-40.

SHEFFIELD.—Prof. B. H. Bentley, formerly professor of botany in the University, has been appointed emeritus professor.

Dr. S. Haastone has resigned his post of lecturer in physical chemistry.

Societies and Academies

Paris

Academy of Sciences (*O.R.*, 208, 237-312, Jan. 25, 1939).

A. GUILLERMOND and R. GAUTHIER: Effect of pH on the vital staining of yeasts. Absorption of Neutral Red, Cresyl Blue and Nile Blue increases with rising pH; the blue dyes are absorbed by the cytoplasm, the red only in the vacuoles.

A. CHEVALIER: Species, varieties and hybrids of American cotton actually cultivated in tropical Africa, and their improvement.

E. ROUBAUD and R. DESCHENS. Capture of infectious nematode larvae by predatory soil fungi. Active larvae of a species of *Strongyloides* and of a species of *Anoylostoma* were captured and digested (under laboratory conditions) by mycelia of certain soil fungi, suggesting the possibility of biological control of these disease organisms.

W. DOBBLIN: Certain aleatory movements.

A. DEMOULIN: Theory of lines traced on a surface.

G. VAN DER LYN: Analytical representation of abstract polynomials.

J. DUFRÉNOY: Exceptional values of meromorphic functions in the neighbourhood of a given meromorphic function.

V. PLATOFF: Measurement of the reaction of a gaseous jet by the pressure it exerts on a disk.

R. BARTHOLEWYS: New list of stars belonging to the Great Bear stream.

N. CABRERA: Law of multiplication of representative matrices of linear differential operators.

A. PÉREZ and C. VOLLET: Improvements made in definition of the lengths represented by the international standards and in the comparison of these lengths. Certain of the standards have been re-engraved, and the apparatus for comparisons improved.

L. ZACHOVAL: Dispersion of ultra-sonic waves in castor oil.

J. BASSET: Fusion of graphite under very high pressure of argon, up to 4,000 kgm./cm.².

W. UYTENDHOF and C. VERBURG: Temperature of electrons I_e in a positive column discharge with alternating current (50 cycles); results for neon.

O. TE-TCHAO: Formation of large ions in gases as a function of the size of the particles in suspension.

MILM. N. MORGULEFF: Absorption in the visible region of the spectrum by sulphur vapour.

P. LATIN and R. SERVANT: End emission of tubes of luminous gas; part taken by reflections from the walls.

G. COURTOIS: Fusibility of mixtures of pure anhydrous sodium sulphide and carbonate.

M. FOLK: Influence of 'temper' on the density of sodic borate glasses.

J. CURNOT and M. BAUDRAND: Corrosion of welded joints of light alloys.

J. TIMMERMANS, J. DE ROOSTER and J. MICHEL: Spontaneous crystallization and the rate of crystallization of water and of heavy water.

(To be continued)

Amsterdam

Royal Netherlands Academy (Proc., 41, No. 10, 1938).

H. J. JORDAN, MISS C. E. SLUJTER and N. POSTMA: Regulation of the muscle tonus by the ganglia pedalia in *Helix pomatia* L. according to the co-ordination scheme.

F. A. VENING MEINESZ: Forthcoming gravity expedition of Dr. W. Nieuwenkamp.

L. S. ORNSTEIN: The theory of liquid crystals.

L. S. ORNSTEIN, J. M. W. MILATZ, E. F. M. VAN DER HELD and W. MAAS: A sensitive method for the measurement of the excitation function of artificial radioactivity.

H. BRINKMAN, L. S. ORNSTEIN and W. LANGENDIJK: Photographic sensitometry for β -ray spectra.

L. S. ORNSTEIN, J. M. W. MILATZ, H. TEN KATE and M. MISSEWICZ: Conditions for the quantitative operation of a Geiger-Müller counter for β -rays. The ionizing power of β -rays as a function of their velocity.

J. G. VAN DER CORPUT and H. J. BACKER: Reaction velocity of mixtures (1). Bimolecular reaction of two mixed substances with a third substance.

L. G. M. BAAS BEKING: Cause of the high acidity in natural waters, especially in brines.

J. F. SCHOUTEN: The perception of subjective tones.

E. F. M. VAN DER HELD: Value of G^2/M^2 in the theory of β -ray spectra.

C. S. MEYER: (1) Integral representations of Whittaker functions. (2) The Kummer function $F_1(a; b; s)$.

M. VAN EIJH: Influence of salt intake on root respiration in *Aster Tripolium*.

F. A. H. W. DE MARRE OYENS: Preliminary note on the occurrence of a new ammonoid fauna of Permian age on the island of Timor.

R. BRUMMEKAMP: Ratio of the surface of the forebrain to that of the whole brain in higher apes and man.

J. L. ADDENS: Presence of a nucleus of Bellonci in reptiles and mammals.

J. DEOOGHEVRE FORTUYN: Systematic arrangement of fibres in capsula interna, thalamus opticus and pes pedunculi.

P. O. FLU: The Mg^{++} cation and lysis of the *Bacterium megatherium* by the antimegathierium bacteriophage.

Washington, D.C.

National Academy of Sciences (Proc., 24, 525-565, Dec. 15, 1938).

H. D. BABCOCK: Some recent observations of sun-spot spectra. Preliminary results with a 21-ft. grating spectrograph with no optical parts except slit and grating, for use in the ultra-violet and photographic infra-red regions.

H. SHAPLEY: Second note on a metagalactic density gradient.

F. G. WATSON: Reflectivity and colour of meteorites. Using a self-recording spectral-photometer, it is concluded, from an examination of seven stony meteorites and one metallic, that they are essentially 'gray-bodies', so that the usual calculation of their temperatures in space are valid. Their geometrical albedoes range from 0.1 to 0.5; colour data do not differentiate between stony and metallic meteors.

W. J. CROZIER and E. WOLF: (1) Duplexity theory of visual response in vertebrates (2). Flicker response of a gecko (rod retina) is little different from that of the diurnal turtle (cone retina), throwing doubt on the validity of associating specifically histological appearance and function in the vertebrate eye. (ii) Specific constants for visual excitation (3). Various animals give the same fundamental form of flicker response curves. They have in common a large assemblage of excitation elements, the frequency distributions of which are fixed by specific genetic constitution.

L. W. LAW: Effects of chemicals on the lethal mutation rate in *Drosophila melanogaster*. Two methods were used: (1) injecting sub-lethal doses into the larvae; (2) immersing fertilized eggs from which the chorion was removed in solutions of sub-lethal concentration of the substances. Copper sulphate increased lethal mutation rate of the X-chromosome. Potassium permanganate and also iodine in potassium iodide produce a slight increase, but colchicine was ineffective.

F. A. BROWN, JUN.: An internal secretion affecting viability in Crustacea. Five species of crayfish (*Cambarus*) were used. Removal of the eyestalk, followed in some cases by injection of eye-stalk tissue into the abdomen, gives results indicating the production in eye-stalk tissue of a chemical substance which is essential to life.

L. M. BLUMENTHAL and G. R. THURMAN: Characterization of pseudo- S_n sets.

B. DE SZ. NAGY: Semi-groups of self-adjoint transformations in Hilbert space.

G. A. MILLER: Groups of order p^m containing $m - \alpha$ independent generators.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Monday, February 20

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Dr. Franz Simon: "The Present Position and Future Objective of Low Temperature Research" (Succeeding lectures on February 22 and 24).*

Tuesday, February 21

UNIVERSITY COLLEGE, LONDON, at 5.15.—G. Tilgham Richards: "The Use of Museums. (3) The Science Museum."*

Thursday, February 23

ROYAL COLLEGE OF PHYSICIANS, at 5.—Dr. Donald Stewart: "Industrial Incapacity and Modern Medicine" (Milroy Lectures. Succeeding lecture on February 28).

BEDSON CLUB, KING'S COLLEGE, NEWCASTLE-UPON-TYNE, at 6.30.—Dr. Olaf F. Bloch: "Some Scientific and Technical Applications of Photography" (Bedson Lecture).

Friday, February 24

ROYAL INSTITUTION, at 9.—S. Casson: "The Collapse of Ancient Civilization: a Study of Archaeological Evidence."

Saturday, February 25

SCHOOL NATURE STUDY UNION (at University College, London), at 3.—Annual Conference. E. G. Boulenger: "Behind the Sciences in the Zoo Aquarium."

ASSOCIATION OF TECHNICAL INSTITUTIONS, February 24-25.—Annual General Meeting to be held in the Hall of the Merchant Taylors Company, Threadneedle Street, London, E.C.2.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

LECTURER IN CHEMISTRY in the Dudley and Staffordshire Technical College and Dudley Training College—The Director of Education, Education Offices, St. James's Road, Dudley (February 20).

ASSISTANT (grade III—refrigeration) in the Ditton Laboratory, East Malling, Kent—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (February 22. Ref. J 29/3).

LECTURER IN METALLURGY in the County Technical College, Wednesbury—The Director, Secondary and Technical Department, County Education Offices, Stafford (February 23).

ASSISTANT FOR RESEARCH IN HOP DISEASES—The Secretary, Hop Disease Investigations, c/o East Malling Research Station, Maidstone, Kent (February 25).

PROFESSOR OF MECHANICAL ENGINEERING in the Manchester Municipal College of Technology—The Principal (March 4).

ASSISTANTS (grades II and III) in the Meteorological Office—The Under-Secretary of State (S.S.B. (Met.)), Air Ministry, Admiralty House, Kingsway, London, W.C.2 (March 4).

LECTURER IN HUMAN PHYSIOLOGY in the University of Manchester—The Registrar (March 6).

SENIOR JUNIOR OBSERVER in the Solar Physics Observatory, Cambridge—The Director (March 7).

ASSISTANT LECTURER IN MATHEMATICS in the University of Manchester—The Registrar (March 11).

DIRECTOR OF THE COMMONWEALTH SOLAR OBSERVATORY, Mount Stromlo, Federal Capital Territory—The Office of the High Commissioner for Australia, Australia House, Strand, London, W.C.2 (March 15).

PHYSICAL CHEMIST in the Chemical Research Department, Dunlop Rubber Co., Fort Dunlop, Birmingham, 24—The Director.

SENIOR LECTURERS IN BACTERIOLOGY, PATHOLOGY AND ANIMAL HUSBANDRY in the Royal (Dick) Veterinary College, Edinburgh 9—The Secretary.

ASSISTANT INSPECTOR under the Alkali, etc., Works Regulation Act under the Department of Health for Scotland—The Secretary, Edinburgh, 2.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

University of Cambridge: School of Agriculture. Memoir No. 10: A Brief Summary of the Papers published by the Staffs of the School of Agriculture and its Associated Research Institutes during the Period Oct. 1st, 1937-Sept. 30th, 1938. Pp. 40. (Cambridge: School of Agriculture.) 1s. net. [231]

Proceedings of the Royal Society of Edinburgh, Session 1937-1938. Vol. 58, Part 2, No. 10: The Anatomy of the Polychaete *Ophelina cheloneis* McGuire 1935. By Robert S. Brown. Pp. 125-160+1 plate. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 2s. 6d. [231]

Scottish Marine Biological Association. Annual Report, 1937-38. Pp. 24. (Glasgow: Scottish Marine Biological Association.) [231]

Board of Education. Report of the Constitutive Committee on Secondary Education, with Special Reference to Grammar Schools and Technical High Schools. Pp. xxxviii+477. (London: H.M. Stationery Office.) 2s. 6d. net. [231]

Publications of the International Tin Research and Development Council. No. 85: The Examination of some Tinned Foods of Historic Interest. Pp. 20. (Greenford: International Tin Research and Development Council.) Free. [231]

The Standard of Living in Bristol: a Preliminary Report of the Work of the University of Bristol Social Survey. By Herbert Tout. Pp. 64. (Bristol and London: J. W. Arrowsmith, Ltd.) 1s. net. [231]

Department of Scientific and Industrial Research: Water Pollution Research. Summary of Current Literature. Vol. 12, No. 1, January, Abstracts Nos. 1-125. Pp. 32. (London: H.M. Stationery Office.) 2s. net. [231]

The School Health Services: their Initiation, Growth and Character. Pp. 112. (London: National Union of Teachers.) [231]

Association of Special Libraries and Information Bureaux. Report of Proceedings of the Fifteenth Conference held at Lady Margaret Hall, Oxford, September 23rd to 26th, 1938. Pp. 124. (London: A.S.L.I.B.) 5s. [231]

Emergency Medical Services. Memorandum No. 1: Structural and other Precautions against Air Raid Risks in Hospitals. Pp. 12. (London: H.M. Stationery Office.) 3d. net. [231]

National Physical Laboratory. Abstracts of Papers published in the Year 1937. Pp. iii+71. (London: H.M. Stationery Office.) 1s. net. [231]

Oileadh na h'Éireann (National University of Ireland). Calendar for the Year 1937. Pp. ix+316+606+398. (Dublin: National University of Ireland.) [231]

The South-Eastern Naturalist and Antiquary: Being the Forty-third Volume of Transactions of the South-Eastern Union of Scientific Societies, including the Proceedings at the Forty-third Annual Congress held at Worthing, 1938. Pp. xxii+92+12. (London: South-Eastern Union of Scientific Societies.) 5s. net. [241]

Hastings Natural History Society. Report and Balance Sheet for the Session 1937-38, with List of Officers and Members, etc. Pp. 14. (St. Leonards: Hastings Natural History Society.) [241]

St. Thomas's Hospital Reports. Editors: Prof. O. L. V. S. De Weeslow, G. Max Page, assisted by N. B. Barrett, Dr. J. St. O. Elkington, Dr. A. J. Wrigley. Second Series, Vol. 2. Pp. 240+23 plates. (London: St. Thomas's Hospital.) 10s. [241]

Publications of the International Tin Research and Development Council. No. 86: Calculation of the Area of Base Metal exposed at Discontinuities in the Tin Coating of Tinplate. By W. B. Hoare. Pp. 8. (Greenford: International Tin Research and Development Council.) Free. [241]

Other Countries

Contributions from the Physical Laboratories of Harvard University for the Year 1937. Series 2, Vol. 4. Pp. vii+54 papers. (Cambridge, Mass.: Harvard University.) [251]

International Institute of Agriculture. Cotton Breeding and Seed Supply. (Appendix to the Monograph on "World Cotton Production and Trade.") Pp. 72. (Rome: International Institute of Agriculture.) [261]

Publications of the Dominion Observatory, Ottawa. Vol. 12: Bibliography of Solarology. No. 19: Items 4031-4133, July, August, September, 1938. By Ernest A. Hodgson. Pp. 885-404. (Ottawa: King's Printer.) 25 cents. [261]

Proceedings of the U.S. National Museum. Vol. 86, No. 3042: Descriptions of New and Little-known Fossil Insects from North America. By Charles W. Gilmore. Pp. 11-26+1 plate. Vol. 86, No. 3043: The Cambridge Millipeds of the United States, including a Family New to the Fauna and New Genera and Species. By H. F. Loomis. Pp. 27-66+1 plate. Vol. 86, No. 3044: Polyzooids of the Coast of North America. By A. S. Fernald. Pp. 67-98. Vol. 86, No. 3045: Hopewellian Remains near Kansas City, Missouri. By Waldo R. Wedel. Pp. 99-106+6 plates. Vol. 86, No. 3046: The Types of the Polychaete Worms of the Families Polynoidae and Polydora in the United States National Museum and the Description of a New Genus. By Olga Hartman. Pp. 107-134. Vol. 86, No. 3047: Review of the Fishes of the Genera Polypterus and Argyropterus (Family Sternopygidae), with Descriptions of Three New Species. By Leonard P. Schultz. Pp. 135-154. (Washington D.C.: Government Printing Office.) [261]

Bulletin of the American Meteorological Society. Vol. 19, No. 5: Some American Papers and Notes on Climatic Variations; Report of the American Committee of the International Commission of Climatic Variations, to the International Geographical Congress, Amsterdam, Holland, July 1938. Pp. 64. (Milton, Mass.: American Meteorological Society.) 50 cents. [261]

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Science and Democracy

A MANIFESTO on the relation of science to present developments in the international political situation has been issued on behalf of American men of science by a committee, of which Prof. Franz Boas of Columbia University, the doyen of American anthropologists, is the protagonist. It is a document which is no less remarkable for the extent and character of the support it receives, in view of conditions in the United States, than for its argument. It is signed by 1,284 scientific workers, including three Nobel Prize winners, Prof. Harold C. Urey of Columbia University, Prof. R. A. Millikan of the California Institute of Technology, and Dr. Irving Langmuir of the General Electric Company, Schenectady, N.Y. The signatories are drawn from a hundred and sixty-seven universities and research institutes, and include eighty-five college presidents, deans, and directors of industrial laboratories and experimental stations; sixty-four are members of the National Academy of Sciences.

The signatories call upon their colleagues to participate actively in the defence of democracy as the sole means of preserving intellectual freedom and insuring scientific progress. It is perhaps unnecessary to recall that, as the oldest and the greatest of existing democracies, the people of the United States cherish as their proudest and dearest political possessions the right of free thought, the right of free speech, and the rule of the majority. These are for them, as they have been for all free peoples (at least of modern times) the fundamental conditions of truth and justice, and as such the basis of free and democratic institutions. The aim of the manifesto is, broadly speaking, to demonstrate, and to urge upon all scientific workers the duty of showing to the people of the United States that the development of political

theory and practice in the totalitarian States cuts at the root of these principles, and at the same time at the freedom of all mankind, as well as endangers the possibility of the advancement of man's well-being through the ministrations of science.

In demonstrating the relation of science to freedom of thought and speech under democratic institutions, the manifesto takes its stand on the recent resolution of the American Association for the Advancement of Science. "Science", it was there said, "is wholly independent of national boundaries and races and creeds and can flourish only when there is peace and intellectual freedom." "If science", the manifesto goes on to say, "is to continue to advance and spread more abundantly its benefits to all mankind, then the man of science has a moral obligation to fulfil. He must educate the people against the acceptance of all false and unscientific doctrines which appear before them in the guise of science, regardless of their origin."

Further, the Fascist position towards science is publicly condemned. It is shown to have violated both truth and justice in the most profound sense by the imposition of scientific theories and doctrines which have been demonstrated time and again to be false, and by debarring a section of the population, Jews or 'non-Aryans', from intellectual and scientific activity; while the "thousands of teachers and scientists who have been exiled . . . bear testimony to the incompatibility of Fascism and science". The manifesto in this connexion goes even further and regards "the attack on freedom of thought in one sphere, even as non-political a sphere as theoretical physics, as in effect an attack on democracy itself. When men like James Franck, Albert Einstein or Thomas Mann may no longer continue their work, whether the reason is race, creed, or belief, all mankind suffers the

loss"; and it concludes, "If we American scientists wish to avoid a similar fate, if we wish to see the world continue to progress and prosper, we must bend our efforts to that end now."

The action of American men of science in issuing this manifesto on the relation of development in the international situation to the progress of science has fallen at a singularly opportune moment; and its implications will not escape the notice of their colleagues in the countries of Europe. Unquestionably it has been to the advantage of the intellectual advancement of the world at large that, while in the political sphere the United States of America has held fast to isolation as a corollary of the Monroe Doctrine—a policy now for the second time within the present century under public consideration in view of danger to democratic institutions—that isolation has not been a characteristic of this great people in matters of the spirit, more especially in the development of the arts and in science. By free exchange and interchange of ideas and personnel, the New World has

co-operated with the Old to their mutual benefit; while the recent approach of the American Association for the Advancement of Science to the British Association, for the promotion of joint consideration and discussion of problems of scientific import and socio-economic application, opens up further prospects of an accelerated movement towards world unity in attack on those broader questions in which science touches the interests and well-being of mankind as a whole. Notwithstanding differences in social conditions between the United States and the countries of the Old World, which would militate against either the utility, or perhaps even the possibility, of like action in the very different circumstances prevailing in the European democracies, nevertheless the pronouncement of American men of science inculcates a principle in its statement of the relation of scientific progress and democratic institutions, which may well be laid to heart; and it is of no less importance that once more it has demonstrated in practical form the essential solidarity of the world of science.

The Census and the Distribution of Population

EVERY civilized community needs a full and accurate knowledge of its human resources; and hence the census has developed far beyond its primary function of merely numbering the people. It has become a periodic stocktaking; and among other aims it should provide precise and full information about the distribution of the people within a country.

Every person is counted at the place in which he, or she, is at the date of the census. This gives the first facts of the distribution, what is called the *de facto* population of each census district and of the country. In the past this has been considered sufficient, provided that the actual census could be carried out within a very short time, so short that no appreciable movements took place during the count. Up to 1921, it was the only distribution directly recorded by the census in Great Britain. But in that year the count was made in June, instead of in April as usual; and the holiday movements which had then begun caused serious uncertainties in the results as compared with those of other censuses and with intercensal estimates. Hence in 1931 there was introduced a question requiring each person to state his usual, or legal, place of residence.

This made it possible to count the regular inhabitants of each district, and so to measure the *de jure* population, by excluding visitors and including temporary absentees, a second stage in an accurate measure of distribution. The difference between the *de facto* and the *de jure* populations may at some places and times be considerable, especially in a holiday resort such as Blackpool; and it is obviously necessary to know the numbers of the resident population for many purposes of administration. The counting of the *de jure* population has always been the aim of censuses taken to determine electoral constituencies, as in the United States of America; it is surprising that it did not come earlier in Great Britain.

The requirement that each person shall state his place of birth enables the census to obtain some information regarding the origins and migrations of the people it enumerates. It is regrettable that the separation of Eire from the United Kingdom in 1922 has been allowed to interrupt the continuity of the records under this head. This can be avoided for the future if under 'birth-place' in the schedule we write 'British Isles' in place of 'United Kingdom'; and so obtain records

comparable with those of censuses before 1922, without losing anything in comparisons with that of 1931. A large part of the recent immigration into Great Britain is from Ireland; and fuller information about these immigrants is much to be desired.

In relation to the birthplace question, however, the chief desideratum is a fuller analysis and tabulation of the results. In 1931, for each administrative county and every town in England and Wales with more than 50,000 inhabitants, the census tables classed the numbers of those enumerated there into those born in that district, those born elsewhere in England, elsewhere in Wales, in Scotland, in Northern Ireland, or in any one of many other countries. But if the classification is to give information about migrations within England, 'elsewhere in England' is a useless grouping. To measure the 'drift to the south' it should be replaced by at least the county of birth of each person enumerated, for the whole of Great Britain or, preferably, for the British Isles. Also these migrants should be classified by age and sex, and perhaps also by occupations, so as to give a measure of the character of the migration. It is clear that to do this will involve much more detailed analysis and tabulation of the results. But the magnitude of the internal movements of our population has been so great in recent years, and its results are of such importance, as to justify a demand for the fuller and more precise knowledge of it which can only be obtained in this way.

Another important group of population movements is that of the daily journeys between residence and workplace. We all know that the day and night populations of many districts differ widely; but this knowledge is rarely precise. In 1921 the census schedule included a question on workplace, the answers to which gave valuable information on this daily ebb and flow of a large part of our population. The question was omitted in 1931; and only partly replaced by the requirement that each employee should state the address of his employer, which is usually the place at which he works. Thus, for 1931, this information is available for only a part of the population. The question should be restored for 1941, and applied to every person engaged in regular work. The importance of a knowledge of this daily movement for the planning of suburban transport, of roads, and of housing, and for other local government purposes, is quite obvious and

sufficient to justify the cost involved in obtaining and tabulating the information.

Recent changes in the distribution of the population in Great Britain have been considerable. The 'drift to the south' (actually towards London and some parts of the Midlands), though it may have been exaggerated and misunderstood in the popular imagination, is a real and important fact. Such migrations, among a people whose numbers are no longer increasing to any considerable extent, involve actual decreases in the population of some other parts of the country. Before we can know the real importance of these movements or take any reasoned steps to deal with them, it is essential to have much more exact knowledge of their extent and range. In what numbers and in what proportions do the migrants come from the distressed areas, from highland areas, or from the rural areas and small towns? Do they spread themselves widely, or do they tend to move and settle in groups? There is urgent need for trustworthy answers to these and other questions concerning the migration; and a fuller analysis of the census returns can provide much material for the answers.

In England the census has provided from time to time, but never for all at the same time, information concerning four groups of facts relating to the distribution of the people. The first of these is the number of the *de facto* population of each census district at the time the census is taken. The second, begun only in 1931, is that of the *de jure* population, at its usual residence, for the same date. The third comes from the comparison of the first, or in future of the second, with the information as to birthplace, age, sex, and occupation; it gives a measure, necessarily incomplete but nevertheless of real value, of internal migrations and of immigration. The fourth group of facts relates to the daily, or other short-period, movements.

The importance of a knowledge of all these facts of distribution has been emphasized recently by considerations of air raid precautions and of civilian defence. A thorough knowledge of the normal distribution of the people is necessary for efficient defence in war, and not less so for any adequate national planning for times of peace. It is, therefore, very desirable that the coming census of 1941 should be used to obtain the fullest possible information about all four groups of facts relevant to the distribution of the population of Great Britain.

Ancient Hindu Algebra

History of Hindu Mathematics:

a Source Book. Part 2: Algebra. By Bibhuti-bhusan Datta and Avadhesh Narayan Singh. Pp. xvi + 314. (Lahore: Motilal Banarsi Das, 1938.) 7.8 rupees; 13s.

THIS is the second volume of the three in which the authors are writing the history of Hindu mathematics. The first contained Part 1, dealing with numeral notation and arithmetic, which was issued in 1935, and noticed in NATURE of January 18, 1936, p. 88; the present volume (Part 2) contains the history of algebra.

Historians of mathematics have hitherto been handicapped in describing the course of development of Indian mathematics because they have generally been dependent upon a few special studies such as H. T. Colebrooke's "Algebra with Arithmetic and Mensuration from the Sanscrit of Brahmagupta and Bhaskara" (1817) and new editions of that work, "Notes on Indian Mathematics" of various dates by G. R. Kaye, a study by the same scholar of the Bakhshārī manuscript, and a few original texts and German or English translations, mostly brought out in India and so not generally accessible. But the published material is small compared with the extent of the sources. The editors' bibliography in Part 1 contains some thirty-eight items setting out the various books and MSS. to which they have had recourse, and from which they have translated in full a vast number of passages. They estimate that about half the content of this second volume is here presented for the first time, so that the future historian will have at his disposal copious material as never before.

The volumes are definitely source-books, and in consequence by no means easy reading. One characteristic of the Indian mathematicians is the careful formulation, *in extenso*, of rules for the solution of every type of algebraical problem (whereas the remains of the ancient Egyptian and Babylonian mathematics contain a multitude of examples, but practically no expressed rules). The rules have all to be expressed in words because the Indian had practically no symbols; the unknown was "yāvat-tāvat" or "avyakta", and was denoted sometimes by a blank with the number representing the coefficient following it, sometimes by abbreviations for the names of various colours, sometimes by letters of the alphabet; signs for operations were limited to + (after the symbol to which it relates), or a superposed dot or small circle, for minus, the others being abbreviations for words;

powers were 'square', 'cube', 'square-square', 'square-cube', 'cube-cube', so that the Indian symbolism had not even in Bhāskara II's time (twelfth century A.D.) advanced beyond the stage represented by Diophantus (third century). It is not surprising, therefore, that the statement of a rule for solving an equation or a set of equations sometimes runs to many lines, equal to a third or a half of the printed page, in one of these volumes.

The subjects include (besides technical terms, laws of signs, fundamental operations, etc.) linear equations in one, two, or more unknowns, quadratic equations, single and simultaneous, a few equations of higher degrees, indeterminate equations of the first degree, simultaneous equations of the first degree, the solution in integers of the equations $Nx^2 + 1 = y^2$ ('square-nature') and $Nx^2 \pm c = y^2$, general indeterminate equations of the second degree, rational right-angled triangles, rational quadrilaterals, linear functions made squares or cubes, double equations of the first and second degrees, and finally the solution of the equation $ax^2 = bx + cy + d$.

The genius of the race for the theory of numbers brought the Hindus by A.D. 1150 to their supreme achievement, the general solution in integers of the indeterminate equation of the first degree in two unknowns and of the famous (miscalled) "Pellian" equation. The first was solved by the method called the 'pulveriser' ('kuṭṭaka'), and the stages through which the solution passed are represented by Aryabhata I (born A.D. 476), Bhāskara I (522), Brahmagupta (628), Mahāvīra (850), Aryabhata II (950), Śrīpati (1059) and Bhāskara II (1150). The editors give the rules stated by each of these writers. The importance attached by the ancient Hindu mathematicians to the method of the 'pulveriser' is attested by the fact that the whole science of algebra was once named after it ('kuṭṭaka-gaṇita', the science of 'kuṭṭaka'). Still more remarkable is the solution in integers of $Nx^2 + 1 = y^2$ (the 'square-nature'). The account begins with Brahmagupta's Lemmas, rediscovered by Euler in 1764 and by Lagrange in 1768, and finishes with the 'cyclic' method described by Bhāskara II (1150). Fermat, Brouncker, Wallis and Euler could do no more than rediscover what the Hindus had given, and only Lagrange supplied the final proof that the 'cyclic' method will in every case produce the desired result whenever N is a number which is not a square.

The book has evidently involved untold research and labour, and cannot be too strongly commended.

Physics in College and School

(1) *Électricité et Magnétisme*

Par Prof. Gaston Jochemans et Fernand Descans. Pp. 416. (Bruxelles: A. de Boeck; Paris: Ch. Béranger, 1937.) 150 francs.

(2) *College Physics*

By Prof. H. A. Perkins. (Prentice-Hall Physics Series.) Pp. ix + 820 + 1 plate. (New York: Prentice-Hall, Inc.; London, Glasgow and Bombay: Blackie and Son, Ltd., 1938.) 3.75 dollars; 15s. net.

(3) *An Outline of Physics*

By Prof. A. E. Caswell. Revised edition. Pp. ix + 590 + 1 plate. (New York: The Macmillan Company, 1938.) 3.95 dollars.

(4) *The Elements of Physics*

By Prof. Alpheus W. Smith. Fourth edition. Pp. xix + 790 + 7 plates. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 21s.

(5) *Light*

By F. Bray. Second edition. Pp. xii + 369 + 4 plates. (London: Edward Arnold and Co., 1938.) 7s. 6d.

(6) *School Electricity*

By W. E. Pearce. Pp. xii + 296. (London: G. Bell and Sons, Ltd., 1938.) 4s.

(7) *Concise School Physics:*

Heat, Light and Sound. By R. G. Shaekel. Pp. ix + 177-477. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1938.) 3s. 6d.

(8) *A Complete Revision Physics, Notes and Questions:*

Hydrostatics, Heat, Light, Sound, Magnetism and Electricity. By S. R. Humby and F. W. Goddard. Pp. viii + 303. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1938.) 3s. 9d.

(1) **T**HE first of the books under notice presents a clear and well-arranged exposition of the foundations of the mathematical theory of electricity and magnetism. It covers the usual ground in electrostatics, magnetism and electrodynamics; and there is an appendix on the equations of Lagrange and Maxwell. Vectors are introduced and used from the beginning. The book is intended for students of electrical engineering at the University of Brussels and, in consequence, more attention than usual is paid to applications of all kinds. The book may be recommended to honour students, who would find the simple and detailed explanations useful.

(2, 3, 4) The next three books in the list are alike in many ways and the title of 'college physics' would apply to them all. They all provide a good

conspectus of the subject; they all assume considerable knowledge on the part of the reader; and they all give something more than a glimpse of the work which awaits a future specialist. In the United States, science is usually presented to the young in a very liberal manner. In these books, the authors consolidate the ideas which the students should have acquired and they carry the story much further. In every case, the books could be used with advantage by those who are preparing for higher school certificate examinations. A further point of resemblance is that the mathematics connected with the work is kept on an elementary level, though Prof. Alpheus Smith introduces the methods of the calculus in some useful appendixes. Now for the differences:

Prof. Perkins uses the language of mathematics freely, for he believes that most students find a concise symbolic treatment easier to grasp than a verbal one. He strongly emphasizes the quantitative aspects of the subject and rather avoids its applications to everyday life. The latter he leaves to the teacher, while he himself endeavours to make his text so clear that the students may understand the physical principles without further assistance. His book is better suited to the future specialist than to one for whom physics will not be of absorbing interest in after life.

Prof. Caswell goes to the opposite extreme. Taking the view that most of the students who use his book will never take a more advanced course in physics, he includes a great deal of illustrative material, the result being that the space which remains seems scarcely sufficient for the orderly presentation of his subject. For example, within the first thirty pages of his text, he defines conservation of energy, mass, vector quantity, gram-molecular-weight, electrons, protons, atomic number and valency; which certainly is quick going.

Prof. Smith steers a middle course by keeping the logical development of his subject in the foreground, while providing a wealth of illustrative matter in small type. Thus the continuity of thought is not broken, but the work is lightened for the student and reality is lent to the whole. In this, the fourth edition of Prof. Smith's work, he has introduced a separate chapter on nuclear physics and has added one on astrophysics.

(5) Mr. Bray's book is a straightforward work with certain pleasing features, one being the insertion of many historical notes. In this edition, the chapters on photometry and spectra have been rewritten in accordance with the progress which

has been made during the last decade. The scope of the work may be indicated by saying that it concludes with a selection of questions taken from higher certificate and university entrance scholarship examinations.

(6, 7, 8) The remaining three books are concerned chiefly with work at about the school certificate level. Many teachers will be glad that Mr. Pearce has followed up his "School Physics" with a "School Electricity", for he writes clearly and his book is beautifully produced. The final chapter on modern developments should incline many students to continue their study of physics.

Mr. Shackel's book is the second part of his "Concise School Physics". It is a worthy successor of the first part, "Mechanics", on which an appreciative comment was made in *NATURE* on September 24, 1938, p. 551.

Finally, Messrs. Humby and Goddard's "A Complete Revision Physics, Notes and Questions" has already proved a useful tool in the hands of teachers during final revision for the school certificate, army entrance and kindred examinations. In the present volume, magnetism and electricity are added to the hydrostatics, heat, light and sound of the former one.

Animal Language

Animal Language

Described by Julian Huxley, recorded by Ludwig Koch and the Parlophone Company. Pp. xi+62+31 plates. (London: *Country Life*, Ltd., 1938.) With 2 Records, 21s. net.

ALTHOUGH the noises made by animals are among the most familiar sounds in Nature, they have seldom been the subject of serious biological or psychological study. The present work is an attempt to provide a clearer understanding of the significance of animal sounds than can be obtained by the perusal of an ordinary book. The publishers explain that a 'sound-book' of this type is the natural medium whereby text, picture and gramophone records form a natural unity in which the text comes to real life through the records and vice versa. Individual readers must judge, for themselves, how far this ambition has been fulfilled.

Preliminary inspection suggests that the book is well illustrated. In a sense this is true, but it is disappointing to find that few, if any, of the numerous illustrations are really relevant in the sense that they aid materially in an understanding of the text or in an interpretation of the records. The photographs, nearly forty in number, are no doubt interesting in themselves, but they are seldom attractive; the harsh contrast of tones produces, on some observers at least, a somewhat displeasing impression.

The text of the book is full of interest, for it reveals the paucity as well as the extent of our knowledge. Dr. Huxley covers the whole animal kingdom in his survey and has collected together a wealth of otherwise scattered information. It is sad to find that we must abandon our belief in the soothing influence of the snake charmer's pipe, but it is comforting to think that the ears of the common female frog may lead her with some

certainly to the embraces of that male whose individual song is best attuned to her own fancy.

The interpretation of animal sounds is a fascinating but difficult subject, and it is therefore unfortunate that the evidence in support of Dr. Huxley's views is seldom presented in sufficient detail to enable the reader to form an independent judgment. At times, Dr. Huxley expresses his own views with considerable confidence. "What is the point of a rattle-snake's rattling? The answer is really very simple. The snake doesn't want to strike unless it has to. It might very easily get trodden on. . . . The rattle is a warning to the intruder to keep away. . . . In the same sort of way those who instal burglar alarms in their houses put up a notice to that effect outside." This may be so, but whether it is an established truth or simply an *ad hoc* hypothesis we are given no real evidence to decide.

The text of the book is of very considerable length, and one reads on in the hope of reaching eventually a detailed consideration of the gramophone records. Unfortunately, one is doomed to disappointment, although the records themselves present unique material for the study of 'animal language'. The first record is composed of isolated sounds from a variety of mammals; most of them are associated with anger, food or sex. Each section of the record must be played several times in succession before it yields its full flavour; it is, however, well worth while to educate one's ear to the 'gurgling' of a satisfied Arabian camel or to the 'whispering whinny' of an amorous panda. The 'African night' record is definitely exciting particularly if played out of doors on a dark night.

The book is extremely well produced, and one gets the impression that a closer liaison between the three authors would have avoided some of the limitations to which this review pays, perhaps, too much attention.

Electrode Potentials

The Electrode Potential Behaviour of Corroding Metals in Aqueous Solutions

By O. Gatty and Dr. E. C. R. Spooner. Pp. xi + 504. (Oxford: Clarendon Press; London: Oxford University Press, 1938.) 25s. net.

MUCH in electrochemistry is controversial, and fresh outlooks and ideas are exceedingly stimulating. This book is justified by the ingenuity of speculation advanced, quite apart from the very considerable amount of data, largely original, presented upon the electrode potential characteristics of a large number of the more important metals.

The arrangement is certainly unorthodox for a work which may well be considered standard, but the context falls easily into the collection of papers presented, and is quite easy for reference even if it does suffer from the lack of a subject index.

A large introductory paper deals with theory: it is well arranged, comprehensive, often original in outlook, and rich in references. There follows, in a number of papers, a treatment of the specific behaviour of many metals; very clear descriptions of the experimental technique adopted are given,

and the analysis and discussion of phenomena presented are critical.

In particular, the paper on iron should receive mention, from the importance of the metal, and from the comparative length of the treatment given. It outlines work published upon behaviour, stresses the importance of the time factor in potential measurement interpretation, and elucidates much concerning the nature of the corrosion of iron, passivity, the effects of solute nature, pH, temperature, grinding, oxygen diffusion, etc. It is exceedingly clear upon the mechanism whereby the inhibition of corrosion is effected by chromates.

There are a number of appendixes of some length, forming a not unimportant part of the whole. One treats with very recent work in over-voltage, some of which has not otherwise been published. Another deals with developments in the theory of tarnishing, applications of which to the treatment of silver, copper, and aluminium bronze, have much promise.

This book is of very definite utility to electrochemists and corrosion chemists, and should be of considerable interest to many others. A. J. G.

Fingerprints

Fingerprints:

History, Law and Romance. By George Wilton. Pp. xix + 317 + 10 plates. (London, Edinburgh and Glasgow: William Hodge and Co., Ltd., 1938.) 12s. 6d. net.

THE central topic of Mr. Wilton's book on fingerprints is the claim of Henry Faulds (1843-1930) to have been the originator of the use of fingerprints in criminal identification and detection. In 1880 a letter appeared in *NATURE*, (22, 605; Oct. 28) from Faulds, a medical missionary in Japan, stating that his study of fingerprints, initiated by his observation of impressions on Japanese prehistoric pottery, had led him to the conclusion that bloody impressions on clay, glass, etc., might lead to the scientific identification of criminals. In a later issue of *NATURE* of the same year (23, 76; Nov. 25), Sir W. J. Herschel wrote to point out that he had used fingerprints in India for more than twenty years.

Mr. Wilton traces the subsequent history of the study of fingerprints in relation to criminal identification and the introduction of the fingerprint system of identification of habitual criminals

in English police work. The part played by Sir Francis Galton in the matter is consistently and sometimes violently attacked. While Mr. Wilton's use of the documentary evidence is not unfair, his championship of Faulds leads him to take an unduly harsh view of Galton's undoubted neglect of Faulds's work. On the other hand, there can be no doubt that it was through Galton's work and influence alone that the police authorities adopted the system, which was introduced by Sir E. Henry at Scotland Yard in 1901.

Had Mr. Wilton a closer acquaintance with conditions at the time, he could scarcely have maintained that Faulds's work affected the issue in the slightest. Priority of publication undoubtedly belongs to Faulds; but it was Herschel's practical experience in India that influenced Galton; and it was Galton's work, especially in the classification of fingerprints, and his prestige as a man of science that was responsible for the substitution of the fingerprint for the anthropometric system which had been adopted by the police on the model of the Bertillon system in the latter half of the nineties of the last century.

La fluorescence en biochimie

Par Prof. Ch. Dhéré. (Les problèmes biologiques, 21.) Pp. xii+318+27 plates. (Paris: Les Presses universitaires de France, 1937.) 80 francs.

IN some respects this treatise may be regarded as a counterpart of the same author's contribution to Abderhalden's "Handbuch der biologischen Arbeitsmethoden" reviewed in NATURE in 1935. However, it is by no means a translation, for the arrangement is different, and much of the matter has been brought well up to date; indeed, the author (p. xi) distinguishes between the two works.

The treatment is concise and eminently practical, throughout, and anticipates possible experimental difficulties on the part of the inquirer; for example, on p. 233, the author, speaking of hæmatoporphyrine in pyridine, leads the reader from the first impression that there is only one fluorescent band to the discovery that there are really two. Apparatus is described in detail. The main themes of practical interest to the biologist are dealt with in separate chapters, where each receives such comprehensive treatment that few readers will fail to gain either the information or the guidance they need; for example, those on glucides, fats, proteins, alkaloids, chlorophylls, bile pigments, vitamins, microbes, each with its own bibliography; these occupy 250 pages. The present reviewer does not recall the toluene experiments attributed to him (p. 69); his own more recent work, as yet unpublished, makes him critical of any observations on the fluorescence of the sugars, including his own earlier work, unless the material has been rigorously purified; hence the data on pp. 65-68 should be read with discrimination.

The book is not burdened with much theory, but it discusses at some length spectroscopic aspects of the subject. It is furnished with fifty-two figures in the text, and a further fifty-six, mainly spectrograms, in twenty-seven plates. The book as a whole is well produced.

S. JUDD LEWIS.

A Systematic Review of the Genus *Phylloscopus* (Willow-Warblers or Leaf-Warblers)

By CLAUD B. TICEHURST. Pp. viii+193+2 plates. (London: British Museum (Natural History), 1938.) 10s.

DR. TICEHURST has for long been recognized as an authority on the willow-warblers, and this critical revision of that group is a model of what such a work should be. He has based it primarily on his own examination of thousands of specimens available in museum collections, and only secondarily on the previous literature. By his determination, there are thirty species in the genus and these comprise, in all, sixty-seven separable forms. They are distributed across Europe and Asia, the largest number of forms being found in the mountain ranges bordering the Tibetan plateau: two are strangely isolated on the islands of Flores and Timor.

Of the three which breed in the British Isles, the ordinary willow-wren and the chiffchaff are scarcely distinguishable by sight under ordinary field conditions, although their songs are strikingly different, and this is indicative of the difficulty of the group as a whole. The complexity is increased by the fact

that allied species show parallel variations in corresponding parts of the area which they jointly inhabit; but this is itself one of the points of general biological interest which emerge in the present study.

Most of the forms are migratory, and although information as to winter ranges is in many cases still far from complete, the general trends are becoming clearer. One form which breeds only in north-eastern Siberia winters in Africa, and one with a breeding range extending as far west as northern Norway does not winter nearer there than Siam: these two movements, the greatest exhibited in the group, cross each other at right angles.

The book includes useful sketch maps illustrating distribution and migration; the two coloured plates by Mr. Roland Green show eleven species of which no plate had hitherto been published.

Index Kewensis Plantarum Phanerogamarum

Supplementum 9: Nomina et Synonyma omnium Generum et Specierum ab initio anni 1931 usque ad finem anni 1935 nonnulla etiam antea edita complectens. Ductu et consilio A. W. Hill. Confecerunt Herbarii Horti Regii Botanici Kewensis Curatores. Pp. iii+305. (Oxford: Clarendon Press; London: Oxford University Press, 1938.) 84s. net.

ONLY five years have elapsed since the publication of Supplement 8 to the "Index Kewensis" and in Supplement 9 botanists are presented with a volume considerably larger than any of its immediate predecessors. Since the first appearance of the "Index" in 1893—made possible by the munificence of Charles Darwin—the publication of each Supplement marks a stage in the progress of systematic botany, and provides the only authoritative list of the names of plants recently described, the author and place of publication of each, together with an indication of the geographical distribution. Of the many important works which emanate from Kew none is so indispensable to botanists in general and to systematists in particular.

The present work is essentially what it sets out to be—an index, and its general plan follows that of earlier Supplements. The size of the volume is some indication of the large amount of work which has been accomplished in the systematic study of Phanerogams during the years indicated on the title page. The new genera which have been described are shared among numerous families, but reference may be made to the considerable number of additions to Compositae, Gramineae and Orchidaceae, while students of so-called critical genera such as *Capsella*, *Rubus*, *Hieracium* and *Taraxacum* will find a large number of new specific names for their consideration.

In the preparation of a work of this kind it is unlikely that omissions will not occur, and in the present Supplement a number of entries refer to species which were described before 1931. There can be nothing but praise, however, for those members of the staff at Kew who have undertaken the compilation of the work and for the great care they have bestowed upon its preparation. The volume is sure of a warm welcome from botanists and horticulturists throughout the world.

J. R. M.

The 200-inch Telescope

By Dr. Walter S. Adams,

Director of the Mount Wilson Observatory, Pasadena, California

DURING the past few years, responsibility for the construction of the 200-inch telescope and the solution of its many problems has lain with the members of three committees organized to deal with various aspects of the project. Of these committees, the Observatory Council is the executive body making final decisions upon major questions which are brought to its attention, the Policy Committee considers general matters relating to the function of the telescope and auxiliary instruments and the future operation of the Observatory, and the Construction Committee deals with all technical subjects connected with the design and construction of the telescope. Both the Policy Committee and the Construction Committee report directly to the Observatory Council.

The membership of the Observatory Council, as at present constituted, consists of representatives from the Board of Trustees and staff of the California Institute of Technology and the director of the Mount Wilson Observatory. The members of the other two committees are from the staffs of the two institutions. Dr. Max Mason is chairman of the Policy and the Construction Committees, and since the death of Dr. George E. Hale has also been chairman of the Observatory Council. Dr. John A. Anderson is the executive officer of the Observatory Council with general charge over the optical and instrument shops, and until January 1, 1939, Captain C. S. McDowell was supervising engineer in charge of construction. The advice and assistance of numerous engineers and men of science throughout the United States have been utilized to advantage on many occasions and have been given most generously.

A review of progress on the 200-inch telescope naturally divides itself into three parts: optical figuring of the 200-inch and auxiliary mirrors; design and construction of the mounting and drive; and construction and erection on Palomar Mountain.

OPTICAL WORK

The present figure of the 200-inch mirror approximates closely that of a sphere with a radius of curvature of 111 feet. The disk was first shaped on front, back, and edges by grinding with coarse carborundum and the centre was then hollowed out to a depth of about $3\frac{1}{2}$ inches with the aid,

first of a 50-inch tool, and then of successively larger tools up to the full size of 200 inches. As the spherical figure was approached, finer grades of carborundum were used so that when optical tests became necessary only a few hours of polishing were needed to give the surface sufficient reflecting power. During the first stages of work upon the disk, the cylindrical holes on the back of the mirror and the large areas between the supporting ribs were filled with plaster of Paris, and after the face and back had been made parallel the 40-inch opening at the centre of the disk was closed with a glass plug weighing about one ton. The plaster of Paris was removed when the surface had reached nearly the required form, and the mirror was placed upon rubber pads which rest on the frame of the support system of multiple counter-weighted levers. The friction of these pads was required to neutralize the strong lateral pull of the grinding and polishing tools making contact over so large a surface, and for this reason the horizontal plates of the supporting system were not engaged. The optical tests, however, were made with the mirror vertical and balanced upon the support system just as it will be when in use on the telescope. Future optical work, including the parabolizing, will be carried on with the mirror resting upon the rubber pads; but these will be removed when the figuring is completed.

From the first the optical tests of the mirror proved to be most satisfactory. No change was seen in the figure when the mirror was tipped repeatedly from a horizontal to a vertical position or when it was rotated. Also no local deformations could be detected at the points of contact of the thirty-six individual lever supports. In fact, the support system was found to be performing quite as well as had been hoped by its designers. The length of the radius of curvature proved to be about two inches less than had originally been planned, but this slight difference, amounting to about one inch in the focal length, is far within the limits allowed for in the design of the telescope, and it is probable that no attempt will be made to reduce the amount through polishing. The surface was found to be reasonably free from zones, but a small amount of astigmatism was present amounting to about 0.1 inch in the optical cut-off at the centre of curvature. This

proved to be due to a slight deformation of the disk caused by the horizontal pads upon which the mirror rests, and is being corrected by a small amount of fine grinding after suitable changes in the supporting pads.

Although the final parabolic curve of the surface of the mirror will be only 0.005 in. deeper than the spherical curve, the area is so great and the

this mirror will be one of the next major undertakings in the optical shop. It is at present shaped on front, back, and edges, and the surface has been ground approximately flat. It is planned to figure the three auxiliary hyperbolic mirrors, one for the Cassegrainian and two for the coudé combination, by the method devised by Hindle, without the use of the 200-inch mirror. Four spherical mirrors,

each about 40 inches in diameter and with a radius of curvature of 25 feet, are being prepared for this purpose, two being very nearly completed. The mirrors will be used side by side in a clover-leaf pattern and provided with adjustments for bringing their centres of curvature into accurate coincidence.

A few figures are of interest as indicating the scale of the optical work on the 200-inch mirror. About five tons of glass have been removed in the process of shaping and figuring, and about 20 tons of carborundum have been used for grinding. During the polishing, about 50 pounds of rouge an hour is the average consumption with the full-sized tool, and but a small fraction of this material can be salvaged. As a result rouge has been purchased in quantities hitherto quite unfamiliar to dealers in optical supplies.

MOUNTING AND DRIVE

The major portions of the telescope mounting have been under construction during the past few years at the South Philadelphia plant of the Westinghouse Electric and Manufacturing Company. They were completed and shipped in October and have been transported to Palomar Mountain, where erection has been in progress since November. These parts include the tube, the north and south

members of the yoke, the two east and west members, each of which consists of three sections, which, when joined, form a 60-foot tube 10 feet in diameter, the declination bearings and the hemispherical south bearing of the polar axis with its oil pads. Several of the individual pieces weigh between 45 and 55 tons, and the total weight of the completed mounting will approximate

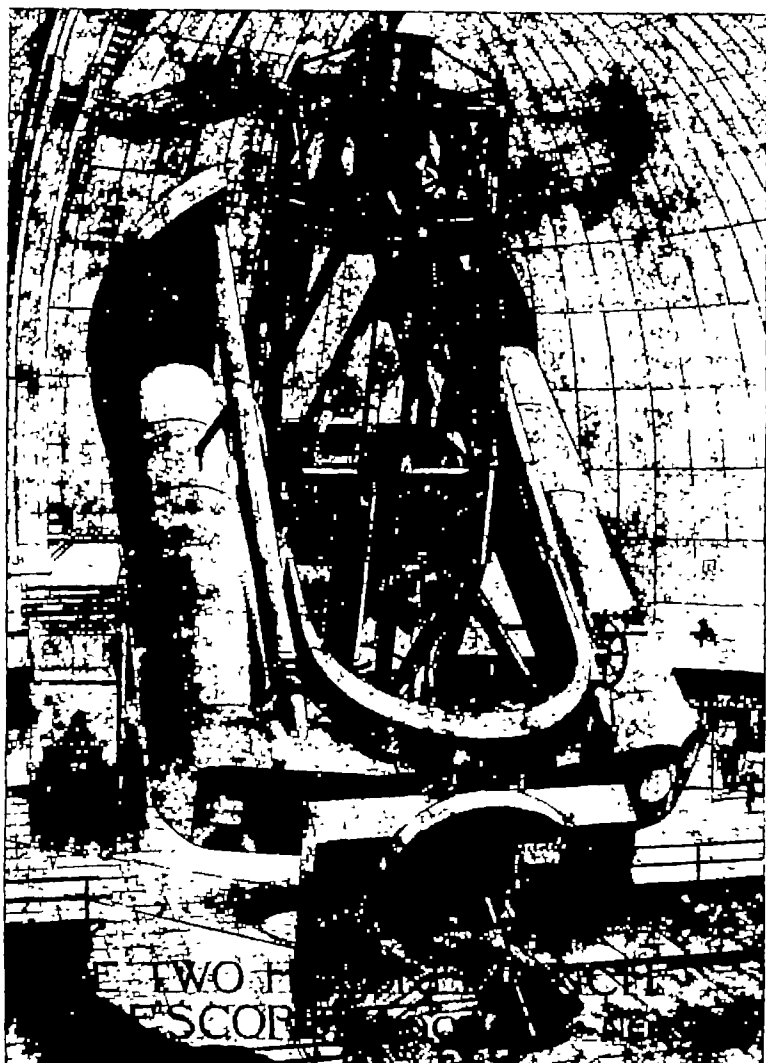


Fig. 1.

DRAWING SHOWING THE SIDE MEMBERS OF THE YOKE WITH THE TELESCOPE 'TUBE' BETWEEN THEM.

process of polishing so slow that it is planned to make most of the change through fine grinding and to leave but the final stages of the figuring to the polishing tool. This procedure has already been found successful in figuring the spherical curve.

Accurate tests of the parabolic figure of the 200-inch mirror will require the use, as an auxiliary plane, of the 120-inch mirror. The completion of

500 tons. The north and south bearings of the telescope are on oil films maintained under high pressure, while the declination bearings are of the ball type. At the present time the south member of the yoke has been placed in position on its bearings and the supports for the oil pads at the north end are installed in readiness to receive the section of the yoke which will form the journal supporting this end of the telescope. This feature of the mounting is a welded structure, shaped like a horseshoe, about 4 feet deep and 46 feet in diameter. It

was machined with the tips of the crescent under tension so that it will have an accurate circular form when carrying the weight of the telescope.

The large gear wheels, two for the right ascension drive and one for the declination, are 14 feet 3 inches in diameter, and are being cut and ground in the Pasadena instrument shop, where all the control mechanism is under construction. The driving control of the telescope will be electric with a five per cent range in rate, and the instrument will be provided with computing devices for automatic settings in position.

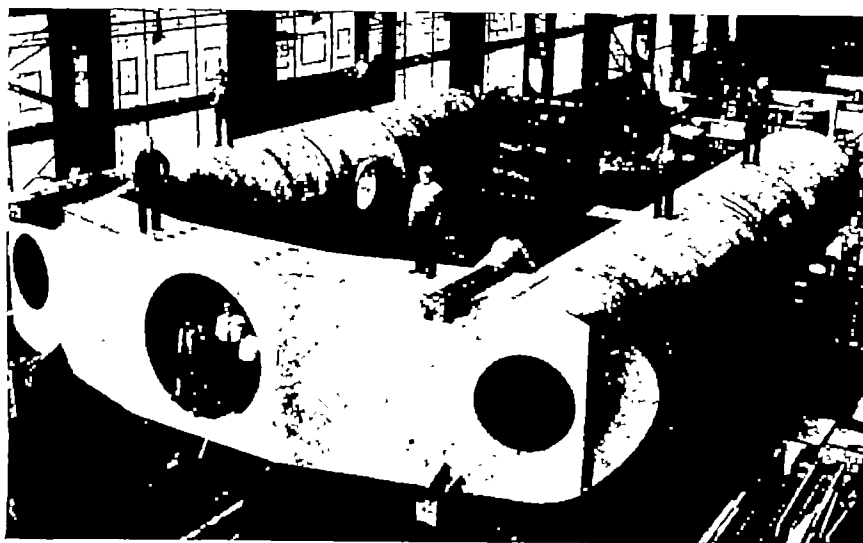


Fig. 2.

SOUTH AND SIDE MEMBERS OF THE YOKE AT THE FACTORY.

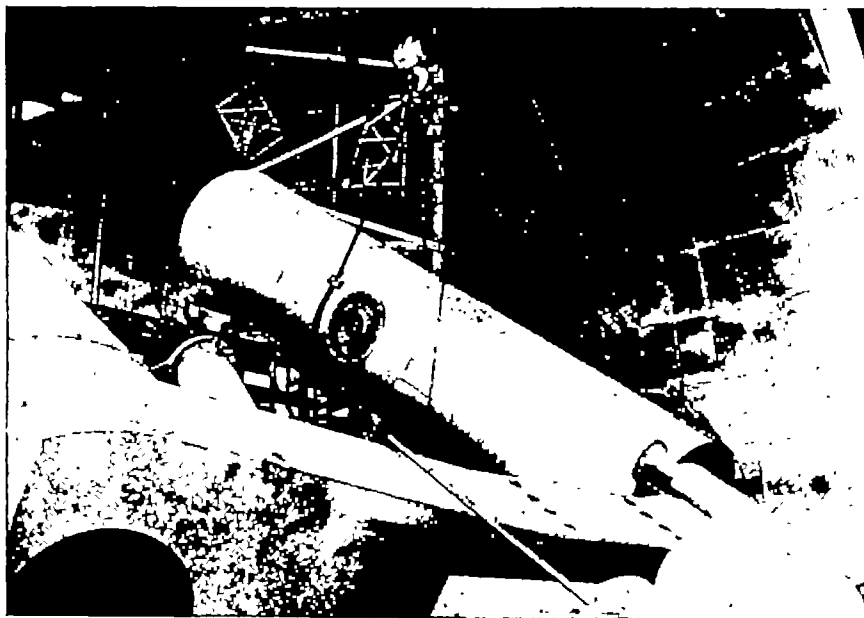


Fig. 3.

ERECTION IN THE DOME ON PALOMAR MOUNTAIN.

CONSTRUCTION AND AUXILIARY INSTRUMENTS ON PALOMAR MOUNTAIN

The dome to house the 200-inch telescope is 137 feet in diameter and has been built and erected. The building is of double construction throughout with an air space between the two walls and heavy insulation on the inner wall. The insulation of the steel dome is by means of aluminium foil set in panels 5 inches thick, which cover the entire interior surface including the 35-foot split shutter. It is expected that the daily temperature range

within the dome will not exceed 3 degrees. The outer shell of the dome is of monocoque construction, consisting of three-eighths-inch steel plates welded together and stiffened by an interior framing of girders and arches.

The dome weighs about 1,000 tons and is mounted on thirty-two trucks with spring adjustments and forged steel wheels. The rails are welded to avoid joints and have been ground to a bevel so that the motion of the dome gives very little vibration. The driving mechanism consists of two motors,

180° apart, which operate through reduction gears to turn rubber-faced driving wheels which are held by springs against the vertical flanges of the rotating dome. This design has proved effective, and the friction of the rubber faces provides a brake against rotation of the dome, by high winds.

A travelling crane with a capacity of 60 tons is attached to the main arches of the dome, and the platform for carrying the observer to the small turret in the centre of the tube at the prime focus of the telescope will also be supported by this part of the structure. The basement of the dome will contain the large aluminizing chamber, a number of offices, photographic rooms under controlled temperature, small physical and chemical laboratories and the pier of the large coudé spectrograph room. The electrical control boards are housed on a mezzanine floor, and above this but just below the level of the telescope mounting is the main observing floor.

It is essential in the case of the 200-inch telescope,

in which the field of sharp definition at the centre of the photographic plate is limited and the value of observing time is extremely high, that the observational programme be defined as accurately as possible through survey work and identification of objects with instruments having wide angular fields and great light efficiency. Two Schmidt telescopes have been planned for this purpose, one of which, with an effective aperture of 18 inches and a focal ratio of 2.0, has been in operation for about three years. It has been most productive in studies of nebulae and the discovery of supernovae. A second instrument of this type, with an effective aperture of 48 inches and of focal ratio 2.5, is now under construction. The 45-foot dome has been erected on Palomar Mountain and the 72-inch pyrex disk for the spherical mirror has been received from the Corning Glass Works. The figuring and support of the 48-inch Schmidt correcting plate, which will not exceed one-half inch in thickness, will present some interesting optical and mechanical problems.

The Cell Theory

Its Past, Present and Future

AMONG the important meetings held by the American Association at Richmond, Virginia, in December, were those dealing with the cell theory—its development, its present status, and its future possibilities. These meetings were in the nature of a symposium and combined the best thought of the three sections of the Association, on history, botany, and zoology, which collaborated in the programme.

Seven outstanding papers by eminent scholars were presented in two sessions, morning and afternoon of December 27. Those taking part were: Prof. L. L. Woodruff of Yale University; Prof. J. S. Karling of Columbia University; Prof. E. G. Conklin of Princeton University; Prof. G. A. Baitsell of Yale University; Prof. Paul Weiss of the University of Chicago; Prof. Franz Schrader of Columbia University; and Prof. C. E. McClung of the University of Pennsylvania. The discussion and attendance throughout were exceptionally good, more than a hundred and fifty being present at the afternoon meeting.

The morning session, which was devoted to historical aspects, brought some surprising results, especially as bearing upon the two men, Schleiden and Schwann, who up to the present day have generally been given most credit with respect to the origin of the cell theory, which they were

supposed to have enunciated a century ago [see also *NATURE* of February 18, p. 293].

There was apparent agreement in the scholarly papers presented by Profs. Karling and Conklin that the cell theory was projected some time prior to the appearance of the works of Schleiden and Schwann, that these two men added nothing either in content or in clarity with respect to the theory as such, and that they in fact lent support to a general view of cell formation which was completely erroneous.

Prof. Woodruff dealt with the preceding period and with the influence of the microscope. One hundred and seventy years before 1838, Robert Hooke had described little boxes or cells seen under the microscope, and from his day onward other significant observations on cells had been recorded by such men as Malpighi, Grew, Wolff, and Lamarck. With the beginning of the nineteenth century, the cell theory came into sharper focus and received fairly clear and explicit delineation at the hands of Mirbel (1802–1809), Dutrochet (1824), Turpin (1826), Meyen (1828–1838), Brown (1831), Demortier (1832), Purkinje (1835), Mohl (1835–1838), and Valentin (1838).

All these significant contributions preceded the works of Schleiden and Schwann. Why then, it was asked, have the two men been called the

founders of the cell theory? Why the amazing situation "that we still continue to call it after them"? It would seem, as suggested by Profs. Karling and Conklin, that bluff and brag on Schleiden's part entered very largely into the picture. He underestimated, ignored, or ridiculed really important contributions of predecessors and contemporaries, and thus gained a wholly unwarranted recognition; and Schwann borrowed from Schleiden's arrogant claims as to plant cells and applied the same views to animal cells. Prof. Conklin concluded his most interesting paper by suggesting that "it would be more accurate as well as more becoming to strike out of our literature these personal possession tags attached to important discoveries, such as . . . the cell theory of Schleiden and Schwann!"

The afternoon session of the symposium, devoted to the present and the future of the cell theory, developed what appeared like a cleavage in points of view between those who see the problem primarily in terms of physical forces (of surface tensions, physical pressures, and electrical attractions and repulsions), and those who hold that living matter exhibits certain characteristics (such as variability, selective direction, and unfoldment in a temporal sequence) which sharply differentiate the organic from the inorganic.

It was generally agreed that the organization of the cell is exceedingly complex and that there is still much to be learned about it. Yet, on one hand it was maintained by Prof. Baitsell that the difference between the organic and the inorganic is "not one of *kind* but merely of *degree of complexity*. . . . Since the same materials are used in both domains, they must conform to the same elemental patterns." Recent advances in cellular knowledge are due primarily to the work of physicists and chemists. Prof. Schrader, who was concerned chiefly with the present status of mitosis, asked for renewed consideration of a 'dynamic'

hypothesis. He suggested, however, that such a hypothesis meets with many difficulties which recent findings have by no means removed, and that it is a foregone conclusion that the final explanation will not be as simple as had once been thought.

On the other hand, it was pointed out by Profs. Weiss and McClung that, although "the cells derived from an egg have definite, innate capacities of their own . . . the fact that the individual cell can differentiate in a variety of directions but actually differentiates only in one, calls for factors which direct each cell selectively into its proper course. These factors, by their very nature, are super-cellular." They apparently derive from the organism as a whole and suggest the presence of "racial material in a linear order within the chromosomes. . . . Since living systems have unique phenomena of a higher order (than the non-living), like reproduction, metabolism, and consciousness, it is only logical to conclude that there must be units of a new order to explain them."

The participants in the afternoon meeting were in if necessary agreement that there is no sharp break between the living and the non-living. The progressive series of integrations does not stop at the molecular but continues to higher orders. Furthermore, the chemical elements found in the living orders, and their physical and chemical properties and interactions, are, it would seem, precisely the same as those found in the non-living orders. If there was difference of opinion, it appeared to be as to whether the integrations of a higher order (such as the cellular) could be completely explained in terms of principles derived from a lower order (such as the molecular), or whether, since the living orders have properties not found in the non-living, they must have their own peculiar units and be explained primarily in terms of those units. The future, it was held, should soon bring us closer to a resolution of such disputed questions. JOSEPH MAYER.

Obituary Notices

Prof. A. Smithells, C.M.G., F.R.S.

THE death of Prof. Arthur Smithells, on February 8 at the age of seventy-eight years, has removed from the world of science one of the most distinguished participants in the successful effort that has been made in the last half century to break down the barriers between a science too isolated and self-satisfied and a community too indifferent and unconscious of its own needs. No man could be more permeated than he was with a real reverence and enthusiasm for scientific work and achievement. His more intimate personal friendships were almost entirely with men of science, and his own work on

the structure of flame was marked by keen insight and exceptional experimental ingenuity and skill.

Smithells was trained at Owens College, Manchester, and went on to enjoy the pleasant life and invigorating mental atmosphere which Munich and Heidelberg offered to students in those days, returning to an assistant lectureship at Owens. But, at the early age of twenty-five years, he was called to the chair of chemistry at the Yorkshire College in Leeds, and there was faced with the responsibilities and opportunities of a provincial college which was aspiring to be a university, and of a school of chemistry in a great industrial centre. Then came a

division of his activities and a multiplication of interests. His distinguished presence and faculty for the vivid presentment of ideas in speech or writing, and his capacity for the formation of wise and tolerant judgments, won for him quickly the confidence of both academic and lay elements inside and outside the Yorkshire College, and his work in aiding its development into the University of Leeds, by way of the federal Victoria University, was of inestimable value. As a trusted member of Senate and Council, as pro-vice-chancellor and as chairman of the Board of Science and Technology, he placed himself unsparingly at the service of the University in a successful endeavour to collaborate in securing for it the best of university traditions, while maintaining and developing its special character as a school of applied science of international reputation.

In 'pure' chemistry, Smithells obtained the co-operation of his life-long friend, Julius Cohen, and that of his pupil, Dawson, for organic and physical chemistry respectively, and was largely responsible for the appearance of such names as Procter, Green and A. G. Perkin on the list of teachers and research workers in special departments of applied chemistry. His own lecture courses were admirably planned and delivered. Although of necessity so much diverted by claims of university statesmanship and administration, he worked for many years on the subject of flame structure. He became a fellow of the Royal Society in 1901 and president of Section B (Chemistry) of the British Association in 1907. His instinct urged the application of this branch of science to practice and led him to make contacts with the gas industry by a series of striking lectures and by productive conversations. One outcome was the foundation by the gas industry in 1910 of the Liversay professorship of coal gas and fuel industries in the University of Leeds as a memorial to Sir George Liversay, W. A. Bone becoming the first occupant of the chair. Another result was the formation of the Joint Research Committee of the University and the Institution of Gas Engineers, with Smithells as its first chairman. This Committee, unique at the time of its formation, has gradually increased the scope of its work, and Smithells was made its first honorary member a few weeks before his death. The Society of British Gas Industries too honoured him by election to its presidency in 1911.

Another way in which Smithells was anxious to see scientific training and method take its proper place in the arts of life was indicated by those activities which led to his appointment as honorary educational adviser on home science and household economics in King's College, London, where such ideas received more toleration than elsewhere and have since come into a well-deserved prominence.

In 1913 came a break in Smithells' activities at Leeds, arising out of the interest he had displayed in the training of Indian students. He was invited to go as special lecturer to the Punjab University, and accepted willingly since he was anxious to illustrate how, in his opinion, the subject of chemistry might be made to appeal to the mentality of

the Indian student and carry him from theory to practice.

His generous and peaceful soul, with its memories of student days in Germany, was greatly shocked by the outbreak of war in 1914; but, like many others, he felt impelled to help and, first as special lecturer in the Northern Command and later as chief chemical adviser on anti-gas training to the Home Forces, with an office at the Horse Guards and the rank of lieutenant-colonel, he rendered services which were recognized by the distinction of C.M.G.

In 1923, after a few more years at Leeds in the busy post-war period, Smithells resigned the professorship he had held so long in order to take up the congenial duties of the director of the Salters' Institute in London. There he was occupied in the selection of promising young graduates in chemistry who might receive the endowment of the Institute in a further carefully planned training which should fit them for responsible work in industry. His personal knowledge of, and friendship with, so many who counted in the universities and in the various chemical industries, and his powers of judging and advising young men were here invaluable, and he was actively occupied with the duties of this post until failing health dictated his retirement in 1937. It was during this period that he interested himself specially in the Institute of Chemistry and was president for the term 1927-30. He was Harrison lecturer in 1935. Manchester, the university of his studentship, and Leeds, that of his professorship, both conferred upon him the honorary doctorate of science.

In writing, as in speech, Smithells was both lucid and convincing. This was apparent in the accounts of his scientific work submitted to the learned societies and in his lectures. His letters were greatly valued by those privileged to receive them for the same qualities, with more intimate, human and humorous touches and occasional accompanying sketches of persons—often children, in whom he delighted. He could never settle down to the writing of a treatise or text-book, but the Oxford University Press published a collection of his addresses, under the title "From a Modern University", dealing with such subjects as "The Relation of Universities to Technical and Professional Education", "The University and Women's Work", "Professors and Practical Men" and "The Modern University Movement".

Arthur Smithells was the third son of James Smithells and Martha, the daughter of James Liversay. He was twice married—in 1886 to Constance Marie (daughter of F. Mawe) and in 1908 to Katharine (daughter of Arthur Booth), who survives him. He had two sons and one daughter by his first, and one son by his second marriage.

JOHN W. COBB.

Prof. Robert Wallace

PROF. ROBERT WALLACE, professor of agriculture in the University of Edinburgh from 1885 until 1922, died at Kincardine-on-Forth on January 16 at the age of eighty-five years. The chair of agriculture, the oldest in the country, goes back to 1790, and Wallace

and his three predecessors in office, all men of mark, between them filled it for 132 years, a rather remarkable record.

The second son of Mr. Samuel Wallace, who farmed in a large way in Dumfriesshire, Robert Wallace studied agriculture at the University of Edinburgh under Prof. John Wilson, a notable teacher, whose "Farm Crops" was long a standard work. From the University he returned to his native county to engage in the practice of farming, whence in 1882, at the age of twenty-nine years, he was called to be professor of agriculture at the Royal Agricultural College, Cirencester. Three years later he was chosen to succeed Wilson in the Edinburgh chair.

While under such notable teachers as Coventry, Low and Wilson, the agricultural classes at Edinburgh had attracted students from a wide field, there had been up to this time no development of a co-ordinated course in agricultural science. Agricultural students could, and frequently did, take the ordinary classes in chemistry, natural philosophy, botany, natural history and economics; but there were no courses relating these subjects to the practice of agriculture. Wallace, with characteristic energy, set himself to remedy this defect, and the immediate result was the establishment by the University of the B.Sc. degree in agriculture, the first to take the degree being the late Sir William Somerville, afterwards Sibthorpean professor of rural economy in the University of Oxford. At a later stage he was instrumental in obtaining endowments for the establishment of the Steven lectureship in agricultural entomology and of the Garton lectureship in Indian and Colonial agriculture.

The earlier years of the present century were a period of great development in agricultural organization and in agricultural education and research, both in Great Britain and in the Colonies, and the Edinburgh School of Agriculture, first in the field with a comprehensive course in agricultural science of degree standard, was called upon in an extraordinary number of cases to provide men to fill key positions in agricultural departments and in agricultural colleges. One has only to recall such names as Somerville, Middleton, Campbell, Greig, Gordon, Gilchrist, Seton, Milligan and Clouston—to mention a few—to indicate the extent to which the Edinburgh School has influenced agricultural development in the last forty years; and just as no trouble was too great for Wallace to get his former students placed, so nothing gave him more pride and satisfaction than the successes later achieved by them.

Throughout the greater part of the tenure of his chair, Wallace lived under the happy dispensation of the two-term (winter session) academic year, and for many summers he travelled widely to study agriculture under varying climatic conditions. India, Australia, South Africa, Rhodesia, the United States, Canada, Mexico, Egypt, Greece and Italy all came under investigation, and the fruits of his studies gave a refreshing quality to opening lectures and were embodied in many books—for he was an indefatigable and voluminous writer. His best

known book is "Farm Live-Stock of Great Britain", which, first published in 1885, has gone through many editions, and is still a standard work.

A fervid champion of a wide range of causes, Wallace could scarcely avoid achieving a state of variance with quite a number of people, but none who really knew him could fail to appreciate the essential kindness, the rare generosity of the man.

E. SHERRER.

Mr. J. O. Borley, O.B.E.

MR. J. O. BORLEY, who died at Bexley, Kent, on December 30, at the age of sixty-six years, had retired only a year or so before from the post of fisheries adviser to the Discovery Committee (Colonial Office), and was still an active member of that Committee. His interest in whaling and antarctic research dated from his membership of the original Falkland Islands Committee, the recommendations of which led to the splendid investigations carried out under the auspices of the Discovery Committee. Borley took a great part in the planning of these investigations and in their administration. His thorough grasp of practical problems and the soundness and sobriety of his judgment were of the greatest assistance in the negotiations which led up to the international regulation of whaling.

The success of his work on the whaling problem was, I think, largely due to his long and intimate experience of fishery research, for up to 1928, when he joined the Colonial Office, Borley's life-work was the investigation of fishery problems. He started his fishery career at Lowestoft in 1903 under the Marine Biological Association, which, at that time, was responsible for the English share of the international fishery investigations. In 1910, when this work was transferred to the Board (later Ministry) of Agriculture and Fisheries, Borley moved to London with his staff, and was associated with Dr. A. T. Masterman in the general direction of the investigations. During the Great War, he rendered valuable services to the Ministry and to the Restriction of Enemy Supplies Department in an administrative capacity, which earned him an O.B.E. in 1918. In 1921, after the reorganization of the scientific staff, Borley returned to Lowestoft to take charge of the new Fisheries Laboratory which had been set up there through the energy of Prof. J. Stanley Gardiner.

Borley's own scientific work was concerned mainly with the plaice and the plaice fisheries, on which he became an acknowledged authority of international repute, publishing many papers of great value on this subject. He was an extremely painstaking and thorough worker, and was never content until he could wring out the last drop of information from the elaborate biological and statistical data at his disposal. He took a very keen personal interest in the difficult question of the protection of the plaice fisheries, and worked amazingly hard on the Plaice Committee of the International Council to bring about some effective measure of international control.

It was, I think, a keen disappointment to him that the recommendations of the Plaice Committee of 1921 and of the Plaice Conference at Amsterdam in 1925 could not be put into operation. But he did not lose heart; he supported his staff in working out just alternative methods of coping with the overfishing problem, which bore their first fruit in the Sea Fishing Industry Act of 1933.

In addition to his papers on the plaice, Borley published in 1923 an admirable study of the bottom-deposits in the North Sea, and was largely responsible for a special investigation of herring-trawling carried out just before the Great War, on which we reported jointly in 1922.

Borley was a colleague of mine for many years, and no man could wish for a better. He was always helpful, always put the work first and himself second. His great knowledge and experience was always freely at the service of his colleagues. He was a

lovable personality, and inspired both affection and respect in all those associated with him in the work of the Fisheries Department, of the International Council for the Exploration of the Sea, and of the Discovery Committee.

E. S. RUSSELL.

We regret to announce the following deaths:

Prof. V. A. Karavajev of Kiev, an authority on the taxonomy and bionomics of ants, on January 7, aged seventy-five years.

Prof. J. P. McMurrich, emeritus professor of anatomy in the University of Toronto, on February 9, aged seventy-nine years.

Prof. N. V. Naasonov, formerly director of the Zoological Museum of the U.S.S.R. Academy of Sciences, on February 10, aged eighty-five years.

News and Views

The Linnean Society and National Parks

As a result of the discussion on the objects of national parks held by the Linnean Society of London on December 8 (*NATURE*, 142, 1087; 1938) and subsequent debates, the Society has adopted the following resolution: "The Linnean Society of London accepts the definition employed in the African Fauna Convention as an ideal for the preservation of Nature; but it knows that the term 'National Park' has been given to areas which for various reasons are unsuitable for inclusion within the definition,—e.g. too limited or situated too near populated areas. For such it recommends the setting apart within each Park of special nature reserves under proper control; and it would like all authorities with power over Parks to seek advice from such bodies of naturalists as are competent to give it." The definition given by the African Fauna Convention (H.M. Stationery Office. Treaty Series, No. 27. London, 1933) is as follows: "The expression 'national park' shall denote an area (a) placed under public control, the boundaries of which shall not be altered or any portion be capable of alienation except by the competent legislative authority, (b) set aside for the propagation, protection and preservation of wild animal life and wild vegetation, and for the preservation of objects of aesthetic, geological, prehistoric, historical, archaeological, or other scientific interest for the benefit, advantage, and enjoyment of the general public, (c) in which the hunting, killing or capturing of fauna and the destruction or collection of flora is prohibited except by or under the direction or control of the park authorities. In accordance with the above provisions facilities shall, so far as possible, be given to the general public for observing the fauna and flora in national parks."

British Dyestuffs: Award of the Perkin Medal

THE Perkin Medal of the Society of Dyers and Colourists has been awarded to Mr. James Baddiley, of Imperial Chemical Industries Ltd., "in recognition of his national services for the renaissance of the British dyestuffs industry through many important investigations in the field of colour chemistry conducted or directed by him". In the thirty years since its inauguration, the Medal has only been awarded eleven times—four times to Englishmen, three times to Germans, three times to Frenchmen and once to an Alsatian. In an address delivered after the presentation, Mr. Baddiley said that great progress has been made in dyestuffs laboratory technique, such as the use of X-ray diffraction methods for determining molecular structure, optical diffraction in the visible and ultra-violet bands, and cathode-ray refraction. In the dyeing of cotton, substantial advances have been made, particularly with regard to light fastness. In the direct cotton colour field constant research had been given to straight-chain poly-azo dyes with 2-5-7 aminonaphthol-sulphonic acid and its derivatives as end-component, and this line of research had led to the production of the Durazols, which are representative of direct cotton colours of high fastness to light.

The dyestuffs chemist, affirmed Mr. Baddiley, has shown his ability to meet the problems presented by new artificial fibres very promptly, by producing the Solacets, a series of truly water-soluble dyes, possessing high affinity and building-up properties and capable of being applied as though they were direct cotton dyes. In regard to pigments, Mr. Baddiley mentioned the invention of the phthalocyanines in I.C.I. laboratories; these, he said,

represent the last word in all-round fastness and in tinctorial properties. Turning to textile auxiliaries, he outlined the fundamental principles involved in the modern 'soapless' detergents, the success of which led to intensive research in long-chain chemistry and the production of many new interesting products of which the best known is Velan PF for producing water-repellent finishes resistant to laundering and dry cleaning. Among other advances associated with the dyestuffs industry, Mr. Baddiley referred to the colour film, the discovery of sulphanilamide, and the synthetic polymers.

Commerce and the Universities

THE question of the suitability of existing arrangements in universities for the training of undergraduates for commercial careers was recently investigated by a sub-committee of the Association of British Chambers of Commerce. This body, having examined the subject in the light of information collected from university appointments bureaux, professional bodies, individual firms and various chambers of commerce, drew up a short "Report on the Commercial Employment of Students with Degrees in Commerce". The report estimates at less than a hundred the deliberate annual recruitment of young graduates into commerce for the purpose of ultimately using them for the higher executive posts. These recruits are taken mainly by large concerns engaged in either manufacturing or retailing: no evidence was forthcoming of any appreciable recruitment to wholesale houses or shipping concerns. It appears that the recruitment of graduates on the business side is sporadic and exceptional and the firms which employ them make no special arrangements, such as are common on the industrial side, for their special training in business methods. The sub-committee considers that it would be advantageous to British commerce if a larger proportion of graduates were recruited, but that this will not be possible unless steps are taken to incorporate practical office and commercial experience in the university courses.

THE Association's Executive Council adopted the report and decided to circulate it with a view to a conference with representatives of the universities for discussion of the subject and for the devising, if possible, of a scheme of training in the operation of which the chambers of commerce would collaborate. The kind of collaboration envisaged is indicated by mention in the report of a sandwich system of six months in business alternating with six months of full-time university work, or a preliminary spell of work in business before entering a university, in which studies would be organized in two parts separated by another spell of business employment. The report has been coupled, not, perhaps, very appropriately, with the Spens Report on Secondary Education in a motion agreed to in the House of Commons on February 15 in favour of the Board of Education consulting local education authorities and others as to how far the recommendations in the reports should be carried into effect. Presumably the recommendation of the Chambers of Commerce will

be taken up by the Universities Committee of Vice-Chancellors and Principals. In the discussion in Parliament, the Board's attitude towards commercial training in secondary schools was summed up. From eleven to sixteen years of age, geography and mathematics may well be taught so as to arouse an interest in the world of commerce, and there is a real place for commercial training on broad lines after the School Certificate; the prejudice against commerce as unworthy to rank with more academic careers should be eradicated.

An Anatomist Analyses

THE editor of the *Lancet* has begun the interesting experiment of throwing open his journal to selected medical men in various occupations, so that they may express unfettered thoughts upon any subject they choose, under the title "Grains and Scruples". The first series of contributions, five in number, appeared in the numbers of December 1938 "from an Anatomist". They discourse on the alleged gradual but definite degeneration of the medical student, who in former days is said to have been far older, more mature, and more responsible than his successor; upon the disappearance of the old-fashioned schoolboy bug-hunter, and other topics familiar to the teacher of long standing. But years have coloured the outlook, for there are still keen schoolboy naturalists, and while maturity and responsibility are difficult qualities to assess, the records show that the age of entry has been rising instead of falling. In the old days, students entered the universities at years of indiscretion undreamed of now, and the writer knew a surgeon-admiral who as a student, having passed all his medical examinations, put in a year on a whaler, until he should attain the legal age of qualification. That cannot happen often in these days.

BUT more profound puzzles confront the "Anatomist", and he poses the recurrent problem of the persistence in many groups of animals of primitive, generalized types. If changing environments demand the evolution of more complex animals to meet the new needs, how is it that there have survived through aeons of time, apparently completely meeting the requirements without significant structural change, basic forms upon which the higher developments of the group are founded? As examples of these 'immature' forms which have not developed their potentialities, he gives the shark, the giant salamander, the tuatara lizard, the ostrich, and following Bolk's thesis of infantilization he would regard man as the permanent baby amongst mammals, emphasising that lack of structural specialization which is man's saving grace. Finally he makes a reasoned plea for linking man ancestrally with the pig. But here he controverts his own premises, for while rightly stressing the need for depending upon characters not liable to environmental adaptation, he selects as major resemblances, dentition and hair-covering, length of tail and colour, than which no mammalian characters are more liable to adaptive variation. He does not suggest

how the extremities of man are to be derived from those of the pig, but perhaps he would include the Devil amongst men.

Sir C. V. Raman, F.R.S.

IN 1928, Sir Venkata Raman published an account of the new radiation effect now generally known as the Raman effect, and the Indian Academy of Sciences, of which he is president, has had the happy idea of celebrating this and Sir Venkata's fiftieth birthday by the issue of a special commemorative volume. This volume, which contains thirty-eight papers, submitted from various parts of the world, opens with a brief biography of Sir C. V. Raman. The writer of this, whilst referring to the fact that Sir Venkata received his early training in physics at the Presidency College, Madras, unfortunately omits to mention how much the future Nobel prizewinner owed to the then head of the department of physics, the late Prof. R. Ll. Jones, who carried to India the traditions of the Cavendish Laboratory.

THE contributions to the commemorative volume deal with the many aspects of physics with which Raman has been associated. Only two papers have been submitted by workers in Great Britain: Sutherland contributes a theoretical paper establishing the connexion between the force constant, the internuclear distance, and the heat of dissociation of a diatomic linkage, whilst Angus gives a valuable critical survey of the Raman spectra of terpenes. From Prof. K. W. F. Kohlrausch's laboratory at Graz, which has played so prominent a part in the application of the Raman effect to chemical problems, there are ten papers dealing *inter alia* with asymmetrical phthalyl chloride, dimeric keten, cyclobutane-1:2-dicarboxylic acid and its derivatives, tetrolic acid and the nitro-group. Papers on analogous subjects have been sent by Bonino and Manzoni-Ansidei, Murti and Seehadri, Mizushima and Moreno. Hibben provides a striking statistical analysis of the trend of Raman effect research during the ten years since its discovery; he shows how the fuller theoretical understanding of the effect (1932-34) gave an impetus to experimental investigation and discusses the types of organic and inorganic substances which have received attention. The remaining papers are concerned chiefly with the other aspects of optics to which Raman and his students have devoted attention. The volume forms a noteworthy tribute to one who has done so much to further original research in India.

A New "Nomenclator Zoologicus"

THE preparation of a new "Nomenclator Zoologicus", announced in 1935, is now approaching completion. It constitutes an attempt to bring together the names of all the genera and subgenera in zoology that have been described from the tenth edition of Linnaeus, 1758, up to the end of the year 1935, with a bibliographical reference to the original description of each. It will also include the great majority of alternative spellings that have appeared during that period. Another feature that will, it is thought,

be found valuable for systematists relates to cases where a new name has been proposed for a homonym. In these instances a cross-reference is given under the homonym to the new name. It is estimated that the work will comprise some 225,000 entries, of which about 5,000 appear to have been omitted from all previous publications of this character. It is proposed to publish the work in four volumes of nearly 1,000 pages each, which it is hoped it will be possible to issue at intervals of about six months. The Zoological Society of London has already borne the whole cost of preparation (approximately £1,800), but the Council of the Society does not feel justified in incurring further expenditure in respect of this enterprise, which would involve an additional £3,600. However, with the aid of various grants from outside sources, the editor, Dr. S. A. Neave, has now been able to arrange for the printing and publication of the work. It is proposed to publish it at the low advance subscription rate of six guineas, postage included, for the four volumes, provided that a sufficient number of undertakings to subscribe can be obtained. If these are adequate, it is hoped to issue the first volume during the coming summer. Subscriptions should be sent to Dr. S. A. Neave, Imperial Institute of Entomology, 41 Queen's Gate, London, S.W.7.

'Modern Man' from Choukoutien, China

SKELTAL remains of 'modern man' of Upper Palaeolithic age have at last been found in material from the Choukoutien caves, near Peking, the now world-famous site of discovery of Peking man. This latest find is no more than was to be anticipated from the discovery here some few years ago of relics of palaeolithic man; and indeed it is overdue. The new material, it is stated in a dispatch from the Peking correspondent of *The Times* in the issue of February 21, is from the Upper Cave, and consists of the remains of seven individuals, who, it would appear, had belonged to one family—an old man, estimated to be more than sixty years of age, a younger man, two relatively young women, an adolescent, a child of five, and a new-born baby. Such a varied assemblage should in the ordinary course provide adequate material for arriving at a fairly close approximation to the racial character of the group; but it would appear that these skeletal remains are remarkably, and indeed unusually, diverse in character for so closely associated a group.

THE brain case of the old man points to a very primitive type, not far removed from Neanderthal man, although in other attributes he approaches European man of the Upper Palaeolithic period, while the facial characters suggest recent Mongolian types without, however, being identical with them. Of the two women's skulls, one presents resemblance to the Melanesian type of New Guinea, while the other is similar to that of the modern Bakimo woman. No features, however, occur among the modern population of North China which would justify attribution of an ancestry leading back to this population of the Upper Cave. Prof. F. Weidenreich

quoted as suggesting that the Upper Cave people may represent the ancestors of the Amerindian population in process of migration to the crossing from Asia to America. Among the numerous artefacts which have been found in association with the remains—stone and bone implements, perforated teeth, shells, and stones used for ornament—several can be traced to an origin varying from 100 to 200 miles away. This lends support to the view that these were a far-travelled people in a stage of further migration. Injuries shown by the skulls indicate that all the members of the group met with a violent end.

British Optical Instrument Display at World's Fair

THE British optical instrument industry, through the Scientific Instrument Manufacturers' Association, is exhibiting a cross-section of the products of the industry at the World's Fair, New York. Eighteen firms are participating, and the exhibit is arranged in four showcases each 8 ft. by 3 ft. 6 in. by 3 ft., also a series of showcases mounted in two panels 24 ft. by 3 ft. stretching from a centre piece formed of a large mass of optical glass, and two photo murals 16 ft. by 12 ft. with showcards let in. The exhibitor firms have regarded the exhibit from a 'prestige' aspect, and by mutual arrangement each firm has endeavoured to end a limited exhibit of its specialities selected so that there may be no overlapping. In other words, makers of theodolites, levels and microscopes are showing a complete range of products, but built up of several makes rather than various models by each maker for the same purpose. The display is very comprehensive. Both in appearance, finish and presentation it should at least equal anything that has hitherto been devised. It is impossible to refer in the course of a brief note to all the different exhibits. These comprise among the more standard types a course-setting bomb sight, aeroplane sextant, echo depth-sounder, Robbin Hill camera, survey lens or aerial camera, spectrograph, spectrometers, apparatus for measuring pressure in mines and dust counters, measuring microscopes, microtomes, prism binoculars, telescopes, photographic lenses and cameras.

Soil Erosion in Jamaica

SOIL erosion in Jamaica forms the subject of a bulletin (No. 17) issued by its Department of Science and Agriculture. The greater part of the cultivated land is situated on steep hill-sides, gradients of one in one being frequent, so that sheet erosion is the major problem. These slopes were originally covered by dense forest and undergrowth, the clearing of which has resulted in rapid loss of surface soil. The rate of loss depends largely on the crop grown. Bananas and coffee, for example, are comparatively widely spaced and are maintained under clean cultivation so that soil exposure is very serious, though the necessity for drains in the case of bananas somewhat alleviates the situation. Sugar-cane, on the other hand, is an excellent soil conserver as it has an elaborate root system and the trash deposited after tapping forms a protective cover. Of the less im-

portant crops the cultivation of yams, sweet potatoes, corn or ginger encourages erosion, but citrus causes little loss as the trees are usually left in the grass cover. Erosion is also promoted by the otherwise valuable system of forking the soil at the end of the dry season to facilitate the penetration of the first rains, and by the improper placing of drains. Other factors which contribute to the problem are the practice of short-period tenancy, which gives the proprietor little interest in conserving the fertility of his land, and the system of renting land for the production of one type of crop only. Some fundamental changes in the current agricultural practices will be needed if further loss of valuable soil is to be prevented.

Earthquakes Recorded in India, January-March, 1938

SEISMOLOGICAL information obtained in India is henceforth to be published quarterly as a separate bulletin. The first of these bulletins (*Seis. Bull.*, Jan.-March 1938, Government of India Meteorological Department, Delhi) has been received. It consists of reports from seven instrumental stations, and non-instrumental reports received at Poona. First is given a list of stations with their latitude and longitude to the nearest minute of arc together with other necessary information, and also a list of the instruments and their constants with which each is equipped. For the quarter, Agra records 56 shocks, Bombay 77, Calcutta 89, Colombo 47, Dehra Dun 13, Hyderabad 41, and Kodaikanal 61. The small number recorded at Dehra Dun may be due to poor instrumental equipment. Records for the observatories are separate, giving in each case date, component, phase, time received, period, amplitude, epicentral distance if determined, and remarks concerning the shock or the reception. The macroseismic evidence collected at Poona is valuable, personal observations numbering 62, 12 being from Dosh. The shock with most macroseismic effect was on March 14. It cracked property at East Khandesh, damaged property at Maheswar (Indore) and damaged property, injuring two children, at East Khandesh. Seismologists will be grateful to those concerned with the report for putting the data obtained in a manner convenient for reference, and for taking the important step of having it published at more frequent intervals.

An Electron Diffraction Camera

Messrs. W. EDWARDS AND CO., Allendale Works, Vaughan Road, London, S.E.5, have recently published details of their Finch electron diffraction camera intended for industrial research. This camera is of the type developed by Prof. G. Ingle Finch, who has done so much to improve the technique of electron diffraction. The camera uses a cold cathode discharge tube as a source of electrons. The fine beam, which is necessary for a sharp diffraction pattern, is obtained by using a series of diaphragms and by focusing the beam upon the screen with a magnetic coil. A useful feature is that both the diaphragm and specimen holders are standardized so that they will fit any of the six ports in the instru-

ment. Moreover, all the necessary adjustments of the diaphragm and specimen can be made *in vacuo* from the outside. The joints are ground and polished flats held in contact by the atmospheric pressure, a point of importance in routine work where quickness in changing specimens is essential. In this instrument the specimen can be exchanged and the system evacuated in a matter of minutes. Only one criticism—a minor one—can be made. The shape and size of the window are such that the eyes must be held quite close if the whole pattern is to be seen, and the screen is then rather near for comfortable vision. Suitable pumps are supplied, a variety of systems being available to suit individual needs, or a standard unit is made up ready for use. This instrument is noteworthy as it marks the entry of the diffraction camera into the industrial research laboratory, where it should yield valuable information upon metallic surface structure, to mention only one of the many possible industrial fields of investigation.

Energy obtained by Transmutation

MR. ROBERT D. POTTER, of 'Science Service', Washington, D.C., points out that the confirmation of the artificial breakdown of uranium announced in New York (see also *NATURE*, Feb. 11, p. 233) is in the direct succession of experiments carried out in recent years on the transmutation of the elements. For centuries, alchemists had dreamed of transmuting base metals into gold. It was imagined that enormous wealth would be at hand for the discoverer of this transmutation, and dire forecasts of the effects of this discovery were made, such as a complete revolution on the financial pattern of the world. We know that this transmutation has now been achieved for most of the known chemical elements. Transmutation's biggest result is the theoretical incentive it has provided for further physical researches. In a similar way, the dream of releasing the large amounts of energy locked inside atoms has been in the minds of men for many years. When the most efficient transformation of energy takes place in the atom of uranium so that a neutron can slip into it, the energy released is only one fifteenth of that required to bring it about. In fact, neutrons are so easily absorbed by all atomic nuclei that many of the neutrons produced with such poor efficiency will only go into atoms other than uranium. There need be little fear of an explosion in Nature due to uranium. The very heavy elements, in which such an energy release can be secured, occur only in very small amounts in the earth's crust. The release of atomic energy can only be achieved by direct experiment with this end in view and with elaborate laboratory apparatus.

Archaeological Discovery near Hove

A somewhat remarkable find of traces of what would appear to be an ancient settlement is reported from the neighbourhood of Hove (*The Times*, February 20). The discovery has been made on the downs, north of Hove, where the existence of such remains had not previously been suspected. It is

thought that they may be Roman, possibly of the first century A.D. The discovery was made on February 17 by a Corporation labourer who unearthed a collection of pottery, less than eighteen inches from the surface, when digging sewer trenches on a municipal housing estate. A further find was an earthenware vessel filled with about 450 small bronze coins, on some of which the head of a Roman emperor has been distinguished, but of a date not yet established. It is thought that the settlement, which overlooks Hove from the hills, may have been established about A.D. 50 and have lasted until the third century. The site is being investigated by Mr. H. G. Massey, curator of the Hove Museum, with the assistance of Dr. Cecil Curwen.

Earthquake in Bulgaria

On February 17, an earthquake of considerable intensity was experienced at Gornadjoumaja and Sofia in western Bulgaria. At the same time a strong roaring sound was heard, and many people fled from their homes, though no serious damage or casualties are reported. The epicentre of the shock may have been about fifty miles south of Sofia, where there is the most pronounced seismic centre in Bulgaria. Between the years 1749 and 1936, 1,420 earthquakes had their epicentres in this region, and one at least had an intensity greater than 7 on the Rossi-Fore scale. The most disastrous shocks in Bulgaria in recent years were those of April 14, 17, 18, and 21, 1928, which were felt at Chirpan and Plovdiv and did more than £4,000,000 damage.

Science and Society

THE Division for the Social and International Relations of Science of the British Association is arranging a programme of meetings at which topics of immediate interest and importance will be discussed. The first of these meetings will be held on March 28 at the University of Reading, when two sessions will be devoted to a discussion on "Milk in its Nutritional and Allied Aspects". The chairman of the sessions will be Sir Richard Gregory and Sir Daniel Hall. Other speakers will deal with deficiencies of diet, health aspects, pasteurization, production, cost economic and social implications. It is also proposed to arrange meetings in the early summer in London and Manchester for review of the social relationship of science, and for discussion with special reference to pressing problems in industry and agriculture. In connexion with the Manchester meeting, Prof. H. Levy has been appointed to deliver the Alexander Pedler Memorial Lecture in which he will explain the method of approach in the study of the social problem of science, with particular illustrations of the application of scientific discoveries to industry. During the forthcoming meeting of the British Association in Dundee (August 30-September 6), the Division will hold three sessions when it is proposed to consider the co-ordination of scientific research, population movements and nutrition. Sir Richard Gregory, chairman of the Division, and lately editor of *NATURE*, will deliver an address on "Science and Social Ethics".

Musick Memorial Trophy

THE first award of the Musick Memorial Trophy of the Royal Aeronautical Society has been made to Mr. Arthur Gouge, chief designer of Messrs. Short Brothers, Ltd. The Trophy was founded in 1938 as a memorial to Captain Edwin Musick and his six companions who were lost on January 12, 1938, on the Samoan Clipper, in the South Pacific, during the first commercial flight from U.S.A. to Auckland, New Zealand. It is awarded annually to "the group, body or individual who have made the contribution, development or improvement which by its practical application has become most effective in furthering the safety of aircraft with special regard to trans-oceanic aviation". The award is confined to citizens of the British Commonwealth of Nations and the United States of America. The Trophy, in silver, is valued at £250.

The Night Sky in March

THE date of the spring equinox is March 21^d 12^h U.T. The moon is full on March 5 at 18^h and new on March 21 at 2^h. λ Geminorum (magnitude 3.6) is occulted on March 2, the disappearance taking place as seen from Greenwich at 0^h 23.6^m at position angle 154° from the north point of the moon's disk. $\times$ Canori, a fifth magnitude star, is occulted on March 3 at 18^h 23.4^m; 97 Tauri (mag. 5.1) is also occulted on March 26 at 18^h 43.6^m. Lunar conjunctions with the planets occur as follows: on March 13 with Mars; on March 17 with Venus; on March 22 with Mercury at 11^h and with Saturn at 17^h. Jupiter is in conjunction with the sun on March 6. Neptune is in opposition on March 13. Mercury is at greatest elongation (18° E.) on March 17. Some ten days previously it may be possible to detect this elusive planet in the evening twilight at 18^h nearly due west and at 5° above the horizon. Saturn is an evening star setting at about 20^h in mid-March. Venus, a bright morning star (mag. -3.8 to -3.6), rises before 5^h, preceded by Mars, the rising of which is more than two hours earlier. Under suitable conditions, the Zodiacal Light may be seen after sunset during this month. In the middle of March, Sirius is due south about an hour after sunset. As the sky darkens, the rich assembly of bright stars west of the meridian contrasts with the sparseness of the eastern half of the sky. It is in this less spectacular region, however, that the great space-penetrating telescopes are able to record the remote extra-galactic nebulae, of which notable clusters are in the constellations of Leo and Ursa Major.

Announcements

PROF. HENRY NORRIS RUSSELL, director of the Princeton University Observatory, has been elected *correspondant* of the Section of Astronomy of the Paris Academy of Sciences in succession to the late Prof. E. W. Brown.

MR. W. S. DAVEY has been appointed head of the Chemical Division of the Rubber Research Institute to succeed Dr. E. Rhodes, who has resigned to take up a post under the British Rubber Producers'

Research Association. Mr. Davey is at present senior chemist on the staff of the London Advisory Committee for Rubber Research (Ceylon and Malaya) at the Imperial Institute.

PROF. HELMUTH SCHEEL has been appointed president and Prof. Theodor Vahlen vice-president of the Prussian Academy of Science.

THE third International Congress, under the auspices of the International Union Against Cancer, will be held in Atlantic City, New Jersey, U.S.A., on September 11-16 under the presidency of Prof. F. Carter Wood, director of the Institute of Cancer Research in Columbia University. Further information can be obtained from the Secretary-Treasurer, Dr. Donald S. Childs, 713 E. Genesee Street, Syracuse, New York.

A CONFERENCE on "China in World Affairs and Our Responsibility" is to be held in the Friends House, Euston Road, London, on March 10-11, under the auspices of the China Campaign Committee. The Conference will discuss the present position in China, economic, political and educational reconstruction in China, the rebuilding of universities, etc. Further information can be obtained from the National Organizer, China Campaign Committee, Parliament Mansions, Orchard Street, London, S.W.1.

THE Meteorological Association of the International Union of Geodesy and Geophysics will be held in Washington during September 4-15, under the presidency of Prof. S. Chapman. The subject of Prof. Chapman's address will be "Atmospheric Tides and Associated Phenomena", and the address will be followed by discussion. Other subjects for discussion will include recent developments in aerology and electric and magnetic phenomena of the atmosphere. Further information can be obtained from the General Secretary of the Assembly, Dr. J. A. Fleming, 5241 Broad Branch Road, N.W., Washington, D.C.

THE Zoological Society of London announces that, beginning with this year, its publications will be reorganized. One or more parts of the *Transactions* will appear each year and the *Proceedings* will appear in two series, as follows: (A) general and experimental; (B) systematic and morphological. These can be subscribed for either singly or in any combination. *Proceedings* (C) will no longer be published. In future an "Abstract and Agenda of the Scientific Meetings" will be published, and may be obtained for an annual subscription of six shillings. One volume of (A) and one of (B) will be published annually. Further information can be obtained from the Secretary, Zoological Society of London, Regent's Park, London, N.W.8.

WE regret that the price of Prof. J. D. Bernal's book "The Social Function of Science", noticed in NATURE of February 18, p. 262, was stated incorrectly to be 2s. 6d. net. The price of the volume is 12s. 6d. net.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 337.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Disintegration of Heavy Nuclei

THROUGH the kindness of the authors I have been informed of the content of the letters¹ recently sent to the Editor of NATURE by Prof. Meitner and Dr. Frisch. In the first letter, these authors propose an interpretation of the remarkable findings of Hahn and Strassmann as indication for a new type of disintegration of heavy nuclei, consisting in a fission of the nucleus into two parts of approximately equal masses and charges with release of enormous energy. In the second letter, Dr. Frisch describes experiments in which these parts are directly detected by the very large ionization they produce. Due to the extreme importance of this discovery, I should be glad to add a few comments on the mechanism of the fission process from the point of view of the general ideas, developed in recent years, to account for the main features of the nuclear reactions hitherto observed.

According to these ideas, any nuclear reaction initiated by collisions or radiation involves as an intermediate stage the formation of a compound nucleus in which the excitation energy is distributed among the various degrees of freedom in a way resembling the thermal agitation of a solid or liquid body. The relative probabilities of the different possible courses of the reaction will therefore depend on the facility with which this energy is either released as radiation or converted into a form suited to produce the disintegration of the compound nucleus. In the case of ordinary reactions, in which the disintegration consists in the escape of a single particle, this conversion means the concentration of a large part of the energy on some particle at the surface of the nucleus, and resembles therefore the evaporation of a molecule from a liquid drop. In the case of disintegrations comparable to the division of such a drop into two droplets, it is evidently necessary, however, that the quasi-thermal distribution of energy be largely converted into some special mode of vibration of the compound nucleus involving a considerable deformation of the nuclear surface.

In both cases, the course of the disintegration may thus be said to result from a fluctuation in the statistical distribution of the energy between the various degrees of freedom of the system, the probability of occurrence of which is essentially determined by the amount of energy to be concentrated on the particular type of motion considered and by the 'temperature' corresponding to the nuclear excitation. Since the effective cross-sections for the fission phenomena for neutrons of different velocities seem to be of about the same order of magnitude as the cross-sections for ordinary nuclear reactions, we may therefore conclude that for the heaviest nuclei the deformation energy sufficient for the fission is of

the same order of magnitude as the energy necessary for the escape of a single nuclear particle. For somewhat lighter nuclei, however, where only evaporation-like disintegrations have so far been observed, the former energy should be considerably larger than the binding energy of a particle.

These circumstances find their straightforward explanation in the fact, stressed by Meitner and Frisch, that the mutual repulsion between the electric charges in a nucleus will for highly charged nuclei counteract to a large extent the effect of the short-range forces between the nuclear particles in opposing a deformation of the nucleus. The nuclear problem concerned reminds us indeed in several ways of the question of the stability of a charged liquid drop, and in particular, any deformation of a nucleus, sufficiently large for its fission, may be treated approximately as a classical mechanical problem, since the corresponding amplitude must evidently be large compared with the quantum mechanical zero-point oscillations. Just this condition would in fact seem to provide an understanding of the remarkable stability of heavy nuclei in their normal state or in the states of low excitation, in spite of the large amount of energy which would be liberated by an imaginable division of such nuclei.

The continuation of the experiments on the new type of nuclear disintegrations, and above all the closer examination of the conditions for their occurrence, should certainly yield most valuable information as regards the mechanism of nuclear excitation.

N. BOHR.

At the Institute for Advanced Study,
Princeton, N.J. Jan. 20.

¹ [NATURE, 142, 239 and 275 (1939)].

Photoactivation of Solids and its Effect on Adsorption

CONSIDERABLE attention has been given recently to chemical processes involving an activating influence of a crystal excited by irradiation¹. The mechanism of such photosensitized reactions, although unknown in detail, is generally believed to be a more or less complete transfer of the energy absorbed by the crystal to the reacting components, physically or chemically. Accordingly, the essential difference between photosensitized processes and real photochemical ones is the distance between the place of absorption and the place of reaction. But there must also be another, more general, effect of irradiation on the activity of crystals. Due to the change in the electronic state of the particles in the lattice by the absorption of light (change in charge and degree of polarization, formation of space charges, etc.), the forces between the particles are changed and, consequently, there is also a change in potential of the

surface field that determines the chemical activity of the crystal. As in a real crystallographic transition, which causes a difference in the reactivity of the modifications under comparable experimental conditions², so irradiation of an absorbing crystal causes a change of the surface activity that might have a detectable influence on sorption or catalytic processes or on real chemical reactions. Naturally, in many cases, such effects would be expected to be rather small.

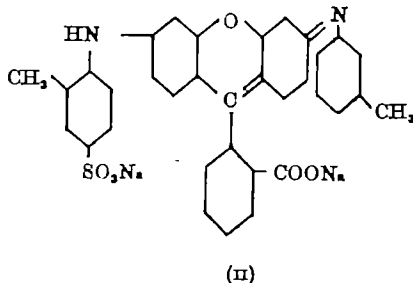
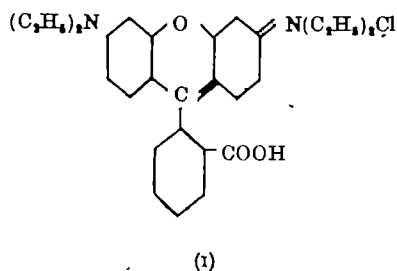
In practice, however, there will often be no possibility of deciding experimentally whether a process is photosensitized or activated as just described. But the latter must at least be the case when processes occurring at the surface of a crystal in substrates which do not absorb the irradiation are more or less quenched by irradiating the crystal. Otherwise, this influence of irradiation can scarcely be understood.

Such a phenomenon has been found in adsorption experiments with cadmium sulphide and phenolphthalein. Cadmium sulphide was shaken with an alcoholic solution of phenolphthalein for a given time with or without irradiation with white light, filtered through ferrous ammonium sulphate-quinine solutions. After centrifuging and adding sodium hydroxide the unadsorbed phenolphthalein was measured colorimetrically. The results are shown by the accompanying table.

Percentage phenolphthalein adsorbed (200 mgm. CdS, 20 c.c. solution—60 mgm. phenolphthalein per litre—time of adsorption 30 minutes).

Dark	Irradiated
10.0	1.0
9.2	0.7
8.6	1.2
9.4	1.8

The decrease of the adsorbing power of cadmium sulphide by irradiation is evident. As the residual concentration of phenolphthalein is increased by irradiation, photosensitized bleaching, if it occurs, cannot cause this effect. In the irradiation experiments there has probably been a certain amount of 'dark adsorption' due to unexposed cadmium sulphide particles and to the centrifuging process. It is, therefore, possible that under suitable conditions the adsorption may be totally suppressed by irradiation of the sulphide.



Similar effects have been obtained with a large number of organic dyes, and it has been shown that an exchange of certain groups of a dyestuff molecule has a marked influence on the change of adsorption during irradiation. With the xanthene dye (I), for example, the adsorption decreased from 33 to 23 per cent during irradiation, whilst the adsorption of the dye (II) remained practically unaltered at 54 per cent. It therefore seems possible to use this effect of irradiation on the adsorbing power of solids for separation purposes.

These experiments were performed by A. Aarsaasen and S. Berger. We acknowledge gratefully financial assistance from the fund of the Royal Swedish Nobel Committee.

J. A. HEDVALL.
G. COHN.

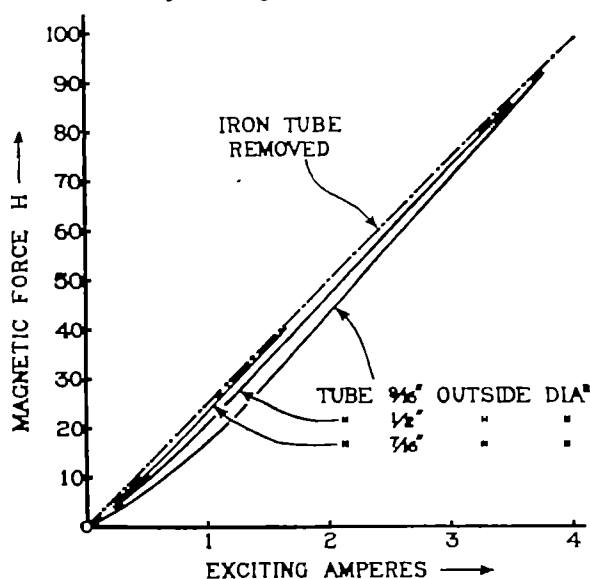
Department of Chemical Technology,
Technical College,
Gothenburg.
Jan. 18.

¹ See, for example, Goodeve and Kitchener, *Trans. Farad. Soc.*, **34**, 902 (1938).

² Hedvall, J. A., "Reaktionsförmågan för faste stoffar", 64 (Lund, 1938).

Mechanism of Magnetization

In a previous note¹ some experimental data were recorded which indicated that one aspect of the classical theory of magnetization is incorrect. For



these experiments a solid-drawn steel tube was used, the thickness of the wall of the tube being 3/16 in., the internal diameter 3/8 in., and the length 24 in.

Further experiments have now been made for which a series of solid-drawn charcoal iron tubes were used as follows. Each tube was of internal diameter 3/8 in. and 24 in. long; the external diameters of the tubes were 9/16 in., 1/2 in. and 7/16 in., respectively, thus giving a thickness of wall of 3/32 in., 1/16 in. and 1/32 in., respectively. The same solenoid was used as for the previous experiments and the results of the tests are shown in the accompanying graph.

The results may be summarized as follows:

- The reduction of the value of H inside the tube becomes greater as the thickness of the wall increases.
- The reduction of H within the tube is a maximum when the tube is magnetized to a condition which about corresponds to the knee of the magnetization curve.
- When the tube is magnetized to a condition

of saturation, the value of H within the tube is practically unaffected by the material of the tube. The results also show that the self-demagnetizing effect of the ends of each tube is negligibly small.

These test data support the view formulated in a previous² note, namely, that the magnetization of a material is initiated at the surface and proceeds inwards by a kind of 'chain effect', so that the flux density near the surface is a maximum and becomes progressively less as the distance from the surface increases.

A comprehensive account of these investigations is now being prepared and will be published shortly.

T. F. WALL.

Department of Electrical Engineering,

University, Sheffield, 1.

Jan. 9.

¹ NATURE, 141, 1039 (1938).

² NATURE, 142, 875 (1938).

X-Ray Diffraction by Supercooled Liquid Sulphur

It has been observed that sulphur may be kept, with a little care, in the supercooled liquid state at the ordinary room temperatures (25°–30° C.) in the form of small globules on clean glass surfaces. In some cases it has been possible to keep one and the same globule in the supercooled state for more than three days, even under X-ray exposures. Supercooled liquid sulphur may be prepared also on metal surfaces, for example, brass, aluminium, etc., but in those cases it becomes unstable and solidifies easily, probably due to the crystallizing forces exerted by the metal surfaces. Again, under given physical conditions, the stability is found to be a function of the size or the diameter of the drops. The greater the diameter, the less is the stability. This is probably due to larger surfaces or volumes being more liable to get disturbed. The drops in the supercooled state are found to retain the colour they had at higher temperatures before cooling. Hence it is supposed that the drops maintain exactly the same physical state as they had at the higher temperatures.

X-ray diffraction photographs of supercooled liquid drops have been taken by the transmission method. Taking the factors of high absorption by sulphur of the copper $K\alpha$ radiation used in the experiment and also the stability of the supercooled drops into consideration, small globules (0.3–0.5 mm. in diameter) of liquid were prepared on an extremely thin glass film. One of the globules was then placed before the slit (0.4 mm.) being mounted on the carrier of a special collimating system¹. The pattern obtained with yellow drops supercooled from a temperature just above the melting point of sulphur is reproduced



X-RAY DIFFRACTION PHOTOGRAPH OF SUPERCOOLED SULPHUR.

herewith. The single band recorded in the photograph corresponds to a Bragg-spacing which agrees well with those observed by Blatchford² and by Das¹ in the case of liquid sulphur maintained at higher temperatures above the melting point. The accompanying table brings together all the results.

BRAGG-SPACING OF LIQUID SULPHUR.

Author	Temperature	Spacing ($\times 10^8$ cm.)
Blatchford ²	130° C.	3.68 $\pm$ 0.01
Das ¹	128° C.	3.76 $\pm$ 0.02*
Das and Das Gupta	27° C. (supercooled)	3.68 $\pm$ 0.02

* This new value of the spacing is yet unpublished. According to Das, it is more accurate than that reported by him previously¹ and than that of Blatchford².

It is interesting to note that the spacing at 128° C. is larger than that at 27° C. This is evidently due to the thermal expansion of the liquid with rise of temperature.

The study of a liquid in the supercooled state by X-ray diffraction has not, hitherto, been reported. The results of further investigations, now in progress, by X-ray and other methods will be published elsewhere; they may be expected to throw much light on the supercooled liquid state, of matter in relation to the ordinary liquid and the solid states.

S. R. DAS.

K. DAS GUPTA.

Khaura Laboratory of Physics,
University College of Science,
Calcutta.

Jan. 21.

¹ Das, *Ind. J. Phys.*, 13, 163 (1933)

² Blatchford, *Proc. Phys. Soc.*, 45, 493 (1933).

Structure of the SnCl_4 -- Group

In a letter in NATURE¹, Cox, Shorter and Wardlaw examined the stereochemistry of bivalent tin and lead and arrived at conclusions which are not in agreement with some of our results.

The compound $\text{K}_2\text{SnCl}_6 \cdot 2\text{H}_2\text{O}$, which is described as being orthorhombic with $a = 12.02$, $b = 9.11$ and $c = 8.23$ Å., and the space-group *Prima*, has been studied quite recently in our laboratories and the results so far obtained, although they lead to the same unit cell and space-group, do not suggest that the SnCl_4 -- group is co-planar.

The actual formula of potassium chlorostannite is worth consideration. Rammelsberg² and others^{3,4} found only one water molecule of hydration, while Richardson⁵ later obtained two water molecules. A thorough study of the dehydration of hydrated potassium chlorostannite gave strong evidence for the existence of only one water molecule in the compound, in agreement with Rammelsberg's results. Moreover, the calculation of the number of molecules contained in the unit cell (density⁶, 2.514) leads to 3.88 of $\text{K}_2\text{SnCl}_6 \cdot \text{H}_2\text{O}$ and to only 3.68 of $\text{K}_2\text{SnCl}_6 \cdot 2\text{H}_2\text{O}$, the difference between this number and 4 being due partly to the over-evaluated amount of water.

A Fourier-Patterson-Harker and a Fourier-Bragg diagram suggested a structure which is almost identical with that found by MacGillivray, de Wilde and Bijvoet⁷ for $\text{K}_2\text{HgCl}_6 \cdot \text{H}_2\text{O}$. Thus the SnCl_4 -- groups are obtained from octahedral SnCl_6 groups sharing edges parallel to the (010) plane and forming columns of so-called 'rutile octahedra' in the direction of the b axis.

In conclusion, may we suggest that the a , b , c axes, as chosen by Cox, Shorter and Wardlaw, be called b , c and a , in accordance with the usual convention.

H. BRASSEUR.
A. DE RASCHENOSSE.

Institut de minéralogie et
Institut W. Spring,
Université de Liège.
Jan. 18.

- ¹ Cox, H. G., Shorter, A. J., and Wardlaw, W., *NATURE*, **130**, 71 (1937).
² Rammelsberg, C. F., *Kryst. Chemie*, 208 (1855).
³ de Marignac, Ch., *Ann. des Mines*, (5), 12-16 (1857).
⁴ Streng, A., *Neues Jahrbuch für Mineral.*, **2**, 142 (1883).
⁵ Richardson, *Amer. Chem. J.*, **14**, 80 (1892).
⁶ Groth, P., "Chemische Kristallographie", **1**, 356.
⁷ MacGillivray, C. H., de Wilde, J. H., and Bijvoet, J. U., *Z. Krist.*, **A**, **100**, 212 (1938).

Direct Perception of Pigment in the Nerve Tissue of Human Retina

DURING spectroscopic study of a flavoprotein compound in heart muscle preparation, it was noticed that two diffuse absorption bands of the pigment remained always perceptible, however dilute was the preparation or thin the layer examined. Further observations have revealed that these two bands remain perceptible even in the absence of muscle preparations. Moreover, examination with a small dispersion spectroscope of any source of artificial light shows the presence of two diffuse absorption bands lying at about 495 m μ and 455 m μ . The first band is more distinctly visible at a lower intensity of light, while the second band can be more easily perceived when the light passes through a suitable filter such as a solution of ammoniacal copper sulphate or Wratten filter D.

In order to see these bands, it is essential to use a very low dispersion spectroscope such as a micro-spectroscope ocular attached to a microscope or a prism pocket spectroscope and a source of light giving a continuous spectrum. The relative intensities and positions of these bands remain constant and are independent of either the optical system or the source of light. This clearly indicates that the absorption bands are not due to the instruments but to a substance present in the observer's eye and lying on the path of rays from the light source to the sensitive portion of the retina. As the cornea, lens, aqueous and vitreous fluids are devoid of any perceptible colouring matter, the pigment responsible for the absorption bands must be present in the retina itself, in the nerve tissue lying in front of the visual cells (cones) and most probably in the *macula lutea* and *fovea centralis*.

The presence of this pigment in the retina can also be deduced from an examination of the visibility data obtained in the 'step-by-step' matching of the intensities of two adjacent spectral regions. In every case these data, whether for normal^{1,2} or for the colour-blind³ eye, reveal two distinct depressions in the visibility curve. These two depressions, ascribed⁴ to a pigment present probably in the optical path of the eye, lie at about 495 m μ and 455 m μ , occupying therefore the same positions as the absorption bands described above.

As to the nature of this pigment, we can suggest only that it may be either a flavin or a carotinoid compound, or possibly a mixture of both and present in the thin layer of nerve tissue of the macula in a concentration sufficiently high to give a perceptible

absorption spectrum. In fact, flavin and its derivatives⁵ as well as β -carotene⁶ have been obtained from ox retina. Both pigments have somewhat similar absorption in the region of the spectrum occupied by the above bands. However, the exact nature of the substance responsible for the perception of these two absorption bands will only be solved by a careful study of the pigments obtained directly from the *macula lutea* of the human eye.

The two absorption bands described above represent, so far, the only slight discontinuities which the eye can perceive in the otherwise continuous spectrum of an artificial source of light. They denote only a very slight imperfection in the eye caused by the presence of pigments in the nerve tissue of the retina itself, an imperfection which is highly magnified by the use of a small dispersion spectroscope.

This observation also serves as warning against the use of the direct method of spectroscopic examination in the general survey of flavin or carotene distribution in different tissues and their extracts. In fact, if this method is used, it will not be possible to detect any cells completely devoid of these pigments.

D. KHELIN.
E. L. SMITH.
(Guggenheim Fellow).

Moltano Institute,
University of Cambridge.
Feb. 1.

- ¹ Gibson, K. S., and Tyndall, H. P. T., *Bar. Stand. Sci. Papers*, **1**, 131 (1923).
² Fedorow, N. T., and Fedorowa, W. I., *C.R. Acad. Sci., U.R.S.S.*, **2**, 377 (1936).
³ Hecht, S., and Shlaer, S., *J. Gen. Physiol.*, **20**, 57 (1936).
⁴ Brunner, O., and Baroni, H., *Sitzber. Akad. Wiss. Wien, Math. natw. Klasse*, **110**, 145, 484 (1936).
⁵ Brunner, O., Baroni, H., and Kleinau, W., *Z. physiol. Chem.*, **236**, 257 (1935).

Differentiation of Disaccharide-splitting Enzymes

WEIDENHAGEN's theory of the specificity of glucosidases and disaccharases¹, as opposed to the theory of specificity of Leibowitz², depends largely upon the claim that the maltose-splitting factor of taka-diastase is an alpha-glucosidase identical with the sucrose-splitting factor (glucosucrase). According to Leibowitz, on the other hand, taka-maltase is a specific glucomaltase, inert to alpha-methyl-glucoside and distinct from the taka-sucrase.

Recently³ we reported the possibility of freeing taka-maltase from accidentally accompanying alpha-methyl-glucoside splitting enzyme on the basis of the thermostability of the former. It has now been found that on brief incubation at pH 8.5 the heat-stable taka-maltase retains full activity whilst taka-sucrase is completely destroyed. Hence it follows that taka-maltase and taka-sucrase are two distinct enzymes. Consequently, the theory of Weidenhagen, against which serious objections have already been raised, may now be considered refuted.

J. LEIBOWITZ.
S. HESTERIN.

Department of Hygiene and
Bacteriology,
Hebrew University,
Jerusalem.
Jan. 22.

- ¹ Weidenhagen, "Ergebnisse der Enzymforschung", vol. 1 (1932); *Z. physiol. Chem.*, **216**, 255 (1933), and elsewhere.
² Leibowitz, *Z. physiol. Chem.*, **149**, 184 (1925); Leibowitz and Mechinsky, *ibid.*, **154**, 64 (1926).
³ Leibowitz and Hesterin, *NATURE*, **141**, 552 (1938).

Reduction of Heart Flavoprotein

WE recently described¹ the catalytic properties of a flavoprotein isolated from heart. At that time we were unable to observe the reduction of flavoprotein by reduced coenzyme I. We now find that, by eliminating coloured impurities in the various components of the catalytic system, the rapid reduction of flavoprotein to its leuco form can be readily demonstrated. Under the conditions of our experiment, the leuco form is non-autoxidisable but can be oxidized by 'carriers' such as methylene blue. The mechanism of the catalytic effect of heart flavoprotein involves a cycle of reduction by reduced coenzyme I and oxidation of the leuco form by some suitable 'carrier'.

F. B. STRAUB.
H. S. CORRAN.
D. E. GREEN.

Moltano and Biochemical Institutes,
Cambridge.
Feb. 7.

¹ Straub, Corrnan and Green, *NATURE*, 142, 119 (1939).

Relative Sexuality in Unicellular Algae

IN a series of papers, Dr. Franz Moewus, working first at the Kaiser Wilhelm Institut für Biologie in Berlin, and later at Erlangen and Heidelberg, has published a number of very remarkable results on relative sexuality in unicellular algae. The qualitative results are in agreement with those of other workers of the same school. We wish, however, to direct attention to a feature of his quantitative data which casts grave doubt on their reliability.

Moewus' last paper¹ described the genetical behaviour of various races of *Chlamydomonas eugametos*. The xygotes derived from crosses within dioecious races, that is, races with genotypical sex-determination, are said to give 3.08 per cent exceptional gametes. Clones grown from these exceptional gametes can produce gametes of both sexes, that is, they show phenotypical sex-determination. These abnormal segregations are ascribed to crossing over between the two non-allelomorphic sex determiners. In each of the crosses 1-9, 18-24, and 37-40 he tested 500, or occasionally 400 or 300 xygotes. In 27 of the 31 crosses, 500 xygotes were tested, and the number of exceptions was between 13 and 17 in every case.

Struck by this astonishing consistency, we applied Pearson's χ^2 test to all 31 crosses, and found $\chi^2 = 2.423$ for thirty degrees of freedom. The probability of obtaining as bad or worse a fit by sampling is $P = 1 - 4.7 \times 10^{-13}$. That is to say, only once in about 10^{11} trials would so good a fit be obtained by chance. In the same paper (Table 7) Moewus once more calculates the above "cross-over" value from four samples of 5,000 xygotes each, by observing the number of cells dying as a result of meiosis. The numbers are 152, 158, 151, and 155, forming exactly 3.08 per cent of the total, as before. We can therefore add the total value of χ^2 obtained from them, namely, 0.201 for four more degrees of freedom, to the former value, obtaining a grand total of $\chi^2 = 2.624$ for thirty-four degrees. This gives $P = 1 - 6.6 \times 10^{-14}$.

A second suggested cross-over frequency between the male determiner *M* and the gene *t* for *Subheterocis* amounting to 9.8 per cent is deduced from six crosses (numbers 26-39 and 42-43). Here $\chi^2 = 0.0410$

for five degrees of freedom. So $P = 1 - 6.3 \times 10^{-4}$ approximately, though even Sheppard's table of the probability integral is not accurate enough to give the second significant figure with certainty.

Nor is the truly remarkable agreement between theory and observation confined to the paper in question. In a paper² on *Protosiphon botryoides*, Tables 2, 3, and 4 record twenty-two experiments in which the cultures segregated into approximately equal numbers. Either the two halves gave different kinds of gamete or one gave gametes and the other did not. In eleven experiments where thirty cultures were counted, the deviation from equality never exceeded 17 and 13. In eleven experiments where ten cultures were counted, the largest deviation is 6 and 4. For twenty-two degrees of freedom $\chi^2 = 5.06$, $P = 1 - 6.9 \times 10^{-1}$.

So good a general agreement with theory would be obtained by chance once in 3.5×10^{11} trials; that is to say, if every member of the human race conducted a set of experiments of this type daily, they might reasonably hope for such a success once in fifty thousand million years. There are two alternatives to the hypothesis of chance. One is that a wholly new type of biological regulation has been unwittingly discovered, by which the frequency of segregation is controlled with extreme sharpness, and that this applies to three segregations in two species. The other is that the author has consciously or unconsciously adjusted his observations to fit his theory. As this work is of fundamental importance for the theory of sex-determination, it is desirable that these experiments should be repeated by an independent observer. Until this is done, those parts of Dr. Moewus' genetical theory which are based on these numbers cannot, we think, be accepted.

U. PHILIP.

Department of Biometry,
University College,
London. Jan. 25.

¹ *Biol. Zbl.*, 58, 516-536 (1938).

² *Biol. Zbl.*, 58, 292-300 (1935).

Embryology of the Symphyla

OWING to the significance which is attached to the Symphyla in speculations on the origin of insects, a knowledge of their embryology has become desirable. Having recently obtained, in large quantity, the eggs of a local species of *Hansenella*, I have been able to work out a fairly complete story of the development of these remarkable animals. A detailed account of this will be published later; the present note records a few points which are significant on phylogenetic grounds.

Cleavage is total, as in Collembola and some Diplopoda. By tangential division of the large yolk pyramids, an outer layer of small cells and an inner layer of very large cells arises, both rich in yolk. From the former arises the blastoderm. From the latter arises by further division the internal mass of yolk-cells. These are not pure vitellophages, however, for from them develop the fat-body and mid-gut epithelium.

An embryonic area forms by ventral thickening of the blastoderm. A precocious flexure then forms in the embryonic area, as in some diplopods, and thereby the germ-band becomes defined. A 'dorsal organ' is present; but there are no embryonic membranes.

The mesoderm arises by bilateral separation of cells from the germ-band. Segmentation of the mesoderm into somites synchronizes roughly with external segmentation of the germ-band. In the head there is no external sign of segmentation. The labial segment arises as part of the abdomen. Behind it are formed seven leg-bearing segments, followed by a pre-anal segment, the appendages of which are the cerci. On the anal segment appendages are vestigial.

In the head, six pairs of coelomic cavities form; each abdominal segment is furnished with a single pair of coelomic sacs. The antennary and pre-antennary coelomic sacs co-operate to form the aorta. The coelomic sacs, from the mandibular backwards, grow through the yolk-cells, enclosing part of these as mid-gut epithelium; they all furnish cardioblasts for the heart. The pre-mandibular coelomic sac undergoes a remarkable development, for from it arises a large excretory gland which degenerates at the time of eclosion; in association with it is a clump of nephrocytes, probably homologous with the sub-oesophageal bodies of insects. The salivary gland is a remnant of the maxillary coelomic sac.

Great significance is naturally attached to the reproductive organs. The genital tubes arise by concrescence of the vestiges of the coelomic sacs from the fourth abdominal to pre-anal segments. Vestigial coelomoducts survive in the pre-anal segment until after eclosion, the larva presenting the appearance of a potentially opisthognate rather than prognate myriapod.

The most noteworthy feature of the nervous system is the development of its ganglia in association with 'ventral organs' as in *Peripatus*. The 'ventral organs' retrogress; from the remnants arise the eversible sacs.

The Symphyla appear to be the survivors of a very ancient stock of myriapods, closely related to the opisthognate forms from which the insects were derived, but already distinguished by the acquisition of a secondary anterior genital opening, which the diplopods have inherited from them.

Zoology Department,
University, Melbourne.
Jan. 3.

O. W. THOMS.

¹ Metchnikoff, H., *Z. Wiss. Zool.*, 24 (1874).

Studies on *Chironomus* Chromosomes with the Polarizing Microscope

In previous communications¹ it was pointed out that in protoplasm there are linear units forming either a brush heap of fibrils or having a symmetrical arrangement of them oriented end-on-end in parallel rows. Furthermore, it has been shown² that, during the appearance of mitotic spindle fibrils, living matter possesses a continuity in structure which only fibrous units can adequately impart to it. In D. M. Wrinch's model³, a chromosome has been pictured as consisting of a net of polypeptide molecules in parallel forming the warp of the fabric, and of nucleic acid molecules constituting the woof. In my opinion, Wrinch's assumption of fibrillar units offers several possibilities, especially in regard to the postulates of genetics and to the findings of the cytologists as to the capacity of the chromosomes to swell, to contract, to grow, and to divide. On the other hand, it is known⁴ that fibrils of nucleic acid are optically negative and run parallel with the axis of sperm heads.

It is the purpose of this note to indicate the essential features of a chromosome model of polypeptide chains in parallel with nucleic acid molecules. Salivary glands of a *Chironomus* sp. were selected from female larvae preparing to pupate. Slight pressure on the salivary gland nuclei not only separates the chromosomes from each other but also reveals most strikingly, at the same time, the chromomeric, banded nature of the heterochromatin⁵. It is true, H. Bauer in 1935 failed to find anisotropy in chromosomes of salivary glands even in a stretched state; but H. Ullrich in 1936 emphasized the fact that the chromomeric bands are doubly refractive after injury. When the chromosomes are pressed out into a favourable medium, for example, paraffin oil, the double-refraction of the transverse bands is, though often weak, nearly always capable of verification. Furthermore, it becomes pronounced when the chromosomes are intensively extended between two micro-needles as used by P. Vonwiller and A. Audova. After cessation of stretching, the chromosomes contract without attaining their initial length.

It has occurred to me that these contractions may be due to the shortening of protein fibrils by molecular folding or helical contraction as postulated by W. T. Astbury⁶ for wool and hair. Along with the lengthening, the chromosome becomes less transparent in the interchromomeric bands, and the anisotropy measured in I-values often increases considerably. But the extended chromosomes are always negatively birefringent with respect to their long axis. So I see no reason for the assumption of a cross-arrangement of nucleic acid molecules, but I assume the same direction of both the polypeptide chains and the nucleic acid molecules. The nucleic acid bands may form zones of alternating density along the micelle⁷. With regard to the chromosome micelle, my agreement with Wrinch consists in the assumption of a contractility and of swelling properties in comparison with which those of the coarse animal fibrils vanish into insignificance.

Our knowledge of the molecular structure of the chromosome micelles is slight compared with the knowledge of the structure of materials like cellulose or other derivatives of protoplasm. Further work is now in progress on some points raised by these experiments, and will be reported in due course.

HANS H. PFLEFFER.

Kolonial- u. Ueberssee-Museum,
Bremen. Jan. 10.

¹ Pfeiffer, H. H., *NATURE*, 133, 1054 (1936); *Physica*, 7, 302 (1936); *Fuji Jubil. Vol.* (Tokyo), 701 (1937); Frey-Wyssling, A., "Submikroskopische Morphologie des Protoplasmas und seiner Derivate", p. 73 (Berlin: Gebr. Borntraeger, 1938).

² Pfeiffer, H. H., *NATURE*, 142, 770 (1937); *Biodynamica*, No. 35 (1938); *Vech. V. Intern. Zellf.-Kongr. Zurich*, 257 (Jena: G. Fischer, 1939).

³ Wrinch, D. M., *NATURE*, 131, 978 (1934); *Proc. Intern. Bot. Congr. Amsterdam*, 2, 24 (1935); *Protoplasma*, 31, 550 (1936).

⁴ Schmoldt, W. J., *Zool. Jahrb.*, 45, 177 (1928); "Die Doppelbrechung von Karyoplasma, Zytoplasma und Metaplasma", 81 (Berlin: Gebr. Borntraeger, 1937); Pätzold, H. O. B., *Z. Zellf.*, 16, 723 (1932); Frey-Wyssling, loc. cit., 184.

⁵ For a general introduction to the properties of the chromosomes of salivary glands of Diptera, see Daddington, O. D., "Recent Advances in Cytology", second edit., p. 175 (London: J. and A. Churchill, 1937); Bauer, Hans, in Hartmann, M., *Fortschr. Zool.*, 1, 6; 2, 11 (Jena: G. Fischer, 1937); Geitler, L., "Chromosomenbau", 99-103 (Berlin: Gebr. Borntraeger, 1938); for the method of preparation: Hellborn, O., *Ann. Agr. Coll. Sweden*, 4, 89 (1937).

⁶ Astbury, W. T., "Fundamentals of Fibre Structure", 146 (London: Oxford Univ. Press, 1933); together with Street, A., Woods, H. J., and Simon, W. A., *Phil. Trans. Roy. Soc. A*, 230, 75 (1931); 232, 333 (1932); *Proc. Roy. Soc. A*, 140, 533 (1933); 158, 76 (1936); Betts, W., *Science*, 88, 21 (1938).
O. Astbury and Bell, Florence O., *NATURE*, 141, 747 (1938).

Food of Salmon Parr

AN investigation of the stomach contents of salmon parr from the River Dee and its tributaries has been in process during the past twelve months, and, in view of the scarcity of published data on this subject, a preliminary note may be of general interest.

The feeding is totally indiscriminate, and a single meal may include representatives of a dozen or more species of animals taken at random from under stones (insect-larvæ), free water (Cladocera and small beetles), or surface-driftage (aerial and terrestrial arthropods), while the large number of dipteran flies (especially Empididæ and Mycetophilidæ), uniform in species, sometimes found within a single stomach suggests that the fish may have snapped at swarms in the air itself.

Until so late as the end of October, food organisms of sub-aerial origin are more numerous than aquatic types in the stomachs, and the numerical abundance of Hemipteran plant pests, especially those associated with the alder (some species of *Psylla* and of *Cicadina*), points clearly to the desirability of encouraging the growth of trees and shrubs along the banks of the streams, especially where the benthic fauna is poor.

Details of the full seasonal cycle and a list of food organisms will be published later.

KATHLEEN E. CARPENTER.

Department of Zoology,
University,
Liverpool.
Jan. 16.

Ancient Egyptian Astronomy

WITH reference to Dr. O. Neugebauer's letter in *NATURE* of January 21, p. 116, on this subject, may I express concurrence in respect to the neglect of this matter? Whereas excellent work has been done by Dareese, Schott, Gundel and Zinner on the Continent and by A. Pogo in America, very little attention is being given to it in England.

The Stobart tables, to which Dr. Neugebauer refers, can, however, never be quite forgotten, since it was by them that Brugsch definitely identified the planets in the astronomical ceilings of the temples of Denderah and Edfu (Roman period), the two temples of Esneh (Ptolemaic period), the temple of Medinet Habu, the Ramesseum and the tomb of Seti I (New Kingdom). Similar identifications of the planets have since been made on the Karnak clepsydra (Amenophis III) and on the Senmut ceiling (Hatshepsut, say, 1500 B.C.) and by Dareese on a Tenth Dynasty coffin from Asiut (say, 2000 B.C.). Venus may perhaps be referred to in the Fifth and Sixth Dynasty Pyramid texts (say, 2500 B.C.). Recently I noticed the planets in the coffin of Heru-neteh-tef-ef in the British Museum (about 350 B.C.).

The standard "schemata coeli" appears to have been developed about the beginning of the New Kingdom (say, 1600 B.C.) and consists normally of three registers, containing (1) the 36 dekans, Sirius, the superior planets, the "meta-dekans" and the inferior planets; (2) the northern stars; (3) the twelve monthly feasts.

In the preceding Middle Kingdom (say, 2000 B.C.), the scheme is simply one of four figures: the Goddess of Heaven, the Great Bear (Ox-leg), Sirius and Orion.

The Pyramid texts contain numerous references to Sirius and Orion.

Pogo¹ has studied the tables of dekanal stars and hours on the Asiut Tenth Dynasty coffins, and it is

clear that, at that era, the Egyptian notions of time were most vague, and similarly the Eighteenth Dynasty Karnak clepsydra is by no means accurate. Even the table of dekans was never standardized, but differs from dynasty to dynasty.

It seems very doubtful if one can safely attribute much mathematical ability to the ancient Egyptians on the basis of the demotic texts to which Dr. Neugebauer refers. From the time of the foundation of the Museum at Alexandria, Greek methods appear to have been adopted. The Denderah planisphere shows that the essential features of purely Greek astrology had been incorporated into the Egyptian system in Roman times, and even the "ancients" (Petosiris and Nechepeo), so frequently alluded to by classical writers, seem to have acquired many notions from the Greeks, if one may judge by the fragments of their lore contained in the writings of Firmicus.

For those who are interested, I may remark that the replica of the Karnak clepsydra in the Science Museum at South Kensington shows most of the features of the standard figure of heaven, and agrees in most respects with the oldest existing example, that from the ceiling of the tomb of Senmut.

HERBERT CHATLEY.

60 Lyford Road,
London, S.W.18.
Jan. 21.

¹ *Iris*, 17, 6 (1932); *Osiris*, 1, 500 (1936); and in Gundel's "Dekane und Dekansternbilder" (1930).

Finance for Scientific Research

I SHOULD like to comment on the leading article in *NATURE* of January 28 on this subject.

I think that the best hope lies in approaching this matter in a truly scientific spirit, when the authorities, it is to be hoped, would not feel in duty bound to defend the present position nor would reformers require to attack it. Research associations were originally formed, with Government help, to introduce research into various industries, and there was a belief that the advantages of research to the industries would become so apparent that after a period industries would provide all the funds for research themselves.

In general, the industries have become convinced of the advantages of research, but their prosperity and hence their ability to finance research has been impaired by circumstances affecting their supplies of raw material and their markets at home and abroad, which have been beyond the influence of the research associations.

Research associations are supposed to confine themselves to research on the processes of their members and leave these other matters alone. In my experience, this limitation cuts off a most important field of research, and tends to preclude any large advance of economic importance. In many cases, certainly in textiles, a large part of the price of the finished article consists of the price paid for the raw material. Unless and until attention is paid to ensuring ample supplies of uniform quality and reasonable price, no amount of research upon processes will overcome the difficulties of British industry.

Again, a research association cannot undertake research to develop entirely new uses for its raw material outside existing channels, because it is working for members who are operating established

processes. It seems to me that many notable advances depend on using some raw material in a new way, such as using rubber for tyres instead of rubbing out pencil marks. By neglecting to finance this kind of research, are we not leaving the most fruitful field without fertilizer?

From the financial point of view, the main expenditure on research is on the salaries and wages of the research workers. At present, there are glaring irregularities owing to differences in organization and finance. Scientific workers in universities are in permanent positions; but they are paid for their educational services rather than for research. Scientific workers in the many Government establishments are in permanent establishments and are paid upon recognized salary scales to do research. Scientific workers in the employ of private firms are likely to have a permanent career and prospects if the firm is sufficiently stable, and they may be paid to some extent by results. At present, the position of scientific workers in research associations is the least satisfactory. The continuance of their employment is only reasonably assured over the quinquennial period for which Government grants are arranged. My experience, which may be usual, is that young people

join the staff to gain valuable experience of industrial research, and seek an assured career in a Government research station, where a better salary and prospects are open to them, or they leave to enter private employment in industry.

This means that co-operative research undertaken by an industry and partly paid for by the industry is at a disadvantage in retaining an experienced staff, compared with an industry, which for some reason or other pays nothing towards co-operative research, either getting it done by a Government establishment or relying on individual and private effort. This is neither just nor advisable. Co-ordination of research effort all along the line is necessary, and research workers should choose their field because they are attracted to it, not because it offers the best opportunities of a career.

W. H. GIBSON.
(Director of Research.)

Liften Industry Research Association,
The Research Institute,
Lambeg, Lisburn,
Co. Antrim.
Feb. 1.

Points from Foregoing Letters

PROF. N. BOHR, discussing the recent observations on the break up of certain heavy nuclei when bombarded with neutrons into particles of approximately equal size, suggests that this effect might be treated approximately as a classical mechanical problem, on the assumption that the excitation energy is distributed among the various degrees of freedom in a way resembling the thermal agitation of a solid or liquid body. The usual radioactive phenomena would then be analogous to the evaporation of a molecule from a liquid drop.

Experiments reported by Prof. J. A. Hedvall and Dr. G. Cohn indicate that the adsorption of phenolphthalein (in alcoholic solution) by cadmium sulphide, is reduced when the latter is activated by irradiation with white light. A similar effect has been obtained with various organic dyes.

Further experiments by Dr. T. F. Wall show that in iron tubes the reduction in the value of H inside the tube becomes greater as the thickness of the wall increases, and is a maximum when the tube is magnetized to a condition which about corresponds to the knee of the magnetization curve. This, he states, supports the views previously formulated that one aspect of the classical theory of magnetization is incorrect, and that the magnetization of a material is initiated at the surface and is transmitted inwards by a kind of 'chain effect'.

An X-ray diffraction photograph of a drop of supercooled liquid sulphur at $25-30^\circ\text{C}$. is submitted by S. R. Das and K. Das Gupta, who point out that the study of supercooled liquids by X-rays has not hitherto been reported.

X-ray studies of potassium chloroplatinate crystals lead H. Brasseur and A. de Rassenfossé to the view that the SnCl_4^- group is not co-planar. In other

respects (that is, size of unit cell and space-group), their findings agree with those of Cox, Shorter and Wardlaw.

By examining with a very low dispersion spectro-scope any source of artificial light giving a continuous spectrum, it is possible, according to Prof. D. Keilin and Dr. E. L. Smith, to observe two diffuse absorption bands at about 495 and 455 m μ . These, they state, are due to a pigment in the retina which may be either a flavin or a carotinoid compound, or possibly a mixture of both.

At pH 3.5, taka-maltase is stable, but taka-sucrase is quickly destroyed. Hence, according to Dr. J. Leibowitz and S. Hestrin, these two are distinct enzymes.

Discussing results obtained by Dr. T. Moewus in his genetical experiments with unicellular algae, U. Philip and Prof. J. B. S. Haldane find that the probability of their occurrence is so low that one must assume that either a new type of biological regulation is involved or that the author has consciously or unconsciously adjusted his observations to fit his theory.

Dr. O. W. Tiegs describes the development of the embryo of the Australian arthropod *Hanseniella*. It indicates that the Symphyla, the insect class to which it belongs, are survivors of a very ancient stock of myriapods distinguished by the acquisition of a secondary anterior genital opening.

From observations of the chromosomes of salivary gland nuclei of *Chironomus*, pressed out into paraffin oil, Dr. H. H. Pfeiffer concludes that they show definite double refraction of the transverse bands, particularly when stretched. The author considers that Dr. Wrinch's model of net-structure offers interesting possibilities of explaining the contractile and swelling properties of the chromosomes.

Research Items

Early Bronze Age in Wessex

MR. STUART PIGGOTT has examined evidence belonging to the final phase of the Early Bronze Age culture of Wessex with the view of establishing the existence of a culture corresponding chronologically with the food-vessel phase of northern England, and intervening, in a ceramic sense, between the beaker and omerary urn, and forming a final phase in the Early Bronze Age (*Proc. Prehist. Soc.*, N.S., 4, 1; 1938). Such a phase had been postulated in the typological series of bronze implements, while for a great many years a remarkable series of grave groups has been known, incorporating elements (often spectacular in their implication of material wealth), which are peculiar to the area. Obviously they throw a great deal of light on trade relations both internal and overseas. Analysis of the archaeological evidence points to an intrusive culture with types divisible into two groups, those of a southern (maritime) origin and those whose affinities suggest early entry overland from the north. In the first category are bronze daggers with mid ribs and/or lateral grooves, certain pottery forms, notably incense cups, beads of blue faience, now established as of Egyptian origin; and in the second group gold ornaments of Irish origin, and beads and pendants, stone battle-axes of the Snowhill type, pins of Germanic type, and perhaps flanged axes. With the two groups are certain exceptional objects. We are thus faced at the end of the beaker phase with the sudden flowering of a true bronze age, marked by an opening up of trade connexions all over Europe, and the appearance of new types of weapons, tools and ornaments, and a radical change in burial rites. Such a change cannot have taken place without external stimulus, so radical that it cannot have been brought about except by actual settlement—a wave of prehistoric migration from Brittany, a dominant and intrusive aristocracy, who lorded it over a basic folk-culture of food-vessel type, which, however, ultimately absorbed it.

Secret Societies of Sierra Leone

A PRELIMINARY report on the expedition of the University Museum, Philadelphia, to West Africa in 1937 ("The Sherbro of Sierra Leone" by H. U. Hall. Pp. 52 with map. Philadelphia: The University Press, 1938) includes among other matters a description of the place and function of the various secret societies among the Sherbro, or Bolom, of Sherbro Island and the chiefdom of Shenge (Kagboro), in which the old Sherbro culture is best preserved. The population of the island is estimated at 15,571, this figure including 1100 Mendi; while Shenge chiefdom is estimated to have a population of about 15,200. Sherbro Island consists of two chiefdoms, over each of which is a paramount chief, chosen from ruling 'houses' or *rams*, exogamous units composed of blood-relations, in some of which patrilineal descent now prevails. The matter of succession by descent figures not only in regard to rulership, but also in the matter of the organization of the more important secret societies, one of which, *Poro*, was formerly a powerful instrument of government. Secret societies still play a very significant part in

Sherbro life. A man who does not belong to *Poro*, or the third society intrusive *Thoma*, has no standing in the community. Membership of the women's society, *Bundu*, is also obligatory for women. *Poro* is exclusively for men, but *Thoma* is a mixed society, as is also the *Niandung* society among the people of the Ndama chiefdom. *Poro* is now 'put in the bush' about once in three or four years, the bush being a grove of large cotton trees, which, though not enclosed, is strictly barred to women and non-members. When *Poro* is in session the *Poro* "devil eats" the candidates, who are seized *pro forma* if willing, and violently if not willing. This is a ceremonial death through which the candidate enters the world of the spirits of the ancestors. Emergence from the bush at the end of the period of initiation is the equivalent of resurrection, or rather a new birth, brought about by "beating the devil's belly" until he vomits the candidates he has swallowed. In former times decisions affecting the affairs of a chiefdom, both internally and in relation to other chiefdoms, were all taken in the *Poro* council.

Distribution of Vitamins A₁ and A₂

G. WALD (*J. Gen. Physiol.*, 22, 391; 1938) has examined the distribution of vitamins A₁ and A₂ in the eye tissues and livers of freshwater and marine fishes by means of the antimony chloride reaction, which yields with A₁ a band at 615–620 mμ and with A₂ a band at about 696 mμ. In the retina the presence of vitamin A₁ is diagnostic of the operation of a rhodopsin and vitamin A₂ of a porphyropsin cycle. The eye tissues of all permanently marine fishes examined except the tautog contained vitamin A₁ alone, while those of all permanently freshwater fishes possessed only vitamin A₂. Those of all potentially migratory fishes, except perhaps the alewife, contained mixtures of both A₁ and A₂. Most livers contained mixtures of both vitamins A₁ and A₂, and occasionally in proportion the reverse of those in the eye tissues.

Nutritional Cytopenia in the Monkey

W. C. Langston, W. J. Darby, O. F. Shukers and P. L. Day (*J. Exp. Med.*, 68, 923; 1938) fed young rhesus monkeys (*Macaca mulatta*) on a diet containing casein, polished rice, whole wheat, salt mixture, sodium chloride, cod liver oil and ascorbic acid, with the result that they developed a syndrome characterized by anaemia, leukopenia and loss of weight. Ulceration of the gums and diarrhoea were common, and death took place between the twenty-sixth and hundredth day. Four animals were given the deficient diet with the addition of 1 mgm. of riboflavin daily and developed the characteristic signs and died in periods of time similar to the survival of the other monkeys. Nicotinic acid alone or combined with riboflavin and thiamin chloride also failed to alter the course of the deficiency. On the other hand, when the deficient diet was supplemented with either 10 gm. of dried brewers' yeast or 2 gm. of liver extract daily, normal development took place, and there was a normal blood picture for a long period. It is obvious, therefore, that yeast and liver

extract contain a substance, for which the authors propose the term 'vitamin M', which is essential to the nutrition of the monkey, and is not identical with any of the factors of the vitamin B complex which have been chemically identified.

Action of Eserine on Pancreatic Secretion

L. LIAOI (*Biochim. et exp. experiment.*, 25, 445; 1938) carried out experiments on dogs to determine the action of eserine on the external secretion of the pancreas. He found that small doses of this drug ranging from 0.10 mgm. to 0.18 mgm. per kilo injected intravenously had a stimulating action on this secretion as the result of two different mechanisms. The first acted through the vagus, while the second was connected with an increase of the stimulus produced by secretin, which in turn had been increased in quantity by the action of eserine. On the other hand, larger doses of eserine led to a diminution of the secretion and larger doses still might arrest the secretion altogether if it had started spontaneously. Liaoi also found that pancreatic juice secreted after the administration of eserine was capable of digesting coagulated albumin without having received any previous activation.

Colonization of Krakatau by Mammals

In 1883, the great eruption of Krakatau destroyed all vegetation and covered the island with a layer of hot ashes several metres deep. It may be assumed, therefore, that, whatever mammals existed previously, none survived the eruption. In an interesting account of the mammals now present on the island, Dr. K. W. Dammerman indicates the stages of the colonization (*Troubia*, 16, 421; 1938). In 1908, Jacobson collected no mammals and saw none, probably none had yet arrived; but by 1919 bats, *Cynopterus brachyotis*, were present on two islands of the group; in 1920 a second species of the same genus was found on Krakatau itself, although on Verlaten Is. it did not appear for ten more years. It is noteworthy that these two species are fruit-eaters and that insectivorous bats were first collected in 1928 (*Hipposideros diadema*); in 1933 a fourth bat species made its appearance. The only other mammals which have so far gained a footing on the islands are rats. There was none in 1917, but by 1919 when a settler had been present for two years, the house-rat (*Rattus r. diardi*) had become a nuisance. By 1924, when the settler had gone and his house had already become a ruin, the rats had gone. This may have been due to the increase of the large python, but that is unlikely because by 1933 rats were again numerous. A second rat (*R. r. jalorensis*), the widespread Malay country-rat, had become established and was plentiful in 1928. The author notes that on his visits in 1933 and 1934 he saw a small and emaciated black dog, which must have escaped from some landing party and had been able to eke out a poor existence.

Migrations of the Gannet

The origins of British gannets are few so that the movements of ringed birds are more easily related to breeding places. Of 6,384 gannets ringed, 203 have been recovered (3.2 per cent) and the recoveries, as analysed by Dr. A. Landsborough Thomson, show that birds in their first year are the most extensive wanderers (*British Birds*, 32, 282; 1939). Indeed more young birds are captured in African waters than in

European. Older birds tend to confine their winter wanderings to the western shores of France and Spain, but it is clear that in general the approach of autumn brings with it a southward movement, which by the end of December has carried at any rate the birds of the year beyond the southern limits of Europe. A few scattered records show that occasionally gannets born on the west coast of Britain find their way in later years to the North Sea and even to the Baltic, and one Bass Rock individual was recovered from the Faeroes, near another breeding station. The oldest gannet recovered had reached an age of nine years, and it was then within a few miles of Ailsa Craig, where it had been ringed as a nestling.

Names of British Fishes

SCIENTIFIC names of even common British animals are still in the melting pot of priority; but a useful effort to establish the nomenclature of ten families of British fishes has been made by A. Fraser-Brunner (*Ann. Mag. Nat. Hist.*, Ser. 8, 2, 410; Nov. 1938). The changes indicated mainly concern generic and subgeneric names, and for the larger families keys to the characters of these groups are given. Two new generic names are used: *Eutrigla* for *E. gurnardus*, which seems to be confined to European waters and is the only member of the genus; and *Diplecogaster* to include three of the gobies, the former *Cyclopterus bimaoulatus*, selected as the type of the new genus, *Lepidogaster microcephalus* and *L. pellegrini*. The list includes two species which have recently been added to the British list—*Syngnathus rostellatus* from the Thames estuary and *Ammodytes marinus* recently described by Raitt.

Size of Nucleus in *Ricinus communis*

In a communication to the Editors, Flora M. Scott, of the University of California at Los Angeles, comments on the very large size of the nuclei in *Ricinus communis*. Nuclei of the apical meristem, 3–4 microns in diameter, measure approximately 38 cubic microns in volume; nuclei of the differentiated pith and cortex, 332 cubic microns. This eight-fold increase has been shown by Monschau (*Protoplasma*, 9, 536; 1930) to be a fairly general condition. In differentiating spiral elements, however, the diameters, or major axes of the larger nuclei range from 30 to 60 microns, so that resultant volumes may reach 50,000–60,000 cubic microns in round figures, an increase approximately 1,500-fold. When volume is plotted against frequency (some 1,800 nuclei were measured) a many-peaked graph is obtained. The earlier maxima occur at 332, 585, 755, 845, 1,146, 1,860 cubic microns, that is, at intervals of approximately 200 cubic microns. Thereafter the peaks occur with somewhat less regularity, and the curve flattens as it passes to 18,000, 22,000, 33,000, 55,000 and 60,000 in round figures. Since the diameters of the largest nuclei never exceed values approximately half the diameters of the containing vessels, nuclear diameter appears to be dependent on vessel diameter. Increase in volume is shown not to be attributable to chromatin. Dehydration of living nuclei by means of absolute alcohol indicates a relatively higher content of free (that is, removable) water in the largest nuclei, but the residual volumes after such dehydration show an actual volume increase over the meristem nucleus, 8 to 250-fold. This material is therefore mainly karyolymph. A detailed account will be published shortly.

A Dwarf Mutation in Coffee

IN an investigation of the genetics of the coffee plant, *Coffea arabica*, C. A. Krug, of the Instituto Agronomico of São Paulo, Brazil, has studied a dwarf type which appears in the variety *Murta* (*J. Genetics*, 37, No. 1). Very little has yet been done with the genetics of coffee, and it takes three years for the plants to mature and produce seed. The variety *Murta* has small leaves, and when selfed yields *Bourbon*, *Murta* and dwarfs in the ratio 1:2:1. *Murta* plants are therefore heterozygous for the recessive dwarf gene. *Bourbon* is somewhat taller than *Murta*, with larger leaves, and does not carry dwarfness. The gene for dwarfness is somewhat unstable, frequently mutating to tallness, and the opposite mutation, tall to dwarf, also frequently takes place.

X-Ray Mutations in Rice

A DETAILED account of X-ray mutations in rice is given by Dr. N. Parthasarathy (*J. Genetics*, 37, No. 1). The seeds of a pure line of rice were exposed to X-rays under different conditions for 1-3 hours and various types of mutations appeared. A semi-sterile mutant gave in the *F*₂ generation normal fertile plants, semi-steriles and dwarfs in the ratio 1:2:1. The semi-sterility was found to be due to the association of four chromosomes in meiosis. A chiasma was frequently present in the homologous regions proximal to the interchange in a pair of chromosomes, thus indicating crossing-over of the interchanged segments resulting in chromatid non-disjunction and abortion of 50 per cent of the pollen grains. One semi-sterile plant had two chromatin fragments, but their presence produced no visible phenotypic effect and they are rapidly eliminated in gamete formation. The dwarfs in the progeny of semi-steriles showed regular meiosis and fertile pollen with the ordinary chromosome number, but they did not set seed. Their origin is discussed and was probably due to a small deficiency or a gene mutation at or near the point of interchange. Two other mutants were trisomic. "Beaked sterile" is a primary ($2n+1$) type; while "stumpy" showed frequently a chain of five chromosomes, indicating that the extra was composed of segments derived from two non-homologous chromosomes of the haploid set.

Empirical Studies of the Seismic Phenomena of Hawaii

THIS is the title of a widely ranged study of the earthquakes of Hawaii by Austin E. Jones (*Bull. Seis. Soc. Amer.*, 28, No. 4, 513; 1938). Small earthquakes in this region are frequent and from a study of the records it appears that the greater number of *P* waves have a period of 0.3 sec. whilst there is a subsidiary maximum of 0.5 sec. The *S* waves chiefly have a period of 0.5 sec., and there exists a subsidiary maximum of waves with a 0.8-sec. period. Large periods and amplitudes appear to go together, and the upper limits of the amplitudes were found to vary with the cube of the periods, though this probably holds only for local shocks. About 60 per cent of the foci are less than 5 km. deep and 70 per cent less than 10 km. deep. Most of the deep foci are under Mauna Loa and in the Kilauea south-east rift zone. A large number of the shallow foci are in and near the Kilauea crater. The location of epicentres near and on the extension of rifts and in pronounced lines and zones suggests a larger and more numerous system of rifts than has previously been mapped. The resulting pattern of rifts about

Mauna Loa is roughly an asterisk, and the main group of epicentres is on the visible active rifts to the south-west and east-north-east of Mokuaweoweo.

Deep-Focus Earthquakes and Earth Structure near Japan

T. SHIDA discussed this subject at the opening of the Beppu Geophysical Laboratory on October 28, 1928; but it was not made generally available in Japan until 1937 (*Tikyū-Buturi (Geophys.)*, 1, 1; 1937). The author's attention was directed to the peculiarities of the earthquake of January 21, 1906, it probably having a great depth of focus; but it was not until the similar earthquake of July 27, 1926, with epicentre near the Biwa Lake, that confirmation could be obtained. The depth of focus of this latter was about 260 km., or about twice the depth of isostatic compensation as generally accepted. The preliminary tremors indicated a shock of the fracture type, and this would seem to indicate appreciable strength to a depth of, say, 300 km., where the pressure may be expected to be of the order of 100,000 atmospheres. In Japan, the origins of some deep focus earthquakes seem to lie on a line running north-west-south-east through Honshū. Shida is of the opinion that some slow process is always going on at a depth of about 300 km. in the neighbourhood of Japan, and that this is the true cause of seismic phenomena there, especially near the centre of the main island. The same author also thinks that there may be a jump in contraction of the earth's crust at a depth of about 300 km., and this may be the true cause of crustal changes and movements all over the world.

Research in Fuel Technology

AT the tenth autumn research meeting of the Institution of Gas Engineers, held in London on November 1-2, a number of papers on topical problems of the industry were received. One of them, however—the forty-third report of the Joint Research Committee of the Institution and the University of Leeds—was concerned with a possible future trend of fuel technology. This is the gasification of coal at high pressure. The report dealt with the condition under which gaseous hydrocarbons are synthesized from the elements at high pressure. It was shown that carbon, which combines only sluggishly with hydrogen at atmospheric pressure, can be caused to react freely at a red heat under pressure no higher than fifty atmospheres. Starting with coal or low-temperature coke, there is a rapid reaction with hydrogen as the temperature rises through a zone of temperature at which the structure of the coal or carbon is changing in the carbonization process. Above this temperature zone the reaction speed is greatly increased by the presence of alkali, and the results leave no doubt of the feasibility of gasifying British coal completely to yield gas of high calorific value suitable for public distribution. Moreover, the rate of gas production is much greater than currently experienced. Under some conditions, the thermal value of the gas produced per ton of coal per hour was more than fifty times greater than now obtained in gasworks practice. Naturally the supply of hydrogen is a vital factor in the economics of such a process, and this is envisaged as being obtained by the gasification of carbon with steam and oxygen under pressure. The results disclosed open the possibility of radical changes in the preparation of gaseous fuel. In such a process the gas would be generated under pressure, which would favour its wide distribution from central generating stations.

The Australian and New Zealand Association Jubilee Meeting

THE jubilee meeting of the Australian and New Zealand Association for the Advancement of Science, founded on the model of the British Association, has just ended after a most successful week of addresses and discussions at Canberra (January 11-18). It is the first time that the Association has met at the capital city of Canberra, and the meeting was probably unique by reason of the high ratio of visiting men of science to local members. Usually the meetings take place every two years at the big Australian and New Zealand cities in turn, where the visitors are lost in the large populations. Canberra is still a small garden city, and the problem of housing more than a thousand visitors was no small one.

The Australasian Association follows the British model very closely; but there are sixteen sections altogether. The president for the meeting was Prof. Ernest Scott, who delivered an address on the "History of Australian Science". The sectional presidential addresses included: Section A (Astronomy, Mathematics and Physics), "Physical Quantities", by Prof. T. Parnell; Section B (Chemistry), "The Atmosphere as a Raw Material", by W. Russell Grimwade; Section C (Geology), "Some Aspects of Glaciation in New Zealand", by Prof. R. Speight; Section D (Zoology), "The Role of Zoology in the Field of Modern Biology", by Prof. E. J. Goddard; Section E (History), "The Study of History: A Synoptic View", by Prof. R. M. Crawford; Section F (Anthropology), "Anthropology in Australia", by Prof. A. P. Elkin; Section G (Economics, Statistics and Social Science), "The Place of Expectations in Economic Theory", by L. G. Melville; Section H (Engineering and Architecture), "The Use and Convenience of Man", by Sir Henry Barraclough; Section I (Medical Science), "Physical Education in Relation to National Fitness", by Dr. E. Sydney Morris; Section J (Education, Psychology, and Philosophy), "Growing Up", by J. R. Darling; Section K (Agriculture and Forestry), "Some Aspects of Plant Pathology", by Dr. W. L. Waterhouse; Section L (Veterinary Science), "Some Modern Trends in the Study of Host-Parasite Relationships in Animal Disease", by Dr. L. B. Bull; Section M (Botany), "The Plant in Relation to Water", by Prof. J. G. Wood; Section N (Physiology), "The Protein Molecule", by Prof. W. J. Young; Section O (Pharmaceutical Science), "Some Aspects of Fifty Years Progress in Pharmaceutical Science", by Dr. E. M. Watson; Section P (Geography), "The Present Status of the Geographical Knowledge of New Guinea", by G. A. V. Stanley.

Among the more important discussions and symposia of the meeting was one on "Radio Research" (Sections A and H). A considerable liveliness in radio research is noticeable in Australia, one especially important field being the investigation of the ionosphere. Closely associated is the work of the Commonwealth Solar Observatory at Mount Stromlo, and considerable attention has been paid to the relationship between solar eruptions and radio fade-outs. Sections P and K enjoyed an excellent discussion on "Soil Erosion", a subject now of importance in Australia. This was introduced by a paper by Sir John Russell, a guest from England.

The subject was tackled from practically every point of view: pastoral, soil chemistry, and geographical and forestry aspects also came into the picture.

Another well-developed discussion in which the Botanical, Physiological and Medical and Veterinary Sections were engaged, with representatives from the Chemistry Section, covered the subject of "Virus Diseases". Needless to say, no definite conclusions were reached as to the nature of viruses (living or non-living). They were accepted as particulate, and as consisting of nucleo-proteins. One view put forward claimed them as specialized derivatives (reduction forms) of bacteria. The chemists arranged symposia on "Colloids", and on "Organic Nitrogen Compounds".

A well-attended meeting of agriculturists held a symposium on the "Pasture Problems of Australia", and the Zoology Section, for the first time in Australia, had a day devoted to "Marine Biology and Fisheries", at which several interesting original papers were read. The Zoology Section also discussed the important problem of conservation of the native fauna of Australia, and resolutions were passed which are noted below.

The geologists held five symposia: "Metasomatism of Country Rock near Ore Bodies"; "Sub-divisions of the Lower Palaeozoics in East Australia"; "The Permian Sequence in Australia"; and "Granitisation in Australia", being four of them.

It is impossible to indicate all the good work at the sections. The list of original papers shows a sustained rise in the results of research of a high standard, much of which has great economic value. Almost three hundred papers were listed for presentation at this meeting.

One of the most important meetings was a discussion covering all sections, the subject being "The Relation of Science to Society". It was opened by Sir David Rivett. This and many of the other discussions and presidential addresses were attended by the Governor-General, Lord Gowrie. The result of the discussion, at which references were made to the new activities of the British Association and of the American Association, was the formulation of several resolutions and the direction for the establishment of a committee to consider the whole subject. One recommendation was to the effect that: "In conjunction with the British and American Associations for the Advancement of Science, we wish to affirm our loyalty to the task of preserving truth, freedom of expression, and justice to the world. These are to-day subject to increasing attacks, which if successful will frustrate the future of Science and Humanity, which require that the labours of the Scientist must be utilised for the benefit and not the destruction of mankind."

Section A asked the Association to associate itself with a movement towards calendar reform.

The anthropologists asked the Association to urge the Australian Governments for funds to support the continuance of anthropological research now that the Rockefeller grants have been exhausted.

One of the most important recommendations adopted was a request from Section D, that all the Australian States should be warned of the importance

of establishing national reserves for the maintenance of the natural fauna and flora, and that these should be set up in more secluded areas and controlled and administered by experts. A request was also made for the beginning of a biological survey of Australia.

Excitement was lent to the proceedings of the Congress by two stimulating lectures given by Mr. H. G. Wells, who had been invited specially to Australia for the meeting. Mr. Wells was provocative, especially with his paper on "The Poison called History" which was delivered to the History Section; but attended by a great crowd, and much appreciated.

Other visitors specially invited from England were Sir John Flett, Sir John Russell, Prof. F. T. Brooks and Prof. N. V. Sidgwick. Prof. Brooks gave a lecture on "Epidemic Plant Diseases" and Prof. Sidgwick read a paper bearing the title "Multiple Links". Another visitor from England, Sir George Simpson, read a paper on "Electricity in Thunder Clouds" to Section A, and delivered a public lecture on "Ice Ages".

The Congress was an unqualified success, despite the terrific heat (109° in the shade one day), all records for Canberra being broken. W. J. DAKIN.

The Underground Water of London

AN excellent and serviceable memoir on "The Water Supply of the County of London from Underground Sources", prepared by Dr. Stevenson Buchan, has been issued by the Department of Scientific and Industrial Research (H.M. Stationery Office. 6s. 6d. net). It is primarily a supplementary development of the "Records of London Wells" by Messrs. Barrow and Wills, published by the Geological Survey in 1913, restricted in purview to the county boundaries and brought up to date by means of the later accumulation of information. Records of 1,080 wells are set out in detail, of which 565 make their appearance for the first time. More than one hundred of the records of strata are fully described, the remainder being in abstract form.

The memoir is commendably complete, for it gives a résumé of the history of London's water supply, with many interesting facts about the early and primitive sources from which it was drawn. So far back as 1236, water was brought to the City through conduits from wells and springs outside the populated area. Tyburn, Paddington, Hackney and Hampstead all contributed their quota during the period 1236-1549. In 1582, water was obtained from the Thames by a pump actuated by water wheels located at London Bridge. Then in 1613, the new river system was inaugurated, bringing supplies from springs in Hertfordshire, because at the beginning of the seventeenth century, the tributary streams through the town had become choked and partly buried, and few of the public wells remained. Towards the end of the eighteenth century, the first deep wells were sunk; but the movement did not make much headway for several years. Water companies were formed about the same period to draw supplies from the Thames and its tributaries, and to store it in reservoirs. These external surface sources now constitute the main feeder system.

As regards the wells, the early shallow borings were sunk to the sand and gravel terraces on the river banks. When, in course of time, these became polluted, deeper borings were made through the London Clay to the strata known as the Reading Beds and Thanet Sands, containing water either percolating from surface outcrops outside London or derived from the underlying chalk, which, acting as an enormous reservoir, to-day is the most important water-bearing bed under London. The water-level, however, is falling both in the sands (some supplies are actually exhausted in the northern area) and in

the chalk, whence water is being extracted more rapidly than the rate of replenishment by the extremely slow flow which is alone possible under existing subterranean conditions.

As examples, the memoir mentions the wells close to the National Gallery, which, at one time, supplied the fountains in Trafalgar Square, many of the public buildings in Whitehall, the old Millbank Prison and the Houses of Parliament. Between 1844 and 1911, the water-level had fallen 127 ft., and the wells were shortly afterwards abandoned. Another well, which used to feed the Serpentine and its fountains, the Palace Lake and the lake in St. James's Park, had its water-level lowered by 96 ft. in the space of forty-eight years and was also abandoned.

With the increase in pumping and the growing competition for supplies, the lowering of the water-level is becoming more and more pronounced. New wells in the district of chalk outcrop are tapping quantities of water which might otherwise travel towards the centre of London. Moreover, land drainage over the surface of the outcrop is now more efficient and the quantity of rainfall available for absorption correspondingly diminished, both from this cause and also from the increase in impermeable surface due to building and road making. Finally, the prolonged periods of drought in recent years have exercised their adverse influence in preventing the recovery of lost levels. With the depression in level, there has been manifested an increase in salt water pollution of many wells down river from Bermondsey.

Wells have been sunk below the chalk to the Old Red Sandstone, the deepest of which is a well at Stonebridge Park, with a depth of 2,225 ft. Unfortunately, after encountering traces of oil and gas from levels below 1,600 ft., the final yield was small and distinctly saline.

The following conclusions are drawn as to the future of supplies from the chalk-sand reservoir under the County of London. The fall in water-level is likely to continue and the annual rate of depression to increase. If a uniform, or slightly increased rate of fall be assumed, the water will reach the base of the Upper Chalk in many parts of London during the present generation, and, at this level, it is probable that a negligible amount of water will be obtainable from the wells. There is, moreover, little likelihood of a supplementary supply from the beds below the Chalk under London.

BRYSSON CUNNINGHAM.

Academy of Sciences of the U.S.S.R.

THE election of members and member-correspondents of the Academy of Sciences of the U.S.S.R. took place in Moscow on January 28-29 at a general session of the Academy. Altogether fifty-six new academicians and a hundred and two member-correspondents were elected, the following being a list of those of scientific interest.

DEPARTMENT OF TECHNICAL SCIENCES

Mechanics: Dr. N. I. Muskhelishvili, president of the Georgian Branch of the Academy of Sciences of the U.S.S.R., founder of a Soviet school in the theory of elasticity; Prof. N. E. Kochin (University of Moscow), a well-known authority on hydrodynamics; Prof. E. A. Chudakov (Bauman Mechanico-Machine Building Institute, Moscow), author of numerous works on automobile engineering.

Mining: Prof. L. D. Sheviakov; Prof. A. P. German, an expert on mining mechanics.

Technical Physics: Dr. N. D. Papalexi, an authority on theoretical and experimental radio-engineering; Dr. M. V. Shuleikin, an authority on radio-communications; Dr. V. P. Linnik, noted for his research in technical optics.

Energetics: Prof. M. V. Kirpichev (Molotov Institute of Energetics in Moscow), an authority on heat engineering; V. P. Nikitin, director of the Bauman Mechanico-Machine Building Institute of Moscow, an authority on electrical welding; Prof. V. S. Kulebakin (Zhukovsky Military Aviation Academy), known for his work on electro-technics.

Metallurgy: Dr. N. P. Chishevsky, noted for his researches in the technology of metallurgical fuel; Prof. N. T. Gudtsov (Leningrad Industrial Institute), noted for his work on special steels.

Transport (hitherto not represented in the Department): Dr. V. N. Obrastsov, an authority on the planning of railway stations and junctions; Dr. V. L. Poedunin, known for his work on theoretical and practical questions relating to shipbuilding.

The following member-correspondents were also elected: G. V. Akimov, P. F. Antipin, I. I. Artobolevsky, I. M. Bakhurin, N. M. Beliayev, A. A. Bochvar, I. S. Bruk, N. G. Bruyevich, A. B. Chernyshev, D. M. Chikhikov, S. A. Christianovich, Z. F. Chukhanov, N. M. Gerasimov, A. V. Gorinov, A. S. Ilyichev, M. A. Kapeliushnikov, M. M. Karnaukhov, V. I. Kovalenko, M. P. Kostenko, A. B. Lebedev, G. P. Peredery, A. S. Predvoditelev, L. N. Sretenaky, S. S. Steinberg, M. A. Velikanov, V. P. Vologdin, I. N. Voronovskiy, B. M. Vul and V. V. Zvonkov.

DEPARTMENT OF MATHEMATICAL AND NATURAL SCIENCES

Physico-Mathematical Sciences: Dr. S. L. Sobolev; Dr. A. N. Kolmogorov; Prof. V. A. Fok (University of Leningrad); Dr. P. L. Kapitza, director of the Institute of Physical Problems of the Academy of Sciences; G. A. Shain, astronomer at the Simeiz Observatory.

Chemistry: Prof. S. S. Nametkin (University of Moscow), author of a number of works on oils and synthetic aromatic substances; Dr. A. P. Orekhov, noted for his research in alkaloids; Prof. P. P. Shorin (Stalin Industrial Academy), noted for his work on the creation of artificial fibres; Dr. V. G. Khlopin,

director of the Radium Institute of the Academy of Sciences; Dr. A. N. Terenin, noted for his research in the complex processes of photographic chemistry.

Geology and Geography: Dr. M. A. Uslov, authority on the mineralogy of Western Siberia; Dr. P. I. Stepanov, authority on coal deposits of the U.S.S.R., particularly of the deposits in the Donets Basin; Dr. A. N. Zavaritsky, noted for his work on the ore deposits of the Urals; Dr. P. P. Shirshov, who took part in the North Polar Expedition on the drifting ice-floe of 1937-38; Dr. A. A. Grigorev, known for his work in physical geography.

Biology: Dr. T. D. Lyssenko, noted for his work on vernalization; Dr. N. V. Taitain, known for his work in obtaining a hardy perennial wheat by crossing winter wheat with couch grass; Dr. L. S. Stern (the only woman academician elected), and Dr. I. S. Beritashvili, both noted for their original work in physiology; Dr. E. N. Pavlovsky, director of the Tajikistan base of the Academy of Sciences, noted for his research in applied zoology; Dr. K. I. Skriabin, an outstanding authority on veterinary science.

Medicine (this is the first time that representatives of medicine have been elected to the Academy): Drs. N. N. Burdenko, A. I. Abrikosov, M. I. Auerbach, N. N. Anichkov and A. D. Speransky.

Dr. Y. M. Shokalaky, known for his work in geography, was elected an honorary member of the Academy.

The following member-correspondents were also elected:

Physico-Mathematical Sciences: A. I. Alikhanov, V. A. Ambartsumian, S. I. Beliaevsky, A. O. Gelfond, A. Y. Khinchin, A. A. Lebedev, M. A. Leontovich, L. S. Pontriagin, I. I. Privalov, D. V. Skobelstin.

Chemical Sciences: P. P. Budnikov, N. A. Izgarishv, A. F. Kapustinsky, I. A. Kazarnovsky, A. N. Nesmeyanov; N. I. Nikitin, V. M. Rodionov, S. Z. Roginsky, G. G. Urazov, S. I. Volkovich.

Geology-Geographical Sciences: N. N. Baransky, E. K. Fedorov, S. F. Fedorov, I. F. Grigoriev, F. N. Krasovskiy, P. I. Lebedev, F. P. Savarensky, S. S. Smirnov, A. N. Tikhonov, A. G. Vologdin.

Biology: E. A. Asratian, V. P. Bushinsky, V. A. Dogel, A. A. Grossheim, K. S. Koshtoyants, A. I. Oparin.

Medicine: N. F. Garmaleya, N. I. Grahenkov, P. A. Herzen, M. B. Krol, B. I. Lavrentiev, V. P. Osipov, N. N. Petrov, O. N. Podvysotskaya.

Early in February, reorganization of the Academy of Sciences was discussed in connexion with the election of the large number of new academicians and member-correspondents enumerated above, as well as the substantial changes that have taken place in the structure of the Academy itself. As against the previous three departments—Department of Technical Sciences, Department of Mathematical and Natural Sciences, Department of Social Sciences—eight departments are being formed, namely: Department of Physico-Mathematical Sciences, Department of Chemistry, Department of Geology and Geography, Department of Biology, Department of Technical Sciences, Department of History and Philosophy, Department of Economics and Law, Department of Languages and Literature.

Paris Academy of Sciences

Annual Prize Awards

AT the annual public meeting of the Paris Academy of Sciences held on December 19, M. Aimé Cotton, president, announced the following prize awards:

Mathematics. Poncelet Prize to Prof. S. Mandelbrojt, for the whole of his work on analytical functions. Francœur Prize to Prof. J. Dieudonné, for his work on the theory of functions.

Mechanics. Montyon Prize to Prof. L. Couffignal, for his work on mechanisms. Fourneyron Prize to V. Hégly, for researches in hydraulics. Henri de Parville Prize to Mme. M.-L. Dubreil-Jacotin, for her work on periodic waves. Henry Basin Foundation (5,000 francs) to M. Mennesson, for his work on the utilization of pneumatic currents for the measurement of lengths and thicknesses.

Astronomy. Lalande Prize to A. Lallemand, for his work on physical astronomy. Damoiseau Prize to H. Fabre, for his work on recurrent movements in celestial mechanics. Benjamin Valz Prize to P. Lacroute, for his work on physical astronomy. Janssen Medal to B. Lindblad, of Stockholm, for his work in theoretical and physical astronomy. La Caille Prize to P. Baize, for his work on visual double stars. Antoinette Janssen Foundation (5,000 francs annually for 1938-42) to V. Kourganoff, for his work on theoretical astronomy.

Geography. Delalande-Guerineau Prize to J. Soubrier, for the whole of his travels in the Sahara, French West Africa and Liberia, northern Albania, Kurdistan and Iraq. Gay Prize to A. Romer, for the organization and starting of the Geophysical Observatory of Martinique and for his observations on Mont Pelée. Tshihatchef Foundation to P. Carton, for his work on the meteorology of Indo-China. Binoux Prize to Capt. A. Nandillon, for the whole of his work on applications of acoustics to navigation.

Navigation. Plumey Prize to M. Serruys, for his work on internal combustion motors.

Physics. L. La Caze Prize to Prof. H. Ollivier, for his work on the relations of magnetism and magnetic rotatory polarization. François Hébert Prize to M. Halesinsky, for his work on atomicity and chemistry. Hughes Prize to P. Girard, for his work on the measurement of dielectric constants. Danton Foundation to P. Lambert, for his researches on radiation. Clément-Félix Foundation to R. Freymann, for his work on infra-red radiation. Général Ferrié Foundation to F. Bedeau, for his work on high-frequency waves.

Chemistry. Montyon Prize (Unhealthy Trades), a prize (2,500 francs) to the late R. Schmutz, for his work on hygiene and passive defence, in particular that which concerns the detection of gases; an honourable mention (1,500 francs) to G. Courtois, who has taken an active part in perfecting apparatus for protection against noxious gases. Jecker Prize to Prof. A. Wahl, for his work on colouring matters and, in particular, on the indigoids. L. La Caze Prize to Prof. P. Jolibois, for inorganic chemistry. Cahours Foundation to R. Guillemet, for his work on [biological] chemical analysis. Housseau Prize to M. Badoche, for his work on bodies of the rubrene family and for his measurements of heats of combustion of numerous nitrated derivatives. Oh. Adam

Girard Foundation to Prof. R. Quelet, for his work in organic chemistry.

Mineralogy and Geology. Fontannes Prize to L. and J. Morellet, for their paleontological studies of the tertiary areas of the Paris region. André-O. Bonnet Prize (paleontology) to J. Piveteau, for the whole of his paleontological work and notably for his memoir "Paléontologie de Madagascar, XXII. Un Amphibien du Trias inférieur. Essai sur l'origine et l'évolution des Amphibiens Anoures". James Hall Prize to J. Goguel, for a thesis entitled "Description tectonique de la bordure des Alpes, de la Bléone au Var".

Geophysics. Victor Raulin Prize to G. Grenet and J. Coulomb, for their work on electrically registering seismographs.

Botany. Desmazières Prize to J. Feldmann, for his researches in algology. Montagne Prize to R. Heim, for his researches on the Agaricimae. De Coincy Prize to Mlle. M.-T. Gertrude, for her work on the morphogenesis of *Veronica Anagallis*.

Rural Economy. Paul Marguerite de la Charlonie Prize to Prof. V. Ducomet and E. Foëx, for their researches on plant pathology and genetics during the past twenty years on the potato.

Anatomy and Zoology. Cuvier Prize to G. Seurat, for the whole of his zoological work. Savigny Foundation to C. Crossland, director of the Zoological Station of the Egyptian University at Ghardaqa, for his researches on the fauna of the Red Sea. Jean Thore Prize to T. Monod, for his work on Crustacea.

Anthropology. André-O. Bonnet Prize to Prof. E. Dubois (Amsterdam), for his discovery of *Pithecanthropus* in Java and his researches on the phylogenetic development of the brain.

Medicine and Surgery. Montyon Prizes (2,500 francs) to Prof. L. Binet and G. Weller, for their book "Le Glutathion"; Prof. A. Pettit, for his book "Sérothérapie antipoliomyélitique d'origine animale"; F. Trens, for the whole of his work on paludal serology. Honourable Mentions (1,500 francs) to Prof. M. Barthélemy, for his book "Les diagnostics chirurgicaux au lit du malade"; A. Bensaude, for his book "L'évolution cancéreuse des tumeurs bénignes du rectum. Son importance pour la prophylaxie du cancer du rectum"; Mlle. M. Ladet, for her book "Le syndrome malin au cours des toxi-infections". Barbier Prize to Prof. L. Courty and M. Ansel, for their work "Le traitement chirurgical du goitre exophtalmique et des goitres avec hyperthyroïdisme". Bréant Prize to P. Remlinger and J.-E. Bailly, for their work "Contribution à l'étude du virus de la maladie d'Anjesky". Godard Prize, no award. Mège Prize (1,000 francs) to A. Donatien and F. Lestoquard, for their work concerning animal rickets. Bellion Prize to Prof. P. Coulouma, for his work "La terminaison des nerfs pneumogastriques et ses variations. Étude d'anatomie descriptive comparée chez l'homme et dans la série des Vertébrés", and the whole of his anatomical work. Baron Larrey Prize to Colonel M. Liégeois, for his memoir relating to the general etiology of scarlatina, its modes of propagation, its prophylaxy and its therapy. Jean Dagnan-Bouveret Prize (5,000 francs) to Mme. A. Randoin (née L. Fandard), for the whole of her researches on the physiology of nutrition.

5,000 francs to X. Henry, for his method of diagnosing paludism called melano-flocculation; 4,000 francs to L. Delhoume, for his work "L'École de Dupuytren: Jean Cruveilhier et Claude Bernard: pensées".

Cancer and Tuberculosis. Roy-Vaucouloux Prize to V. Vilter, for his researches on the physiological mechanism of the variations of colour of amphibians and fish. Louise Darraq Prize, awarded for work in the fight against cancer, to A. Peyron and his co-laborators of the Institut Pasteur, for the whole of their work. Eugène et Amélie Dupuis Prize, not awarded.

Physiology. Montyon Prize to M. Fontaine, for the whole of his work. L. La Caze Prize to Prof. A. Mayer, for the whole of his work. Pourat Prize to M. Florkin, for his work "Physiologie comparée du milieu intérieur dans la série animale". Martin-Damourette Prize to R. Duffau, for his work "Avitamines et Métabolisme glucidique musculaire".

Statistics. Montyon Prize (1,000 francs) to H. Bunle, for the whole of his statistical work; and 1,000 francs to Prof. G. Ichok, for his work "La mortalité à Paris et dans le département de la Seine".

History and Philosophy of the Sciences. Binoux Prize: 2,000 francs to Prof. A. Seamat, for his works "Le système absolu classique et les mouvements réels" and "Les systèmes privilégiés de la physique relativiste"; 1,500 francs to J. Torlais, for his work "Réamur".

Works of Science. Henri de Parville Prize: 2,500 francs to A. Danjon and A. Couder, for their work "Lunettes et télescopes. Théorie. Conditions d'emploi. Description. Réglage"; 2,000 francs to M. Duportet, towards his work on the topobibliography of France, of which three volumes have appeared.

Medals. Berthelot Medals to the late R. Schmutz, M. Badoche, and R. Quelet.

General Prizes. State Prize (Grand Prize of the Mathematical Sciences) to Prof. J. Favard, for his work in algebra and geometry. Bordin Prize to H. Scholler, for his geological work in the Alps and his hydrogeological researches in Tunisia. Lallemand Prize to A. Fessard, for his researches on the rhythmic functions of the nerves. Serres Prize to Prof. R. Courrier, for his work on the genital function in mammals. Vaillant Prize to Prof. L. Bounoure, for his researches on the embryogeny of amphibians. Estrade-Deloros Prize to Prof. J. Jolly, for the whole of his histophysiological work. Houlléviague Prize to B. Lyot, for his work on the solar corona. Saintour Prize to A. de Cugnae, for his work on the Gramineae. Jules Mahyer Prize to R. Echevin, for his work on plant physiology. Lonchampt Prize to J. Levollay, for his work on the biochemistry of magnesium. Henry Wilde Prize to H. Huhubei, for his discovery of element 87, belonging to the series of alkali metals. Caméré Prize to Prof. L. Grelot, for his contribution to the progress attained in the construction of metal and reinforced concrete bridges. Gustave Roux Prize to Prof. H. Vigreux, for his work "Le soufflage du verre dans les laboratoires scientifiques et industriels". Thorlet Prize, not awarded. Albert I^{er} le Monaco Prize to Prof. A. Denjoy, for the whole of his mathematical work. Marquet Prize to Prof. R. Bricard, for his work in geometry. Général Muteau Prize to Prof. H. Abraham, for his work in electricity, principally for apparatus he has devised, some of which has been used in national defence, and for progress made in high precision measurements.

Priz des Grandes Ecoles. Laplace Prize to R. Joison. L.-E. Rivot Prize between R. Loison (750 francs), L. Boucheny (500 francs), A. Pages (750 francs) and P. Olos (500 francs).

GENERAL FUNDS FOR SCIENTIFIC RESEARCHES

Trémont Foundation to Mme. L. Nouvel, for her work "Contribution à l'étude de la mue, de la croissance et de la régénération chez les Crustacés Natantia".

Gegner Foundation to M. Aubert, for his researches on internal combustion motors.

Jérôme Ponti Foundation to Prof. J. Pères, for his work on the mechanics of fluids.

Hirn Foundation to Prof. H. Chrétien, for his researches on optical instruments.

Henri Becquerel Foundation to Prof. P. Delens, for his work on analysis and geometry.

Loutrouil Foundation (total grants, 117,500 francs).

Researches on set problems. 3,000 francs to Mlle. F. Bloch, for work on cutaneous tuberculosis; 2,000 francs to A. Brizard and R. Florio, for researches on dermatoses of the horse and of the dog; 7,500 francs to D. Chalonge, D. Barbier and A. Arnulf, for work at the international scientific station at the Jungfrauoch; 6,000 francs to Prof. L. Daniel, for work on the pedigree culture of the Jerusalem artichoke; 3,000 francs to Prof. R. Dubrissay, for studies of the action of sulphur on different metals, and notably silver; 5,000 francs to A. F. de Lapparent, for work on the Dinosaurs of the south of France; 2,000 francs to Prof. A. Métrol, for work on the improvement of output of heat engines by the transformation into reactive energy of the potential and kinetic energy of the exhaust gases; 5,000 francs to Prof. M. Pierre, for researches on the regulatory mechanism of calcæmia and of phosphatæmia in the domestic animals.

Researches to be carried out in France Overseas. 8,000 francs to A. Lasserre, for work on terrestrial magnetism in Algeria and the Algerian Far South.

Purchase of laboratory material. 4,000 francs to Prof. F. Diéart, for apparatus for utilising geophysical methods for the study of subterranean currents; 5,000 francs to Prof. P. Fleury, for a Moll double thermo-converter, for the study of the photometry of incandescent lamps fed with alternating current; 3,000 francs to Prof. P. Frémy, for a photomicrographic apparatus; 3,000 francs to Prof. P. Lamare, for a precision balance; 2,000 francs to Prof. J. Lefèvre, for microphotography material; 10,000 francs to Prof. E. Marchoux, as a contribution towards a Feussner spectrograph installed at the Pasteur Institute; 9,000 francs to P. Teilhard de Chardin, as a contribution towards the equipment of his laboratory for advanced studies in human paleontology.

Libraries. 7,000 francs to the National Veterinary School of Alfort, for the purchase of periodicals; 7,000 francs to the National Veterinary School of Lyons, for the purchase of books and foreign periodicals; 2,000 francs to the National Veterinary School of Toulouse, for the purchase of books and scientific publications; 2,000 francs to the National Agronomic Institute, for the acquisition of foreign periodicals.

Publications. 8,000 francs to the Comité de physique du globe des colonies, as a contribution to the publication of the *Annales de physique du Globe de la France d'Outre-Mer*; 3,000 francs to P. Chabanaud, for the publication and illustration of works on the morphology of non-symmetric teleosts; 3,000 francs to G. Guilbert, for printing a work entitled "L'Orage, sa genèse, ses mystères, sa prévision"; 8,000 francs to Prof. P. Lemoine, to assist in the publication of a geological study of Mauritius.

Mme. Victor Noury Foundation (four prizes of 2,500 francs each): A. Lenoble, for his researches on

the chronological succession of the volcanic eruptions of central Madagascar, the age of the *coulées* of the east side and his discovery of organic remains in the Cristallophyllian of the island; Prof. A. Luquet, for his biogeographical work and particularly for that concerning the Central Massif; E. Thallier, for his work on the magnetisation of clays and of burnt earthenware, with application to the study of the evolution of the terrestrial magnetic field; P. Vintemberger, for his researches in experimental embryology.

Millet-Ronssein Foundation: 4,000 francs to A. Balachowsky, for his work on agricultural entomology, and in particular for his book "*Les Insectes nuisibles aux Plantes cultivées*", published in collaboration with L. Mesnil; 3,000 francs to Prof. A. Carpentier, for his paleobotanical work, and particularly for that concerning the oil earthenware of the north of France and of the Central Massif, the Permian, the Jurassic and the Cretaceous of France, Morocco and Madagascar; 3,000 francs to Prof. H. Chermeson, for his work on the Cyperaceae and the flora of Madagascar.

Villemot Foundation: 12,000 francs to L. Blaringhem, for the installation at the Gaston Allard Arboretum, at Angers, of an exact electrically heated bed; 14,000 francs to Mlle. G. Cousin, for the purchases of stoves; 10,000 francs to G. Deflandre, for the purchase of microscope objectives; 12,500 francs to Prof. L. Dumoyer, for the purchase of a Ribaud optical micropycrometer; 5,500 francs to E. Esclançon, for the construction of a double clock with two dials, indicating simultaneously, with very high precision, mean solar time and mean sidereal time; 15,000 francs to Prof. H. Guillon, for perfecting an apparatus for the measurement of high temperatures of gases by the method of aspiration pyrometry; 10,000 francs to C. Harnist, for his projected researches on the manufacture of sulphuric acid from gypsum; 10,000 francs to the Institut Marey, for researches on the ultra-rapid cinematography and ocellographic recording of the nerve influx; 25,000 francs to P. Lejay, director of the Observatory of Zi-Ka-Wei, for his researches on the application of the inverted electrical pendulum to the precise determination of the inclination of the axes of astronomical instruments; 10,000 francs to Prof. M. Machébeuf, for his researches on the chemical phenomena of immunity; 15,000 francs to R. Martin, for perfecting thermochemical material intended for the determination of the quantity of energy resulting from the chief combustions and reactions utilized in industry; 8,000 francs to A. Peyron, for his experimental and comparative studies of the pathology of tumours; 20,000 francs to A. Savornin, for the purchase of an inclination needle for absolute magnetic measurements; 12,000 francs to H. Vincent, for the purchase of reactive experimental animals for his researches on the pathogeny of certain infectious maladies and the conditions of immunity; 10,000 francs to R. Wurmsier, for the purchase of experimental animals.

Charles Frémont Foundation to C. Berthelot, for his works "*Technique et Économie nouvelles des carburants de synthèse*" and "*Épuration, séchage, agglomération et broyage du charbon*".

SPECIAL FOUNDATIONS

Lannelongue Foundation to Mme. G. Cusco; Girbal-Baral Foundation (10,000 francs each) to F. Marty and F. Roger; D'Aumale Prizes (5,000 francs each) to the widow of C. Gravier and the daughter of the late C. Flahault.

Science News a Century Ago

Samuel Cunard and Robert Napier

THE long connexion of Robert Napier with the Cunard Steamship Company, for which he built eighteen trans-Atlantic steamships, began with two letters, one written by Samuel Cunard on February 25, 1839, and the other, Napier's reply written three days later. Writing from Piccadilly to his Glasgow agents Cunard said, "I shall require one or two steamboats of 300 horse power and about 800 tons. I am told that Messrs. Wood and Napier are highly respectable builders and likely to be enabled to fulfil any engagement that may enter into." In his reply to Cunard's agents, Napier said, referring to the price, "I have done them as low as £35 per ton of total measurement of the vessel, and I have got above £50 per ton for some others. I may, however, state that good vessels, warranted to stand any inspection and give entire satisfaction both as to the vessel and machinery, cannot be done for less than from £40 to £42 per ton—this for the vessel ready for sea, with cabins, sails, rigging, anchors, cables, etc. . . ."

After further negotiations a contract was arranged for the construction of the four vessels, *Acadia*, *Britannia*, *Caledonia* and *Columbia*. The *Britannia*, 1,150 tons, 420 horse-power, was the first finished, and she sailed on her maiden voyage from Liverpool to Boston, July 4, 1840.

University College, London

THE annual meeting of the proprietors of University College was held on February 27, 1839. The chief topic handled in the report of the Council, said the *Athenaeum* of March 2, was the regulations of the University dealing with the degree in arts. From the report it added, "we learn that the Exhibitions offered by the Government as a reward for proficiency in passing the matriculation examination have been divided between students of University College and King's College." Among the novelties announced were the class for schoolmasters, the class for civil engineers and the school for practical chemistry; the erection of a spacious building for the practice of anatomy, and the fitting up of a large room as a library for medical students. In 1837-38 there were 497 students in medicine, 142 in arts and 387 boys in the Junior School.

Prof. W. T. Brande as a Lecturer

ON March 1, 1839, Faraday's colleague at the Royal Institution, Prof. William Thomas Brande (1788-1866), gave a lecture on steel, a report of which appeared in the *Mechanics' Magazine* of March 16, 1839. The report concluded with saying, "No one will question the great ability of Mr. Brande as a lecturer, but we could almost indulge the wicked wish of being able to tamper with, and manœuvre a little, the progress of the clock in order to see the good effect for once of surprising him out of the extreme deliberateness of his delivery. . . . Unfortunately, also he does not think it necessary to raise his voice higher than in common conversation, but though his enunciation is so beautifully distinct, that with listening attention, he may be heard in most parts of the theatre, yet the continued effect to give such attention, especially at this time of the year, when everybody thinks it his duty to cough, soon becomes very fatiguing, and at last so painful as quite to mar the pleasure of hearing him lecture."

Societies and Academies

Edinburgh

Royal Society of Edinburgh, February 6.

P. A. M. DIRAC: The relation between mathematics and physics (Address). In setting up a theory of natural phenomena, one strives in the first place for simplicity; but it seems that mathematical beauty is really a more important quality than simplicity. It is difficult to put any limitation on the extent to which mathematics applies to the description of the universe, and one is led to think that it must apply to everything. In such a complete scheme one could scarcely expect simplicity, but one may well have beauty. The discussion of these questions is much influenced by modern advances in quantum mechanics and in cosmological theory.

R. A. ROBB and T. R. TANNAHILL: Lunar atmospheric pressure variations at Glasgow. The Glasgow barograph records of 1868-1912 have been examined for the determination of the lunar atmospheric tide at Glasgow. It is found that on barometrically quiet days there exists a local lunar variation, mainly diurnal in character, not predicted by theory. The diurnal component appears to increase progressively with quietness of day. Removal of this variation results in a probable value of the normal lunar tide of:

$$0.0110 \sin (2\theta + 60^\circ) \text{ millibar,}$$

θ being reckoned from upper lunar transit.

Paris

Academy of Sciences (C.R., 208, 237-312, Jan. 23, 1939).*

L. DOMANGE: Stability of manganic sulphate in aqueous solutions of sulphuric acid.

MILLES, M. MONTAGNE and Y. ISAMBERT: Action of ethylmagnesium bromide on butyric ethylanilide.

P. GRAMMATICAKIS: Secondary reactions observed in the course of the condensation of organo-magnesium compounds with phenylhydrazones.

L. PALFRAY, S. SABETAY and A. HALASE: Preparation of some alkoxy- and arylalkoxyethanols and higher homologues.

E. A. DE LA RÛN: Contribution to the mineralogical study of the coast of French Somaliland.

A. MICHEL-LÉVY and J. WYART: Synthesis of ortho- and of albite by pneumatolysis with the aid of explosives.

E. DESGUIN and A. DAUVILLIER: Origin of life.

P. DANGHARD: The alga *Vaucheria* observed in the region of the south-west [of France], and a new species of this genus.

G. LAISNÉ: Variations of the osmotic pressure of tissue sugar of *Fraxinus excelsior* L. and of some other plants in the course of artificial haymaking.

J. LÉVYRE: Similarity of the cytological effects exerted by phenylurethane and colchicine on plants.

J. COMANDON and P. DE FONBRUNE: Preparation and mode of action of traps of predatory fungi for nematodes; investigations by the aid of micro-manipulation and cinematography.

R. GIRARD: A case of evolution of *Hypoderma botis* De Geer on the horse.

M. PIETTRE: Conditions of preparation, at low temperatures, of crystalline oxyhaemoglobin.

G. MOURIQUAND: Resistance to avitaminosis.

(*Continued from p. 307)

Cracow

Polish Academy of Sciences and Letters (C.R., *Classica Sci. Math. et Nat.*, Jan. 9, 1938).

W. FRIEDBERG: Attempt at a stratigraphy of the Miocene of Poland, based on the molluscan fauna (2).

F. ROGOWSKI: (1) Chlorophyll and the carotinoids of some marine algae (from the Gulf of Naples). Carotinoids are present in relatively large quantities in brown and green algae, but in small quantities in red algae. Chlorophyll is low in brown and red algae, while in certain green algae the quantity is greater than in many land plants. (2) Chlorophyll in the digestion of larvae of certain Lepidoptera. Gravimetric estimation of the chlorophyll in the excrement of certain Lepidoptera shows that it is present in considerable quantity and unaltered in form.

W. SWIENTY: Blood vessels in the ventral fins of certain teleosts.

A. KOZŁOWSKI: Researches on the summer eggs of aphids. Synchronous and heterochronous segmentation are found in these parthenogenetic eggs up to the sixth division. During the seventh division and later, synchronous division of all the cells was never observed.

Dublin

Royal Irish Academy

R. LLOYD PRAeger: A further contribution to the flora of Ireland. This is an epitome of recent advances in our knowledge of the flora of Ireland, so far as the higher plants are concerned, and forms a supplement to the census of the Irish flora which was given in "The Botanist in Ireland" published in 1934.

Tokyo

Imperial Academy (Proc., 14, No. 10, 359-397; 1938).

KOSAKU YOSIDA, YUKIO MIMURA and SHIZUO KAKUTANI: Integral operator with bounded kernel.

KOSAKU YOSIDA: Operator-theoretical treatment of Markoff's process.

MASAO INOUE: Process of constructing the solution to Dirichlet's problem.

KIISIN SUEUKI, MASAAKI HIRUHATA and GORÔ KUBOIIWA: Photographic observations of new variables and some known variables in Cygni. With the 10-cm. triplet camera attached to the 20-cm. refractor at the Tokyo Science Museum, 125 photographs were taken around α and η Cygni.

KOJI HIDAKA: (1) Horizontal oscillations of bay water induced by tidal currents. (2) Free oscillation of water in an oval basin.

SHÔSHIRÔ HANEKAWA: Studies on the foraminiferal fauna found in the bore cores from the deep well in Kita-Daitô-Zima (North Borodino Island). The following characteristics were examined: (a) lithological character of the bore cores; (b) organic contents and the state of preservation of fossils; (c) distribution of the foraminiferal fauna in the bore core and their stratigraphical ranges; geological ages of the bore cores.

TORANOSUKE SUGIURA: A list of chromosome numbers in angiospermous plants. (5). Species from eighteen families are given.

TOKI-O YAMAMOTO: Distribution of temperature constants in *Oryzias latipes*.

SEIGO FUNAKO and NORITOKI SAITO: Study of lymph.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Monday, February 27

UNIVERSITY COLLEGE, LONDON, at 5.—Dr. L. Young: "Animal Detoxication Mechanism" (succeeding lectures on March 6 and 13).*

Tuesday, February 28

UNIVERSITY COLLEGE, LONDON, at 5.15.—Dr. W. E. Swinton: "The Use of Museums. (4) Natural History in Museums".*

CHADWICK PUBLIC LECTURE (at the Royal Society of Tropical Medicine and Hygiene), at 5.30.—Prof. Major Greenwood, F.R.S.: "Occupational and Economic Factors of Mortality".*

GRISHAM COLLEGE, at 6.—A. R. Hinks, F.R.S.: "Different Kinds of Nebulae" (Gresham Lectures on Astronomy. Succeeding lectures on March 1, 2 and 3).*

ROYAL PHOTOGRAPHIC SOCIETY (SCIENTIFIC AND TECHNICAL GROUP), at 7.—Annual General Meeting.

Wednesday, March 1

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section). Symposium of papers on "Direction Finders" presented by Dr. R. L. Smith-Rose.

Thursday, March 2

CHEMICAL SOCIETY (at the Imperial College of Science and Technology), at 5.30.—Symposium on "Micro-technique in Organic Chemistry" to be opened by Prof. I. M. Heilbron, F.R.S.

Friday, March 3

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at the Institute of Chemistry, 30 Russell Square, W.C.1), at 5.—Annual General Meeting.

Sir Henry Dale, F.R.S.: "Biological Standardization".

UNIVERSITY COLLEGE, LONDON, at 5.15.—K. de B. Codrington: "The Use of Museums. (5) Museums, Past and Future".*

GEOLOGISTS' ASSOCIATION (at University College, London), at 7.30.—Annual General Meeting.

Prof. H. L. Hawkins, F.R.S.: "A Short History of Sea-Urchins".

ROYAL INSTITUTION, at 9.—Sir William Bragg, O.M., F.R.S.: "Liquid Films".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

CHEMIST at the Royal Gunpowder Factory, Waltham Abbey—The Principal Clerk, Royal Gunpowder and Small Arms Factories, Hatfield Lock, Middlesex (March 3).

TEACHER OF TELECOMMUNICATIONS AND PHYSICS in Woolwich Polytechnic, London, S.E.18—The Secretary (March 3).

HEAD OF THE DEPARTMENT OF CHEMISTRY in Bradford Technical College—The Director of Education, Town Hall, Bradford (March 4).

ASSISTANT NATURALIST in the Millport Marine Laboratory—The Secretary, Scottish Marine Biological Association, 185 St. Vincent Street, Glasgow, G.2 (March 6).

JUNIOR SCIENTIFIC OFFICER in the External Ballistics Department of the Ordnance Board, Royal Arsenal, Woolwich, London, S.E.18—The Secretary (March 8).

SCIENTIFIC OFFICER (physics or engineering) in the Air Ministry Scientific Research Pool—The Under-Secretary of State, Air Ministry (S.E.D.), Berkeley Square House, London, W.1 (March 11).

PROFESSOR OF MATHEMATICS in the University of Durham (Durham Division)—The Registrar (March 16).

EXAMINERS in various science subjects for the Matriculation and General School Examination of the University of London—The Secretary to the Matriculation and School Examinations Council, University of London, W.C.1 (March 17).

ASSISTANT CIVIL ENGINEER in the Civil Engineer-in-Chief's Department of the Admiralty—The Civil Engineer-in-Chief, Admiralty, S.W.1.

ASSISTANT INSTRUCTOR in ENGINEERING in a new trade school in Hong Kong—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (2/78306).

RESEARCH OFFICER to the Tyneside Council of Social Service—The Director, 17 Ellison Place, Newcastle-upon-Tyne.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Imperial Institute. Annual Report, 1938. By the Director, Sir Harry Lindsay, to the Board of Governors. Pp. 79. (London: Imperial Institute.) [80]

University of Leeds: The Brotherton Collection. The Third Annual Report of the Brotherton Collection Committee. Pp. 4. (Leeds: The University.) [80]

Scientific Proceedings of the Royal Dublin Society. Vol. 23 (N.S.), No. 6: The Constitution of Lamination; Isolation of 2:4:6-Trimethylquopyranose. By Vincent C. Barry. Pp. 59-68. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [80]

A Road Policy for the Lake District. Pp. 35+4 plates. (Ambleside: Friends of the Lake District.) [80]

Lord Hailey's African Survey. Surveyed for the Royal African Society by the Rt. Hon. Lord Hailey and a distinguished body of collaborators. Edited for the Society by F. H. Melland, and published as a Supplement to the Society's Journal for January. Pp. vii+70. (London: Macmillan and Co., Ltd.) 2s. net. [80]

University of Leeds: Department of Coal Gas and Fuel Industries, with Metallurgy. Report of the Livestock Professor (John W. Cobb) for the Session 1937-8. Pp. 12. (Leeds: The University.) [80]

Report of the First Imperial Veterinary Conference, 15th-18th August 1938. Pp. 97. (Weybridge: Imperial Bureau of Animal Health.) 5s. [81]

Stonyhurst College Observatory. Results of Geophysical and Solar Observations, 1937; with Report and Notes of the Director, Rev. J. P. Howland. Pp. xviii+40. (Blackburn: Stonyhurst College.) [12]

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The Spens Report and Technical Education

WHEN the report of the Board of Education's Consultative Committee on the Education of the Adolescent (afterwards known as the Hadow Report) was noticed in these columns (NATURE, Feb. 5, 1927), we recorded our regret that the position and importance of the junior technical school had not received adequate treatment. No such charge can be made against the Committee's recent report, now already widely known as the Spens report (see also NATURE of January 21, p. 103, and February 18, p. 259, and p. 363 of this issue).

An outstanding recommendation is that there be established a new type of higher school of technical character quite distinct from the traditional academic grammar school, and as a first step towards that end "a number of existing junior technical schools oriented towards the engineering and building industries and any other technical schools which may develop training of such a character as (a) to provide a good intellectual discipline altogether apart from its technical value, and (b) to have a technical value in relation not to one particular occupation but to a group of occupations should be converted into technical high schools".

It is the intention of the Committee that these schools shall be accorded, in every respect, equality of status with schools of the grammar school type. Clearly, if that intention is to be carried out, there must be equality in respect of the age of entry. Hitherto the age of entry into the junior technical school has been thirteen plus. That has meant that, since the secondary (grammar) schools recruited at the age of eleven, they have had the opportunity of taking the cream of the pupils before the junior technical school could have its chance of selection. If the Committee's

recommendation be accepted, that grievance will be removed, for it has agreed "that pupils should be recruited for technical high schools at the age of 11 plus by means of the general selective examination by which pupils are at present recruited for the grammar schools".

That does not mean, however, that at the age of eleven years the curriculum will be what is called 'vocational'. Nor does it mean that, at any time during the course, it will be 'vocational' in its narrowest sense. Indeed, the Committee has been careful to guard in advance against the charge that its views may involve "the danger of premature specialization of a vocational character". It is pointed out, and in our view rightly, that much of the fear of vocationalism has arisen through misunderstanding and failure to define the term and to face the facts of educational development. The Committee underlines a point which had been made more than once in these columns : that, "in any subject worthy of inclusion in a school curriculum, it should be possible to lead the pupil to look beyond the immediate processes in which he is engaged to a wider human and social background"; and if that be not the path towards a really liberal and humane education, we confess that our own views stand in need of considerable revision. With that, and all its implications in mind, the Committee has recommended that the curriculum for pupils between the ages of eleven plus and thirteen plus in technical high schools should be broadly of the same character as the curriculum in other types of secondary schools of equal status. For pupils above the age of thirteen years the curriculum "should be designed so as to provide a liberal education with science and its applications as the core and inspiration".

Let there be no mistake : in making these recommendations the Committee has in mind certain junior technical schools and those alone. There are, under the general heading of schools providing technical education, trade schools, junior commercial schools, junior art departments and home training schools for girls. But, for reasons which the Committee examines with some care, and with which there will be a large measure of agreement, it is not prepared to say that such schools shall become technical high schools.

It may be, of course, that, just as some pupils after two years in a grammar school may be recognized as those who would gain the greatest educational benefit in a technical high school, there will be pupils of the latter who will be recognized as those who will profit most from the education of the grammar school. No system of education can be allowed to develop rigidity without diminution of its full possibilities. We are glad, therefore, to note that the Committee has recommended that there should be close relations between grammar schools and technical high schools, "so that the opportunity of transfer at about the age of 13 should exist for those pupils whose later development would be better suited by an alternative form of education".

Equality of status is further emphasized by a suggestion that the fees for technical high schools should be the same as those in grammar schools in the same administrative area. While fees exist, we believe that is a wise suggestion. We need not here go into the reasons for that belief. It is sufficient to say that there are still people who believe (and they are not altogether to be blamed) that the cost of an article is the truest indication of its value.

Hitherto, the junior technical school has perhaps owed a much larger measure of its success than is usually realized to its freedom from examinations. But, if equality is to be ensured, the present value placed by some upon the School Leaving Certificate is not to be neglected. In connexion with that certificate the Committee has expressed itself in terms discussed in *NATURE* of February 18. While, however, the Committee recommends that technical high schools should have some kind of school leaving certificate which will have general currency and bring before parents, employers and the public generally the fact that these schools are of equal status with the grammar schools, it guards, and very wisely in our view, against the imposition of a rigid external examination. Accordingly it

suggests an examination similar to the national certificate examinations, which have worked so well in senior technical colleges and which permit of internal examination with external assessment.

No one would deny that, if the fullest benefit is to be derived from the new technical high schools, their value should be made clear to all. "We find," says the report, "that there is much ignorance and misunderstanding of the aims, scope and work of the technical schools." The modern way of treating a defect of that kind is the way of publicity. The Committee does not shrink from that. "We think that education authorities might be well advised to give greater publicity to the aims and character of their technical schools, both to industry and to the general public. We have already indicated one or two reasons why the general public should know and appreciate more the work of these technical schools ; but there is at least one excellent reason for directing towards them the keener attention of industry."

That reason involves the question of apprenticeship, and we agree with the Committee that this should receive the immediate and earnest consideration of industry. The conditions of apprenticeship should be re-examined if only because there appears to be no uniformity of practice. Some firms will not accept a boy after the age of sixteen years. Some will do so, but insist that his apprenticeship should not end until five years after the date of his entry. Others will accept after sixteen years of age and will remit a period equivalent to that between the date of his sixteenth birthday and the date of his acceptance into industry. Others, still, will remit one year of apprenticeship to a boy who has satisfactorily completed a three-year course at an approved technical school. That, surely, is a position which needs alteration, and we feel with the Committee that it should be considered by employers' associations and by trade unions in order that a definite pronouncement of policy should be made. We do not think the Committee exaggerates when it says "a wise industrialist will be prepared and even eager to take as apprentices boys who have completed a technical school course at the age of 16 plus and should at least grant remission of that period between the sixteenth birthday and the date of actual commencement of apprenticeship, so that in all cases the apprenticeship would be completed on the twenty-first birthday."

It will be observed that, throughout what we have said, there have been no recommendations

affecting the senior technical colleges. That is to be expected, because the senior colleges did not come within the Committee's terms of reference. It may be noted here that the new technical high schools will, where possible, be housed in, and be departments of, technical colleges. The head master of the school will be the head of that department. Even where the school cannot be housed in the college, it is recommended that "its buildings should be linked with buildings of the college in order to facilitate participation in equipment and staff". The school, however, should have its own sub-committee of governors to whom the head master should have direct access.

We welcome the Committee's suggestion of the new technical high school not only because it is needed as part of a unified system of secondary

education, but also because it recognizes the liberal quality inherent in technical education, and, in doing so, it faces what it has itself called the facts of educational development. It recognizes the efforts which are being made to evolve a new type of secondary school "providing a liberal education, based on a more realistic and scientific curriculum than that of a grammar school", and in doing so it underlines a point which we have made more than once in these columns: that culture is not necessarily an unchanging quality, but something which may change with the progress of mankind. Perhaps, then, it is not too great an exaggeration to say that, behind the apparently sombre and shapeless civilization which we are making, there lies the possibility of a nobler culture than has yet been known.

Some Seventeenth Century Astronomers

Hevelius, Flamsteed and Halley :

Three Contemporary Astronomers and their Mutual Relations. By Eugene Fairfield MacPike. Pp. ix+140+4 plates. (London: Taylor and Francis, Ltd., 1937.) 12s. 6d. net.

IN this book the editor of the "Correspondence and Papers of Edmond Halley" has brought together brief, straightforward lives of the three great astronomers named in the title; a separate consideration of their commerce together and mutual relations; and, in appendices, several documents and letters concerning them, chiefly Hevelius. Where the pieces are in Latin a translation has in some, but not in all, cases been furnished by the pen of Mr. A. H. White.

This method of assembling the information set before the reader is not without its disadvantages, for it is bound to lead to either gaps or repetitions. Thus, in the life of Halley, only passing reference is made to the extremely important visit to Hevelius, when Halley tested telescopic sights against the open sights always used by the Danzig astronomer. This matter is dealt with at length in the joint consideration of the three astronomers, while the matter of the piracy, or call it what you will, of Flamsteed's observations is considered, with considerable repetition, in both the separate and the joint life. The book is, perhaps, rather a collection of valuable notes than balanced biography.

In his preface, the author refers to a manuscript autobiography of Flamsteed, preserved at

Greenwich, which he has used. This may account for the uneven style of the life, which is a mixture of the modern idiom and typical seventeenth century phrases, taken, we hazard, unchanged from the source, such as, for example, the following: "... lent him Sacrobosco's *Spheres*, in Latin, a work which, being perfectly suited to the natural turn of his genius, he perused with uncommon satisfaction", and elsewhere we find "dioptrics" and "Sir Clowdisley Shovell" used in the ordinary text. The life of Halley is much fuller than the others, in accord with the author's special interest. The quarrel between Flamsteed and Halley is discussed at some length, and put down to Flamsteed's jealousy, as in a sense it may have been, but Flamsteed was a man who had suffered many genuine wrongs, who had spent his scanty private means and all his energies freely in the service of astronomy and who had "endured long and painful distempers". Perhaps he was jealous of the genial, social, worldly and successful Halley, who must certainly have been a very much more entertaining companion, but it is a jealousy that may excite our pity rather than our scorn.

The book is of great interest to those concerned not only with the astronomers themselves but also with Hooke, for it was Hooke who in his "Animadversions on the first part of the *Machina Coelestis*" first insisted on the advantages of telescopic sights over open sights, and clearly explained the nature of optical resolution. The tests which Halley carried out at Danzig with telescopic sights and with the instruments of Hevelius frequently come

up for mention, and they are described at some length, with quotations from Halley's letter, in the part which deals with the mutual relations of the astronomers. Halley was surprised at the agreement which Hevelius could obtain with two different instruments, and implies that angles could be accurately measured to within five seconds with open sights, which seems astounding. He left a testimonial letter with Hevelius which exists in Olhoff's scarce collection, but is, unfortunately, not reprinted here. We could wish that these tests, and the whole question of the accuracy obtainable with the best open-sight instruments, might be discussed in more detail by a practical observer. That Halley could not do better with his telescopic sextant may have been due to a mechanical, as against an optical, inferiority of his instrument.

Halley himself, in spite of his favourable opinion of the observations of Hevelius, soon rallied, with the rest of the learned world, to Hooke's opinion, for while the Danzig visit took place in 1679, we find him writing to William Molyneux in 1686, "The controversy between Mr. Hevelius and Mr. Hook, as you very well observe does, as Hevelius manages the matter, affect all those observers that use Telescope sights, and myself in particular, and

it is our common concern to vindicate the truth from the aspersions of an old peevish gentleman, who would not have it believed that it is possible to do better than he has done". This kind of change of tone must be taken into account in considering Flamsteed's estimate of the character of Halley. Flamsteed, writing at about the same time, with the same views, does himself credit with the following generous sentiment: "Nor doe I find myselfe so far concerned in his writings as that I can thinke myselfe obliged to stand up in their defence at this time, hee [Hevelius] is very old, has obliged the World much by his labors, has taken a vast deal of paines and been at great cost to publish them, hee has suffered much of late and it would look like a piece of Inhumanity to vex him with an examination of his workes, under these circumstances".

Mr. MacPike's book is beautified with some excellent portraits, including one of Elisabeth Hevelius, surely the first recorded woman astronomer, the forerunner of Caroline Herschel and so many other illustrious ladies. It has an excellent index of names, and deserves a place on the shelves of students of the seventeenth century.

E. N. DA C. A.

Wild Flowers of Attica

Wild Flowers of Attica

By the late Shirley Clifford Atchley. Prepared for publication by Dr. W. B. Turrill. Pp. xix+60+22 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1938.) 25s. net.

MR. SHIRLEY ATCHLEY, long a member of the British Legation at Athens, was a man who published nothing, but enjoyed a scholar's reputation among men of learning. For he knew the paths and the by-paths, the beaten and unbeaten tracks of Greece as no one else did and probably no other man had ever done; and his knowledge was so great as to become almost legendary of the language and its dialects, the folklore and not least the field-botany, both of the mainland and of the islands. He dreamed of the books he should write some day; he even planned one on the vernacular names of the Greek plants, but nothing came of it. But he kept on sending plants, rare and common, to Kew until he built up a great herbarium, and the more his reputation grew the more kindly and good-humouredly did he answer the countless questions which men were wont to ask him.

The pretty book before us, based on his own

scanty notes and subscribed for as a keepsake by his friends, will so far serve its purpose, and keep in remembrance a learned, lovable and sweet-natured man. It is enriched and beautified by coloured drawings of some seventy or eighty flowering plants, the work of the author's friend and doubtless kindred spirit, Mr. W. O. Everett of Athens. There has been little or no selection here, for many of the plants figured are common familiar things; we feel even a little surprised to see *Cheiranthus Cheiri*, *Smilax aspera*, *Marrubium vulgare* and *Vinca major*, all faithfully portrayed. But after all, the book itself is no catalogue of rarities, and these common things do help somehow among the rest to suggest or recall the flower-carpet of Hellenic spring. The drawings are interesting in another way; for they look like the work of some old sixteenth-century herbalist, Brunfels perhaps, who knew little and cared nothing about the structure of the flower or even the precise outline of a leaf, but just gathered his plant, flowering or seeding, withered or green, and drew it exactly as it came. The mandrake on the frontispiece is a perfect drawing of its kind, and startlingly like this famous plant as one meets it growing by the wayside.

Beautiful as the book is, it saddens one to think how little is saved, how much is lost, of all the author's learning. There is little or nothing new or even strange to botanists and scholars in all these brief and sketchy annotations: even the vernacular names are few, and look odd in plain typography. Save only that a few are noted as Cretan names, there is nothing to show for what Atchley could alone have given us and what we should have so gratefully received, an account of the local plant names in provincial and insular Greece. The ancient name of 'mandragóras' still survives, says Atchley; but I should like to know whether he had ever heard it called γοργόκτυ as Unger found it many years ago. Of the forty or more Greek verbascums, only one is figured; we are merely told that "in various parts of Greece

species of *Verbascum* are used as fish-poisons", and, like some other poisonous plants, are called "phlómos": nothing more! Now Aristotle talks of the plant φλόμος as a fish-poison, and Aelian tells how it will rid our ponds of frogs; and Sibthorpe found one of the spurges so used and so called in his time; and Robert Walpole found it used by Albanian settlers at Salamis; and Heldreich found mullein and spurge and daphne and dog-mercury all called by the same name, and perhaps all used in the same way. We may take it for sure and certain that Shirley Atchley, and he alone, could have told us, precisely and adequately, the whole story, what species are used of this genus or of that, and where, and how—but now the rest is silence.

D'ARCY W. THOMPSON.

An Italian Psychologist

La psychologie expérimentale en Italie (École de Milan)

Par Dr. A. Manoil. (Bibliothèque de philosophie contemporaine.) Pp. viii+490+16 plates. (Paris: Félix Alcan, 1938.) 80 francs.

THIS book might well have been entitled "The Work of Agustino Gemelli", founder of the Catholic University of Milan and director of its Department of Psychology. As the following sketch of his life indicates, Prof. Gemelli is a remarkable man; in Dr. Manoil he has found a devoted and competent Boswell. After obtaining his doctorate at Pavia both in medicine and in science, he served for five years from 1898 as assistant to the histologist Golgi, carrying out research during this period on the hypophysis of the brain. But in 1903 he turned aside to theological studies and for four years led the life of a Franciscan monk. Then he resumed his scientific work, visiting between 1907 and 1911 the biological and neurological laboratories of Nussbaum and Verworn at Bonn and of Edinger at Frankfurt. In 1909 he promoted in Italy the neo-scholastic movement, which had also been introduced into the Catholic University of Louvain, the home of his distinguished colleague in experimental psychology, Prof. A. Michotte. In 1912 he obtained his doctorate in philosophy. Thereupon he began his career as an experimentalist psychologist, working in Germany at the psychological laboratories of Külpe and Kräpelin and carrying out research at the laboratory of Turin under Keesow. In 1916 he was at Munich studying 'psychological profiles' with reference to occupational selection. On the entry of Italy into the Great War, he joined her

army first as doctor and priest, later establishing the first psycho-physiological laboratory of the Italian army, for the study of aviation and the selection of airmen.

With this unique experience, Gemelli founded at Milan in 1921 the Catholic University of the Sacred Heart, which he provided with a large scientific library and with well-equipped biological and psychological laboratories. The latter laboratory he has since directed with remarkable energy, efficiency and versatility. For as Dr. Manoil rightly says, "there is virtually no field in theoretical, experimental or applied psychology which Prof. Gemelli has left untouched". In this volume he attempts to describe these manifold activities, both before the foundation of the Catholic University at Milan and, together with those of his colleagues and students, after its foundation. A bibliography of some 175 published papers is appended, of which by far the majority bear Prof. Gemelli's name. Some of those which are here described, generally in a historical setting, are to be found at full length in the six large volumes of *Contributi* from his laboratory which have appeared between the years 1925 and 1935.

The most important of these contributions relate to (a) the use of the psycho-physical method of 'equivalents' in the study of tactual illusions; (b) the elaboration, based on new experimental data, of a theory of perception; (c) electro-acoustic investigations of speech; and (d) the selection of air-pilots. The book also contains shorter chapters describing Prof. Gemelli's anatomical experiments concerning the psycho-physiological factors in emotion, his investigations in animal and industrial psychology, and his

applications of psychology to the problems of physical training. Throughout he insists on the 'finalistic principle', the 'purpose' in view, which directs the 'synthetic activity' of the subject.

Gemelli agrees with Michotte that in perception the fundamental and terminal factor is the apprehension of meaning—an intellectual act so closely bound up with the intuitive, sensorial organization of the data that they are usually only distinguishable under experimental conditions. Cinematographic investigations lead him and his colleagues to distinguish four degrees or phases in the developing perception of form and meaning—(i) of mere 'presence', (ii) of a 'form', (iii) of the apprehension of meaning, (iv) of identification by name. Other investigations are described into perception in peripheral and twilight vision, the perception of ambiguous profiles, etc. Throughout he is far from being a complete adherent to the Gestalt school, although he lays great stress on the function of the 'whole'.

Gemelli's experiments on speech (conducted with

his biologist colleague, Prof. Giuseppina Pastori) are based on an analysis of oscillograms, several of which are illustrated in fifteen plates. He insists that each unit—whether 'phonem' (the most elementary unit), word or sentence—is a whole; possessing an individuality which, however, is widely modifiable. Thus a phonem, especially a vowel, will be modified in the oscillogram according to accent, its situation in the word, and the nature of its neighbouring consonants; the vowel is influenced by the syllable, as the syllable is influenced by the word, the 'whole' being pre-existent in regard to the 'part' and determined by meaning and expression. Yet each phonem has a characteristic acoustic structure and an oscillographic form which gives it a specific and recognizable form.

These brief accounts must suffice to illustrate the broad field and the inevitably variable worth of Prof. Gemelli's labours. They deserve the international attention which they will receive by their publication in the present volume.

Birds of Sussex

A History of Sussex Birds

By John Walpole-Bond. Vol. 1 (Raven to Eastern Great Reed-Warbler). Pp. xix+382+12 plates. Vol. 2 (Reed-Warbler to Teal). Pp. vii+384+19 plates. Vol. 3 (American Blue-winged Teal and Red-legged Partridge). Pp. vii+384+22 plates. (London: H. F. and G. Witherby, Ltd., 1938.) 3 vols., £5 5s. net.

JOHN WALPOLE-BOND, a distinguished ornithologist of many years standing, in this his most recent work, in three volumes, has had the assistance as illustrator of Philip Rickman. Between them, author and artist (aided by that high standard of book production which is expected from the firm of Witherby) have produced a work which, it is safe to say, will rank as a standard one on Sussex birds.

The scope of the work can be realized when it is stated that more than four hundred bird species are dealt with. Of that number 112 nest regularly in the county.

Of the fifty-three coloured plates by Philip Rickman which nobly illustrate the work, the three which to some eyes are the most attractive are Montagu's harrier hunting, a shoveler duck and drake, and a male black redstart. The shovelers are portrayed with rare delicacy, and the harrier is shown moving above his feeding haunts; the graceful and buoyant, and yet somewhat furtive flight of the harrier has been caught with rare faithfulness by the artist.

The author in the compilation of this great work has laboured long and faithfully, and he has many interesting records of the birds of the county. He tells us that the raven no longer nests in Sussex although it still visits the Sussex coast on migration. The peregrine falcon, fierce pirate of the skies, still nests on the less accessible cliffs, the hobby still rears her young in the native woods, and in comparatively recent years a pair of Montagu's harriers nested in the county. Mr. Walpole-Bond does not say whether these birds succeeded in hatching their second clutch—the first was taken—but presumably he did all in his power to see that these rare eggs escaped the collector.

The peregrine is, it is interesting to learn, a bird which sometimes nests so near to villages that the rubbish from the dust-bin chute almost sprays the eggs:

The eyrie was—for the site has long since crumbled away, as chalk often will—only some fifteen feet down the steep on a long, broad bench which culminated in the chute down which the dust-bin refuse from the adjoining village was shot once a week; and the eggs were habitually laid only a foot or two from the chute itself. On this ledge could always be seen every conceivable sort of rubbish and in 1905 in the eyrie itself, and almost touching its contents, reposed an oblong strip of cardboard (Vol. II, p. 247.)

Of the supposed aerial climb of the swift into the sky of a summer evening he has something to say. It has been suggested by some ornithologists

that the swifts on occasion spend the night in the air, sleeping lightly as they soar at great heights above the earth. But Mr. Walpole-Bond, from many nocturnal vigils in the Horsham belfry, is convinced that swifts do return to roost after this evening flight to high altitudes. He has seen some of the merry-makers rush home at about 10 p.m. G.M.T., but all the birds were not home until after midnight—that is 1 a.m. by British Summer Time. These valuable observations show that the eyesight of swifts must be extremely good, as the bird must make an entry, flying at full speed, into its narrow nesting hollow during the darkest hour of the summer night.

In his chapter on the swift Mr. Walpole-Bond mentions the astonishing pertinacity of life in a click beetle. The author was handling a juvenile swift which in its agitation disgorged a click beetle. In two hours the limp, moist 'corpsé' had completely revived, although it had been caught in the mouth of the parent swift and had perhaps been carried a considerable distance, and had then been given to, and swallowed by, the young swift.

Writing of the autumn migration of the swift, the author mentions a single swift seen in Sussex on October 28, 1906. This calls to the reviewer's mind that he and his wife watched for some time a pair of swifts flying backwards and forwards over the leafless birches at Aviemore on the Spey Valley in Inverness-shire, where the river bed is 700 ft. above the level of the sea, on November 11 of a recent year. That day was unusually mild, yet the Cairngorm Hills were already thickly coated with their winter snowfall, and there was severe frost a few days before, and again almost immediately after, these wandering swifts were seen. Whence they had come, and how they had survived the frost was unknown, and we sometimes wondered whether their subsequent migration south had been successful.

It has of course been proved that swifts do on occasion become torpid in their nesting hollows in spring if severe weather should catch them after their arrival at their nesting haunts, but so far as is known, there is no record of their having been found in this condition in autumn. S. G.

Chemistry of the Brain

Chemistry of the Brain

By Dr. Irvine H. Page. Pp. xvii+444. (London: Baillière, Tindall and Cox, 1937.) 34s.

INTEREST in the biochemistry and physiology of the nervous system is increasingly being taken, not only by purely scientific investigators, but also by clinicians, psychiatrists and many of those who come into contact with the abnormal manifestations of the nervous system. Dr. Page's book has an appeal to all such workers, and presents a real stimulus to those for whom mental activity—normal and otherwise—is associated with the dynamic equilibria taking place in the brain.

The book commences with a brief biography of Thudicum, "the founder of brain chemistry". It passes on to a survey of our present knowledge of the sterols, the importance of which in the make-up of the brain is well known but of the significance of which in brain metabolism we are as yet ignorant. The chemistry of the phosphatides is next considered, and then Dr. Page turns to such subjects as fatty acid metabolism, cerebroside, carbohydrates and nitrogenous metabolism. The subjects are dealt with briefly but sufficiently adequately to present the most significant findings to a clinical research worker and to those whose main interest is the study of the brain.

There are omissions, and in places the subject-matter is out of date; but this is inevitable in a book which does not pretend to be a text-book of biochemistry and in a subject where advances are made so rapidly. Wherever possible Dr. Page keeps the clinical aspects well to the foreground, and one of the most valuable features of the book is the description of clinical findings in psychiatry and their possible interpretations in the light of our knowledge of the biochemistry of the nervous system. Effects of oxygen deprivation, of alterations in calcium ion concentration, of deprivation of magnesium and manganese, of the action of narcotics and drugs are a few of the many subjects which are considered. There is a brief survey of the parts played by the vitamins in maintaining the integrity of the nervous system, and the penultimate chapter (by Dr. J. H. Quastel) is devoted to a description of oxidations of the brain with a very brief survey of the present (that is, until 1936) situation concerning oxidations in the living cell.

References to original articles—clinical and otherwise—are copious. Much information is present which is not elsewhere readily available, and the book is a boon to biochemical and physiological workers in the psychiatric domain.

The book is well produced, but there is a fair number of misprints and incorrect formulæ.

Introduction to Bessel Functions

By F. Bowman. Pp. x+135. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1938.) 10s. 6d. net.

THIS book is designed to provide a readable introduction to the subject for non-mathematical specialists. Beginning with functions of zero order, the author sets forth in a clear and straightforward manner the solutions of Bessel's equation of zero order. The student is thus introduced not only to $J_0(x)$, but to Neumann's Bessel function of the second kind of zero order, and this leads to the general solution. The properties of the functions are then considered as far as the use of the Fourier-Bessel expansion, and some valuable illustrations of their application are made to the vibrating membrane and the hanging chain.

The modified function of zero order is next discussed and well applied to the flow of an alternating current in a wire of circular cross-section. Then follows a brief consideration of the simplest definite integrals involving $J_0(x)$, such as those of Parseval, Liapchitz and Weber, which are applied to the problem of the electrostatic potential of an electrified disk. The next chapter is devoted to asymptotic expansion with as much relevant theory as is essential to an intelligent understanding of the need for such expansion. Finally comes a clear, though brief consideration of the Bessel functions of any real order with an exposition of their chief properties. This is followed by some interesting applications, including Kepler's problem, the critical length of a thin uniform elastic rod clamped vertically and the normal modes of vibration of a circular membrane with its circumference fixed.

Each section contains some well-chosen exercises for the student's use and there is a useful index. The book is excellently printed with some clear diagrams, and should certainly prove very useful not only to students of physics and engineering, but also to mathematical students in general. F. G. W. B.

Plant Growth-Substances:

their Chemistry and Applications, with Special Reference to Synthetics. By Hugh Nicol. Pp. xii+108+4 plates. (London: Leonard Hill, Ltd., 1938.) 3s. 6d.

PLANT growth-promoting substances are now becoming of increasing importance not only to the research physiologist but also to the practical horticulturist. It has been the topic of international conferences and of discussions held at the Royal Botanic Gardens, Kew, and elsewhere.

Though full of information of value to the research worker, Dr. Nicol's book will prove of even greater value to the professional horticulturist. The subject-matter is based on a series of articles published in the *Manufacturing Chemist*. The following subjects dealt with in the book will appeal to students: synthesis of growth substances; results of work on the effect of such substances; growth-substances from natural sources; some constituents of urine; chemistry in relation to growth; classification,

nomenclature and identification of growth substances. The practising horticulturist will find these well-written chapters of interest and value also, and he is offered still further help in the first two chapters. The tabular index at the end is very useful.

Dr. Nicol is to be congratulated on a very useful book which his publishers have issued at a reasonable price. It can be strongly recommended to students of, and research workers in, plant physiology, and to the horticulturist who is alive to the opportunities which scientific research is offering him to his advantage.

Cataloguing in Special Libraries:

a Survey of Methods. By John L. Thornton. Pp. xii+268. (London: Grafton and Co., 1938.) 10s. 6d. net.

THIS book, by the assistant librarian of St. Bartholomew's Hospital, will interest all librarians who have charge of special collections. It is an investigation of the cataloguing methods used in various types of special library—national, government, university, learned society, commercial, technical and school—with examples of how their special difficulties are met. Representative libraries of each type are dealt with in detail. In addition there are chapters on alphabetization, treatment of serial publications and co-operative cataloguing.

The survey reveals a great diversity of cataloguing systems and a great shortage of cataloguing staff. Mr. Thornton's comments are shrewd and at times outspoken. He does not, happily, belong to the school which aims at transforming librarianship from a useful art to an arcane science. His style is clear, concise and free from jargon, and he keeps the library user always in the foreground. The book is illustrated with specimen card and other catalogue entries. Except for some minor details, it is well produced and printed. B. S.

Varieties of British Butterflies:

a Selection of Rare and Interesting Specimens of Aberrations, including Gynandromorphic and Homoeotic Forms; Albinism and Melanism. By F. W. Frohawk. Pp. 200 (48 plates). (London and Melbourne: Ward, Lock and Co., Ltd., 1938.) 42s. net.

MR. FROHAWK'S object is apparently to figure rare and interesting varieties and other unusual forms, including gynandromorphs, of British butterflies. In so far as this object is concerned, the task has been well carried out. Mr. Frohawk is a highly skilled entomological artist and the forty-eight colour plates illustrating this book bear ample testimony to his artistic ability. Abnormal forms of butterflies have, in recent years, become highly prized by collectors and consequently fetch considerable prices at auction sales. For the collector, therefore, this work is certainly admirable. We regret that a book so highly priced should contain very little scientific information on the subject treated. The real student who desires to know something regarding modern views as to the underlying causes producing the remarkable 'forms' will have to go elsewhere for information.

Cause, Purpose and Economy of Natural Laws*

Minimum Principles in Physics

By Prof. Max Born

WITHOUT claiming to be a classical scholar, I think that the earliest reference in literature to the problems which I wish to treat here is contained in Virgil's "Aeneid", Book I, line 369, in the words "taurino quantum possent circumdare tergo."

When Dido landed at the site of the citadel of Carthage, she opened negotiations with the inhabitants for some land and was offered for her money only as much as she could surround with a bull's hide. But the astute woman cut the bull's hide into narrow strips, joined them end-to-end and with this long string encompassed a considerable piece of land, the nucleus of her kingdom. To do this she had evidently to solve a mathematical question—the celebrated 'problem of Dido': to find a closed curve of given circumference having maximum area. We do not know how she solved it, by trial, by reasoning, or by intuition. In any event, the correct answer is not difficult to guess: it is the circle. But the mathematical proof of this fact has only been attained by modern mathematical methods.

In saying that the first appearance of this kind of problem in literature is that quoted above I am not, of course, suggesting that problems of minima and maxima had never occurred before in the life of mankind. In fact, nearly every application of reason to a definite practical purpose is more or less an attempt to solve such a problem: to get the greatest effect from a given effort, or, putting it the other way round, to get a desired effect with the smallest effort. We see from this double formulation of the same problem that there is no essential distinction between maximum and minimum; we can speak shortly of an 'extremum', and 'extremal' problems.

It was during Isaac Newton's lifetime, at the end of the seventeenth century, that geometrical and mechanical problems of extremals began to interest mathematicians, and shortly after Newton's death (1727) the metaphysical idea of purpose or economy in Nature was linked up with them.

One of the simplest examples is the optical 'law of reflection' which can be expressed as a minimum principle: the beam of light from a point P_1 to another point P_2 selects just that reflecting point Q which makes the total path

$P_1Q + QP_2$ as short as possible. The light behaves as if each beam had a tendency to contract, and the French philosopher, Fermat, has shown that all the laws of geometrical optics can be reduced to the same principle. Light moves like a tired messenger boy who has to reach definite destinations and carefully chooses the shortest way possible. Are we to consider this interpretation as accidental, or are we to see in it a deeper metaphysical significance? Before we can form a judgment, we must learn more about the facts and consider other cases.

The straight line is the shortest connexion between two points in space. But if we travel on our earth, we can never go exactly in a straight line since the earth's surface is not plane. The best we can do is to follow a great circle, which is the curve in which the sphere is intersected by a plane passing through the centre. The globe, however, is not an exact sphere, but is slightly flattened at the poles and bulges at the equator. What, then, about the shortest line on such a surface?

Gauss hit on this problem when occupied with a geodetic triangulation of his country, the electorate of Hanover. He attacked the problem from the most general point of view and investigated the shortest lines on arbitrary surfaces. But in remembrance of his starting point he called these lines 'geodesics'. They are in many ways of fundamental importance for physics.

Let us consider a point P on a surface and all curves through P which have the same direction at P . It is evident that there is among them a 'straightest curve', that is, one with the smallest curvature. Hence the geodesic can be characterized by two somewhat different minimum properties: one which can be called a 'local' or 'differential' property, namely, to be as little curved as possible at a given point for a given direction; and the other, which can be called 'total' or 'integral', namely, to be the shortest path between two points on the surface.

This dualism between 'local' and 'total' laws appears not only in this simple geometrical problem, but also has a much wider application in physics. It lies at the root of the old controversy whether forces act directly at a distance (as assumed in Newton's theory of gravitation and the older forms of the electric and magnetic

* Substance of the Friday evening discourse delivered at the Royal Institution on February 10.

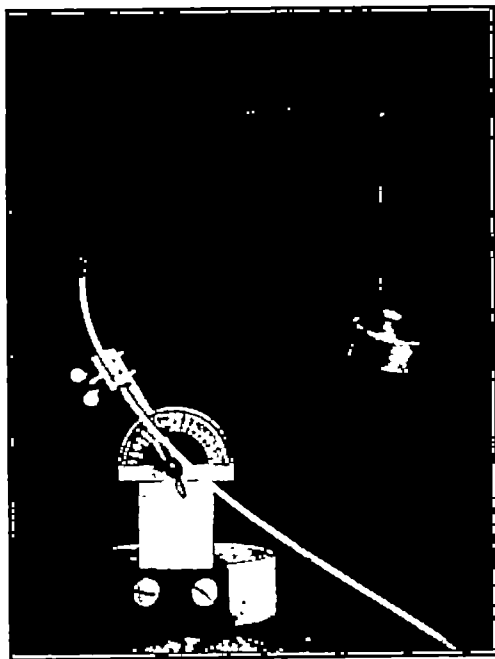


Fig. 1.

theories), or whether they act only from point to point (as in Faraday's and Maxwell's theory of electromagnetism and all modern field theories).

There seems to be no objection to extremal laws of the local type; but those of the integral type make our modern mind feel uneasy: although we understand that the particle may choose at a given instant to proceed on the straightest path, we cannot see how it can quickly compare all possible motions to a distant position and choose the shortest one—this sounds altogether too metaphysical.

But before we follow out this line of thought, we must convince ourselves that minimum properties appear in all parts of physics, and that they are not only correct but also very useful and suggestive formulations of physical laws.

One field in which a minimum principle is of unquestionable utility is statics, the doctrine of the equilibrium of all kinds of systems under any forces. The centre of gravity tends to descend as far as possible; to find the configuration of stable equilibrium, one has only to look for the minimum of the height of the centre of gravity. This height, multiplied by the force of gravity, is called potential energy.

A chain hanging from both ends assumes a definite shape, which is determined by the condition that the height of the centre of gravity is a minimum. If the chain has very many links, we get a curve called the catenary. It can readily be shown by means of a heavy chain, the centre of gravity of which is marked by a construction,

of light levers, that disturbance of the equilibrium of the chain in any arbitrary way causes the centre of gravity of the chain to rise.

Fig. 1 illustrates an example where gravity competes with another force, elasticity. A steel tape is clamped at one end and carries a weight at the other. This weight is pulled downwards by gravity, while the tape tries to resist bending in virtue of its elasticity. This elastic force also has a potential energy; for a definite amount of work must be done to bend the tape into a given curved shape. Now there are definite positions of equilibrium in which the total energy, that of gravitation plus that of elasticity, is as small as possible. Generally there are two such positions. Changing the clamping angle carefully, a position is found when a jump suddenly occurs from one position to another on the opposite side. This instability is determined by the condition of minimum energy. We can summarize the facts connected with the limits of stability by drawing a graph, Fig. 2, not of the elastic lines themselves, but by plotting the angle of inclination against the distance from the free end. We obtain wave-shaped curves, all starting horizontally from the line representing the end carrying the weight. These curves have an envelope which separates the regions in which one or several curves are going through each point, and calculation shows that this envelope is just the limit of stability. We shall return to this example later when discussing the minimum principles of dynamics.

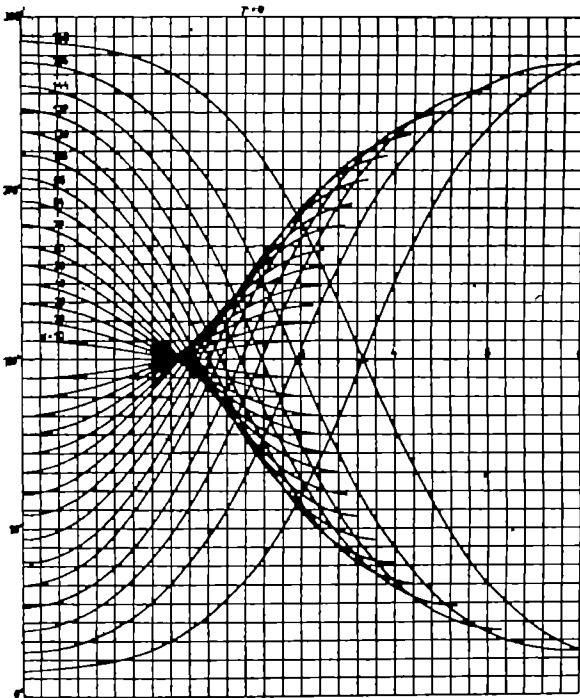


Fig. 2.

Another example of the statical principle of minimum energy is provided by soap bubbles. Soap films have the property of contracting as much as possible; the potential energy is proportional to the surface area. Therefore soap films are surfaces of smallest area, or minimal surfaces. Nature is an expert mathematician, quickly finding the solution.

These experiments are not merely pretty toys without serious background. They have been chosen only for the sake of illustration. The real importance of the principle of minimum energy can scarcely be exaggerated. All engineering constructions are based on it, and also all structural problems in physics and chemistry.

Models of crystal lattices provide examples of this. A crystal is a regular arrangement of atoms of definite kinds in space. Now the models representing the crystal lattices of two chemically similar compounds, namely, common salt (NaCl) and caesium chloride (CsCl) are different in structure. Why are they different? Because, as the caesium atoms are much larger than the sodium atoms, the potential energy differs in the two cases and its minimum is attained for different configurations.

Considerations of this kind, more or less quantitative, enable us to understand a great number of facts about the internal structure of solid matter.

Before we proceed to the consideration of minimum principles in dynamics, where the situation is not as clear and satisfactory as in statics, we must first mention another part of physics which in a sense occupies an intermediate position between statics and dynamics. It is the theory of heat, thermodynamics and statistical mechanics.

There is a very important extremum principle, discovered by Lord Kelvin, which governs irreversible processes: a quantity called 'entropy' increases in the process and has a maximum for the final equilibrium state. It is not easy to describe this miraculous entropy in terms of directly observable quantities, such as volume, pressure, temperature, concentration, heat. But its meaning is immediately obvious from the point of view of atomic theory. A model will facilitate the explanation. Take a flat box like a little billiard table into which marbles can be put. If I carefully place them in the right-hand half, I have a state of partial order; if I shake the box they spread out over the whole box and attain a configuration of lower order. If I throw some marbles into the box one after the other so that their position is purely accidental, it is very improbable that they will all fall in the right-hand half. One can easily calculate the probability of a uniform distribution over the whole box as compared with one in which the majority of the marbles is in the right half;

and one finds overwhelming odds in favour of the uniform distribution. Now the statistical theory of heat interprets the entropy of a system with the aid of the probability of the distribution of the atoms, and the tendency of entropy to increase is explained by the obvious fact that states of higher disorder have a higher probability.

Let us now come back to the minimum principles of dynamics.

The first problem of this kind—first both in historical order and in order of simplicity—was formulated at the end of the seventeenth century by Johann Bernoulli of Basle, one of a great family which produced many famous scholars and especially mathematicians. It is the problem of the curve of quickest descent or brachistochrone: given two points at different levels, not in the same vertical line, to determine a connecting curve in such a way that the time taken by a body to slide without friction under the action of gravity from the higher point to the lower is a minimum—compared of course with all possible curves through the two points. With a model having three paths, namely, a straight line, an arc of a circle and an intermediate curve known as a cycloid, it can be shown that it is not the straight line on which a rolling ball arrives first, nor the steep descent of the circular arc, but the cycloid. If you were to try with any other curves, you would always find the same result, for the cycloid has been constructed according to the theoretical calculation.

The determination of this brachistochronic property of the cycloid was a very satisfactory piece of mathematics. It attracted much attention, and there is no philosopher of this period who did not test his analytical powers by solving similar extremal problems. Another member of the Bernoulli family, Daniel Bernoulli, developed at the beginning of the eighteenth century the minimum principle of statics and applied it to the catenary and the elastic line. Encouraged by these successes, he raised the question whether it was possible to characterize the orbit, and even the motion in the orbit, of a body subject to given forces—for example, a planet—by a minimum property of the real motion as compared with all other imagined or virtual motions. He put this question to the foremost mathematician of his time, Leonard Euler, who was very much interested in it and found, in the autumn of 1743, a solution which he explained with the help of various examples in a book published in 1744. It is the basis of the *principle of least action* which has played so prominent a part in physics right up to the present time.

The history of this principle, however, is an amazing tangle of controversies, quarrels over

priority and other unpleasant matters. Maupertuis, in the same year, 1744, presented a paper to the Paris Academy of Sciences in which he substituted for Fermat's optical principle of the shortest light path, which we have already discussed, a rather arbitrary hypothesis, and extended the latter, in 1746, to all kinds of motions. He never gave a satisfactory proof of his principle (which is not surprising as it is incorrect), but defended it by metaphysical arguments based on the economy of Nature. He was violently attacked by Chevalier d'Arocy in Paris, Samuel König from Bern and others, who showed that if Maupertuis's principle were true, thrifty Nature would be forced in certain circumstances to spend not a minimum but a maximum of action! Euler, whose principle is quite correct, behaved rather strangely; he did not claim his own rights, but even expressed his admiration for Maupertuis's principle, which he declared to be more general. The reasons for this attitude are difficult to trace. One of them seems to have been the publication by König of a fragment of an alleged letter of Leibniz in which the principle was enunciated. The genuineness of this letter could never be proved, and it seems probable that it was a forgery designed to weaken Maupertuis's position. This may have brought Euler over to the side of Maupertuis, who was at this time president of the Berlin Academy and a special favourite of the king, Frederic II, later known as the Great. The dispute was now carried over into the sphere of the court of Sanssouci and even into the arena of politics. Voltaire, friend of Frederic, who heartily disliked the haughty president of the Academy, took the side of the 'underdog', König, and wrote a caustic pamphlet, "Dr. Akakia", against Maupertuis. But the king, although he thoroughly enjoyed Voltaire's witty satire, could not sacrifice his grand president and was compelled to defend Maupertuis. This led at last to the disruption of their friendship and to Voltaire's flight from Berlin, as described in many biographies of Frederic and of Voltaire.

The curse of confusion has rested for a long period on the principle of least action. Lagrange, whose work was the culmination of the development of Newton's dynamics, gives an unsatisfactory formulation of the principle. Jacobi restricts it in such a way that the minimum condition determines the orbit correctly; the motion in the orbit must be found with the help of the energy equation. This was an important step. But the spell was at last broken by the great Irishman, Sir William Rowan Hamilton, whose principle is mathematically absolutely correct, simple and general. At the same time, it put an end to the interpretation of the principle expressing the economy of Nature. For there is,

by a kind of fortunate mathematical coincidence, a statical problem for which the statical minimum principle for the potential energy coincides formally with Hamilton's principle of least action for the pendulum; this statical problem is the loaded steel tape considered before. The curves representing the angle of inclination of the elastic line as a function of the distance from the free end are exactly the same lines as those representing the angle of deflection of the pendulum as a function of time (see Fig. 2).

Now we have seen that only those regions of the graph which are simply covered by the lines correspond to a real minimum, a stable configuration of the elastic line. There are other regions, those beyond the envelope, where two or more lines pass through a given point. Only one of those lines corresponds to a real minimum. But both represent possible motions of the pendulum. Although the conditions at the ends of the elastic tape do not correspond exactly to those at the ends of the time interval in Hamilton's principle, there is this fact in common: if the length of the tape or the corresponding time interval in Hamilton's principle for the pendulum exceed a certain limit, there is more than one possible solution, and not each of them can correspond to a true minimum, though to a possible motion. In this way we come to the conclusion that the actual motion is not in every case distinguished by a genuine extremal property of action but by a less obvious mathematical property called 'stationary' configuration.

Thus the interpretation in terms of economy breaks down. We may regard the idea of finding purpose and economy in natural laws as an absurd piece of anthropomorphism, a relic of a time when metaphysical thinking dominated science.

The importance of Hamilton's principle lies in a different direction altogether. It is not Nature that is economical, but science. All our knowledge starts with collecting facts; but proceeds by summarizing numerous facts by simple laws and these again by more general laws. This process is very obvious in physics. We may recall, for example, Maxwell's electromagnetic theory of light, by which optics became a branch of general electrodynamics. The minimum principles are a very powerful means to this end of unification. The ideal would be to condense all laws into a single law, a universal formula, the existence of which was postulated more than a century ago by the great French astronomer, Laplace.

If we follow the Viennese philosopher, Ernst Mach, we must consider economy of thought as the only justification of science. I do not share this view—there are other aspects and justifications of science. But I do not deny that economy

of thought and condensation of the results are very important, and I consider Laplace's universal formula as a legitimate ideal. There is no question that the Hamiltonian principle is the adequate formulation of this tendency. It would be the universal formula if only the correct expressions for the potential energy of all forces were known. Nineteenth century thinkers believed more or less explicitly in this programme, and it was successful in an amazing degree.

By choosing a proper expression for the potential energy, nearly all phenomena could be described, including not only the dynamics of rigid and elastic bodies, but also that of fluids and gases, as well as electricity and magnetism, together with electronics and optics. The culmination of this development was Einstein's theory of relativity, by which the abstract principle of action regained a simple geometrical interpretation. The motions of the planets can be considered as 'geodesics' in the four-dimensional space formed by adding time to our common space. Einstein's law of gravitation, which contains Newton's law as a limiting case, can also be derived from an

extremum principle in which the quantity that is an extremum can be interpreted as the total curvature of the space-time world.

We call this period of physics which ends with the theory of relativity the classical period, in contrast to the recent period which is dominated by quantum theory. The new quantum mechanics assumes that all laws of physics are of statistical character. The fundamental quantity is a wave function which obeys laws similar to those of an acoustical or optical wave; it is not, however, an observable quantity, but determines indirectly the probability of observable processes. The point which interests us here is the fact that even this abstract wave function of quantum mechanics satisfies an extremum principle of the Hamiltonian type.

We are still far from knowing Laplace's universal formula, but we may be convinced that it will have the form of an extremal principle, not because Nature has a will or purpose or economy, but because the mechanism of our thinking has no other way of condensing a complicated structure of laws into a short expression.

Science at the Golden Gate Exposition

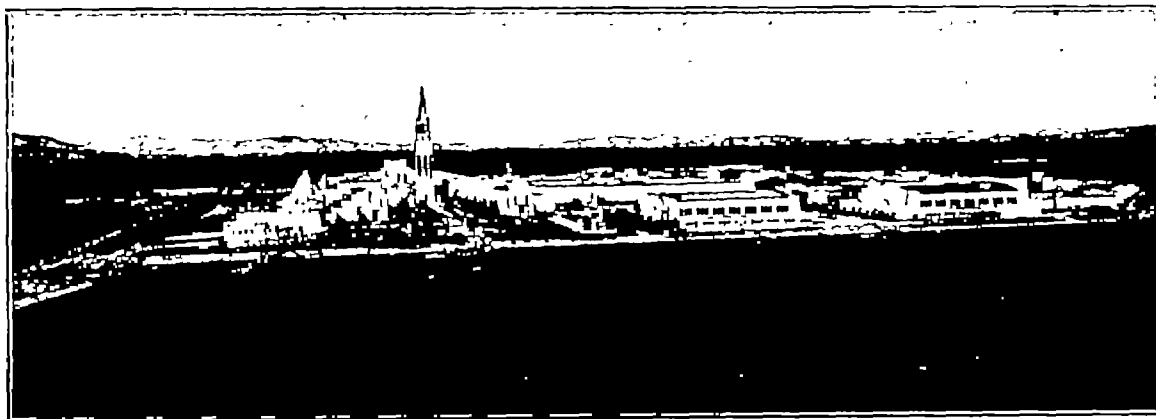
By Science Service, Washington, D.C.

A SUPER-SPECTACLE of science at work is unfolded at the Golden Gate International Exposition, the World's Fair of the West, at San Francisco, which was opened on February 19. Treasure Island itself is an engineering triumph, for it is entirely a man-made island in San Francisco Bay, 400 acres in area. After the close of the fair, the buildings will be razed and the island will become the San Francisco-Bay Area airport; already Pan-American Airways Clippers to the Orient use the island as the home port. From the hunt for subatomic particle of tiniest size to wondering about the course of a distant star, from war on death-dealing virus too small to be seen under an ordinary microscope to giant engineering projects like man-made Treasure Island itself, science dominates the 50,000,000 dollar show.

Only one hall bears the identifying label, "Hall of Science", but the entire exposition is as much a demonstration of the research worker's genius and accomplishments as this single building. Student of biology or of physics, layman or lover of the spectacular—all will find what they want in this twentieth-century panorama. Rats are thriving on synthetic food, insect friend of man battles insect foe, two liquids become artificial rubber, a machine

talks in words that never issued from a human throat—all this happens and much more during the 288 days the fair will be open.

The keynote of the entire science display is an exhibit which cost a quarter of a million dollars, prepared by the University of California. Among the exhibits of particular scientific interest are the following. (a) 'Test tube' plants, grown by scientific workers of the Plant Nutrition Division of the University of California in a demonstration of the most significant contribution of agricultural science to modern farming—'soilless farming'. Just as Pan-American Airways is doing on tiny Wake Island to supply fresh vegetables to clipper passengers and crews and as California planters are now learning, tomatoes and other truck products are grown in water containing nourishing chemicals instead of in soil. Spectators will see for themselves the tremendous yields made possible by this method. (b) Californian men of science show in a specially constructed chamber just how harmful noise can be to the human organism, and what can be done about it. (c) No playthings are a set of dolls which are displayed. They teach the curious thousands how mother and father pass on their characteristics to their



[Science Service]

FIG. 1. A GENERAL VIEW OF TREASURE ISLAND, SITE OF THE GOLDEN GATE INTERNATIONAL EXPOSITION, AND THE EXPOSITION BUILDINGS.

children. Colour of eyes is the specific characteristic traced in the set of exhibition mannequins. (d) The University of California, where Prof. Ernest O. Lawrence, of cyclotron fame, is a faculty member, is a world centre of research into the secrets of the atom. So it is to be expected that a model of the world's and California's greatest cyclotron should be there.

California's biggest academic institution, however, is not the only science exhibitor. Pan-American Airways is staging a great aviation show by demonstrating the operation of the clippers that fly to China and the Philippines. Small boys face plenty of competition from their elders for space behind the glass partition in Pan-American Airways' great new hangar. On the other side, 'grease monkeys' and members of crew and passengers go about their business. Treasure Island has become the new San Francisco base for the airline that flies the Pacific, and all operations will be visible for the duration of the Fair. After December 2, closing day, and after the exhibit buildings have been removed, other airlines will transfer their headquarters from Oakland Airport and Mills Field on the San Francisco side of the bay to this single skyport.

Riches of the earth and the miner's art are shown in a synthetic mountain, Treasure

Mountain, which visitors enter through a 'valley' between two 'mountain ranges'. Every type of mining operation on different key ores of the mineral-laden West is shown in working form—a 2,500-miles science trip in a few minutes. The peak is 50 ft. high and 400 ft. long.

Anthropologists and archaeologists will find assembled unbelievably old treasures, dating back to earliest times, from the countries bordering the Pacific. Stone axe heads forty-nine centuries old from Siam, and gorgeous specimens of the goldsmith's art in the Chimu culture that preceded Peru's highly civilized Incas of four hundred years ago, that have added to man's store of knowledge concerning himself, are shown on Treasure Island.

The Federal exhibit, which cost one and a half million dollars, shows activities of the National



[Science Service]

FIG. 2. TREASURE ISLAND JUST BEFORE BUILDINGS, TREES, SHRUBS AND FLOWERS AND EXHIBITS BEGAN TO BE MOVED ON TO THE ISLAND.

Government, as they affect citizens, around seven central themes. One, for example, displays in dramatic form what Uncle Sam does for Mr. Average Man from birth through old age—how, for example, Public Health Service grants provide better maternity care and how the Social Security Board now provides for a man in his declining years.

Indians demonstrate their handicrafts in the Federal building. Not only do they show their unique art, but also they may start a vogue for Indian handicrafts among visitors. Planners of the exhibit certainly hope so, for such a boom would prove a boon to the Red man, who has not had an easy row to hoe in adapting himself to the white man's civilization.

Chemical wizardry, as practised by industrial giants whose ever-new products enter into everyone's life every day, are also shown. The Dow Chemical Company shows how it makes ocean water yield up magnesium, the lightest metal now in use, and iodine and bromine, two vital chemicals which enter into, among other things,

the old stand-by antiseptic and photographic film respectively.

A chemist pours the clear contents of one beaker into another and a gummy substance, which is then moulded into proper shape, results. It is allowed to solidify, and, lo! a rubber tyre. How chemistry makes for better living in this and in other ways is shown by E. I. du Pont de Nemours and Co.

An 'iron lung', about which much has been heard recently and which has saved many lives, is there. Visitors have a chance to watch one at work in a model hospital erected by Dr. Gabriel Barnett.

In charge of the vast science programme in the Hall of Science alone has been Dr. Milton Silverman. Co-operating with him as exhibitors he has had some of the foremost scientific institutions in the United States. Harvard University, the Mayo Clinic, the Jackson Clinic and the American Medical Association, to mention only a few, are taking part. More than two hundred and fifty industrial exhibits, of which many are science shows all by themselves, are represented.

Technical Education in Great Britain

AS was to be expected, the principal discussion at the annual meeting, held in London on February 24-25, of the Association of Technical Institutions, centred around the recommendations with regard to technical education put forward in the Spens Report. Sir Henry Steward, chairman of the City and Guilds of London Institute, who has succeeded Sir Robert Pickard as chairman of the Association, presided over the meetings, which were held in the Hall of the Merchant Taylors Company.

The discussion was opened by Principal J. Paley Yorke, one of the signatories to the Report, and chairman of the Council of the Association. He said that the general trend of the Report has been aptly expressed by one commentator as "a shifting of the basis of education from one of *social habit* to one of *natural aptitude*". Who should say that a parent should not take account of the social implications which attach themselves to a child by attendance at one school or another? But if some equality of status can be secured between schools of different educational types the parent will no longer find himself forced to weigh social esteem against educational provision. He need only think of the fitness of the curriculum for the aptitude and the inclinations of the child. The text of the Report on the inside title-page is "Chacun doit être à portée de recevoir l'éducation qui lui est propre." The recommendations endeavour to make that possible.

Mr. Paley Yorke then went on to describe and explain the findings of the Committee set out in Chapter viii—"Technical High Schools and other Technical Schools". He pointed out that the terms of reference made it necessary for the Committee to give a detailed consideration of the aims, objects and work of those schools called Junior Technical Schools and to determine their actual and potential relation to secondary schools of other types. This is the first time in history that so complete an examination has been made by so important a Committee. The members of the Committee found it necessary to collect a large body of evidence, and they visited a number of representative schools to obtain for themselves a true picture of their work, of the staffing, equipment and corporate life. The Committee was greatly impressed through these visits and was the better able to assess the oral and written evidence received. It recognized that there are two main groups of Junior Technical Schools in existence—one frankly and definitely preparing its pupils for entry into a specific occupation and developing in them a substantial measure of personal skill in the processes of that occupation—the other providing an educational foundation and background with science and its applications as the core and inspiration of the curriculum for those whose broad intention it is to enter industry without reference to any particular occupation within it. It came to the very definite conclusion that the schools of this second

group are capable of developing, and indeed already had developed in a large degree, a form of secondary education which ought to be regarded as an alternative to that of a Grammar School.

From this the Committee made its now famous recommendation that a new type of school should be established to be called a Technical High School—to be accorded in every respect equality of status with schools of the Grammar School type, yet to be wholly distinct from them. As a first step it was recommended that a number of these Junior Technical Schools at present providing a curriculum based on the engineering and building industries should be converted into Technical High Schools. The recommendation carried with it the provision of a minimum course of five years with a recruitment at 11 plus years, the recruitment based on the method of the general selective examination by which children are recruited for the Grammar Schools, the ultimate selection being determined in accordance with the choice of the parents, the report of the head of the contributing school and the result of interviews.

It was considered essential, of course, that the curriculum of the 11 plus to 13 plus pupils should be broadly of the same character as that in other secondary schools so that there could be another age point, *in all schools*, namely 13 plus, at which transfers should, if desirable, be made—equally for eliminating misfits, and for the encouraging of aptitudes which might have emerged and for allowing a change of choice on the part of the parents.

Several points emerged from the recommendations, and Mr. Paley Yorke made special reference to the question of the housing and staffing of the Technical High Schools, because he feels that there has been much misunderstanding about it and much non-understanding criticism from established secondary school quarters.

The Consultative Committee had no doubt whatever that the special value of the Technical High School depends upon its contact with the equipment and with the staff of a Technical College. The examples were before it. The evidence was there. The experiment has been conducted for more than thirty years with the 13 plus to 16 plus group, and there is no doubt at all about the results. Therefore it said that where possible Technical High Schools should be housed in the Technical Colleges and Technical Institutes and should be a department of the College, and the head master of the School would be head of that department. It is recognized, however, that the discipline, the corporate life and the general conduct of the school are necessarily distinct from those of the College, and that for these the head master should be responsible. It is also considered an *essential* feature of the Technical High School that it should

have some use of some of both the equipment and the staff of the College. Thus the head master of the School will have certain staff units wholly under his direction and will also have other members of the college staff working for him for a portion of their time, but who are not full-time members of the *school* staff. These teaching units will be attached to the College under the direction of one or other of the several heads of the departments of the College.

This organization of a Technical College into departments is not known in the secondary school world—and that accounts for the non-understanding of the essential condition that the principal of the College must secure and maintain the co-operation of the several heads of the specialized departments and their staffs, and the use of the laboratories, shops and special equipment, in the work and the life of the school.

There need be no fears about all this. It has been in operation for years and it is completely successful. The Committee is satisfied that—provided that a sub-committee of the Governing Body be appointed to manage the school and the head master has direct access to it, and the appointment of staff engaged exclusively in the work of the school be made in consultation with him—the organization of a Technical College through its principal and heads of departments allows a sufficient measure of autonomy to the head masters of the Technical High Schools whilst securing that vital contact of the School with the staff and equipment of the College which it regards as of primary importance.

Finally, in his review, Mr. Paley Yorke dealt with the vitally important recommendation of a form of school-leaving certificate based on internal examinations—assessed by approved assessors and endorsed by the Board of Education. As a body, the Association is familiar with certificates of this form through the now well-known and highly successful National Certificates and Diplomas. He is glad indeed that the Committee had been able to state so clearly that it does not seek to impose upon the Technical High Schools any system of external examination, with the necessarily rigid syllabus which would inevitably follow in its wake.

In the course of the subsequent discussion—a discussion which was carried over to the next morning—criticism came from those interested in education for commerce that the Committee has not recommended the establishment of Technical High Schools with a curriculum based on commercial education. Mr. Paley Yorke replied that the Committee had taken the view that, as at present constituted, the Junior Commercial Schools recruiting at 13 plus and 14 plus are more directly

comparable with those Junior Technical Schools preparing their pupils for entry to a specific occupation. Their usefulness and functions are not denied. He pointed out that this decision was based on the evidence received, but that though the door has at present been closed against their becoming Technical High Schools, it has not been locked or bolted; and indeed might be said to be

slightly ajar. In reply to other points raised, he pointed out that it was recommended that the word 'Junior' should be discontinued and that the official designation should be *Technical Schools* for the two and three-year course schools and *Technical High Schools* for the others; but it was also recommended that each school should have its own local name.

Obituary Notices

Prof. Karl Schröter

THE nector of Swiss botanists, Karl Schröter, emeritus professor in the Federal College of Technology, Zurich, died on February 7 in his eighty-fourth year. Up to the last he was physically and mentally active, and so recently as January 28 he delivered a public lecture to a leading scientific society in Zurich. Unfortunately, after a brief attack of pneumonia following upon influenza, his long and active life came to a sudden end.

Karl Schröter was born in 1855 in Esslingen in Germany, where his father was then chief engineer in a large engineering establishment, but later appointed professor of engineering in the Federal College of Technology, Zurich. At this institution, his son Karl, who acquired Swiss nationality, commenced his studies of natural science and came under the stimulating influence of Karl Cramer, who persuaded him to devote himself to the study of botany. Two years after graduation in 1876, he established himself as *Privat Dozent* and a few years later he was invited to give a course of advanced lectures in place of Prof. Heer, who was taken seriously ill. He proved himself to be such a successful lecturer that on the death of Prof. Heer he was appointed, at the age of twenty-eight years, to the vacant professorship, which he held for forty-two years.

Schröter had been influenced in his botanical studies by his predecessor, choosing for his doctor's thesis the examination of some fossil woods collected by Heer in the far north.

Schröter was, however, more interested in living plants, and as an assistant he took an active part in the organization of botanical excursions for the students, by which means he acquired a very wide and varied acquaintance with the Swiss flora, which characterized his later work both as a teacher and as an investigator. In 1889, he published a pocket-flora of alpine plants which was translated into both French and English. He was, however, specially interested in the relationship of plants to their surroundings, and thus was one of the founders of the modern study of ecological botany. After many years work on alpine meadows and moorlands, he published, with the assistance of other botanists, in six parts during the years 1904-8 his "Plant-life in the Alps", a very comprehensive study of alpine vegetation. At the same time, he was collaborating

with J. Früh in the production of a monumental volume on the bogs of Switzerland. He did not, however, confine himself to flowering plants, but paid attention to the plankton flora of the Swiss lakes and published several accounts of the periodicity of some of its algal forms.

In 1898, Schröter undertook a journey around the world, visiting the United States, Honolulu, Japan and Java. The result of his trip made him an enthusiastic supporter of the movement to organize international phytogeographical excursions, and in connexion with these he visited both Great Britain and the United States. Though already ageing in 1923, he organized and led a party of plant geographers through the Swiss Alps. By that time, the Swiss National Park had been established in the Lower Engadine, and Schröter, who had been keenly interested and active in its establishment and had taken part in its botanical exploration, naturally included it in the itinerary of the excursion.

Schröter's many-sided botanical labours received due recognition both in Switzerland and abroad. He was elected a foreign member of the Linnean Society of London in 1925 and delivered the Hooker Lecture of the Society in 1926. His lively and charming personality gained him many friends at home and abroad, not a few in England, which he visited on several occasions.

He married in 1884 a fellow student, Margaret Middelberg of Amsterdam, who died in 1925. Five years later he married Mrs. Teterode, by whom he is survived.

F. E. WEISS.

Prof. J. Versluys

THE death is announced, at the age of sixty-six years, of the eminent Dutch zoologist, Prof. Jan Versluys, professor in the University of Vienna.

Versluys was a fine, tall man, with a fluent command of English, German and French, and was well known to, and highly respected by, many British zoologists who met him either abroad or in Great Britain on the occasions when he attended the meetings of the British Association. He was a pupil of his life-long friend the late Prof. Max Weber of Amsterdam.

As a young man, Versluys accompanied Max Weber as a naturalist on the memorable voyage of S.S. *Siboga* on its marine exploration of the seas of the Malay Archipelago during 1899-1900, and on

his return to Holland wrote the monographs on the two families of the Gorgonacea—the Chrysogorgiidae and Primnoidae—collected by the Expedition. The care he took in the description of the species, his skilful illustrations and his references to type specimens, which he examined whenever available, have rendered these monographs of extraordinary value and interest. They are still the standard works on the subject. After the completion of his work on these coelenterates, he turned his attention to the study of the skull of reptiles and published his first paper on the morphology of the columella bone before he left Amsterdam. In 1904 he migrated to Germany and became a *Privat Dozent* and later an assistant professor in the University of Gießen, and during the following ten years he produced several papers on the skulls of recent and fossil reptiles bearing on what he called “Das Streptostylie Problem”, or the mobility (kinetism) of the bones of the jaws on those of the brain case.

At the outbreak of the Great War, Veraluys remained in Germany, but after the occupation of Belgium by the German army he was appointed a professor in the Flemish University in Ghent and remained there until the Armistice. Returning to Holland, he made a home in the beautiful town Hilversum and there he began a study of another subject, which he called “Das Limulus problem”. Working in collaboration with R. Demoll, of Munich, a number of papers were published on the appendages and other structures of recent and extinct Arachnoidea, especially of *Limulus* and the other Merostomata.

The general conclusions reached by these authors were startling in their originality but have not been accepted by most of the zoologists in Great Britain. They suggested that the evolution of *Limulus* was on lines exactly the reverse of those suggested by Sir Ray Lankester in his well-known essays on this subject. *Limulus* was derived, according to their view, not from an aquatic but from an air-breathing, tracheate ancestry; and, moreover, that even the Crustacea are descended from a remote terrestrial group of animals of which *Peripatus* is the only living representative.

After a few years in Holland, Veraluys accepted the position of professor in the University of Vienna and remained there until his death. I have not been able to find any record of his original work in this last period of his life, except an abstract of a paper he read at the British Association meeting in 1934, on the distribution of the Primnoidae with reference to the Wegener hypothesis.

He leaves a widow and three children.

SYDNEY J. HICKSON.

Eng.-Commander J. J. Walker

THE death on January 12 of Eng.-Commander James John Walker will be deeply regretted by very many British naturalists, especially by students of his favourite insects—Coleoptera and Lepidoptera.

Elected in 1878, Walker had been for some years the senior fellow of the Royal Entomological Society

of London, and was president in 1919 and 1920, his two addresses being on “The Fringes of Butterfly Life” and “Some Aspects of Insect Life in New Zealand” (*Proc.*, 1920 and 1921). Two of his papers in the *Transactions* of 1890 and 1895 dealt with Lepidoptera from the Straits of Gibraltar and the butterflies of Hong Kong, respectively, while the *Proceedings* (1907–31) includes many of his interesting notes on British and a few on foreign insects. The vast majority of his observations made on voyages and at home appeared, however, in the *Entomologist's Monthly Magazine*, of which he became editor in 1904, on the death of Robert McLachlan. The first of his notes and papers in this excellent journal—more than three hundred in number—appeared in 1872, and the last, dated December 20, 1938, less than a month before his death, was published in January. It records the more interesting of fully three hundred species of Coleoptera which he had observed in about thirty acres of meadow and cultivated land between his house and the River Owerwell.

Among Walker's papers were many on interesting subjects which he always kept in mind and added fresh records as they came to light. Such were his notes in 1908, 1911, 1912, 1928 and 1931, on immigrant insects which invaded Great Britain; in 1922, on butterflies which have reached Iceland and on the Lepidoptera of North Atlantic islands; in 1931, on insects at sea; in 1914, 1915 and 1928, on the Monarch butterfly, *Danous plexippus*, and its migrations. Among the many British localities from which he published records the most frequently named are, Isle of Sheppey, Sheerness, Chatham, Kent, Portland, New Forest and especially Oxford, which became his home in May 1904. The honorary M.A. was conferred on him by the University in the following year.

Walker was a constant visitor to the Hope Department of Entomology in the University Museum, Oxford, where he gave immensely valuable help in describing, arranging and recording the historic collections. He joined the Ashmolean Natural History Society in 1904, became president in 1913–14 and from 1911 onwards was editor of the *Proceedings*, in which he published (1907–30) a valuable list of Oxford Coleoptera with supplements; also twenty-three interim reports (1911–38), the last four including Lepidoptera in addition to Coleoptera.

The above is a very condensed account of some of the chief publications of one who, in spite of his great age—eighty-seven years—retained to the very end his wonderful memory, keen interest and the never-failing desire and ability to help his brother-naturalists.

E. B. POULTON.

Prof. Albert Sauveur

PROF. ALBERT SAUVEUR, emeritus professor of metallurgy in Harvard University, whose death occurred recently in Cambridge, Mass., was a Belgian by birth, but was long known as the leading teacher of metallurgy in the United States.

Born at Louvain in 1863, he studied in the School of Mines of Liège, and later crossed the Atlantic to enter the Massachusetts Institute of Technology.

where he graduated in 1889. His first post was as chemist to the Pennsylvania Steel Co.; but after a year he was chosen to take charge of the research laboratory of the Illinois Steel Co. in Chicago. From that time onwards he carried out many researches on iron and steel, making great use of microscopical methods, a field in which there were still few workers. His first paper on the microstructure of iron and steel appeared in 1893 and had many successors. In 1905, he was appointed to the chair of metallurgy at Harvard, which he occupied until his official retirement in 1935, with an interval from 1917 until 1919, during which he acted as director of the Metallurgy Division of the Air Service in France, work recognized by his appointment as a Chevalier of the Legion of Honour.

Sauveur's investigations were concerned almost exclusively with the metallurgy of iron and steel, especially with the problems of hardening and of deformation. His contributions, clearly expressed and admirably illustrated, have played an important part in the development of the subject. In 1898 he founded a journal, the *Metallographist*, which became the medium for the publication of much original work from many countries. Although it lasted only for five years, being then absorbed into another journal, its volumes are often consulted by students. His text-book, "The Metallography and Heat Treatment of Iron and Steel", which first appeared in 1912, has passed through several editions, and is greatly valued. A few years ago he discussed, in the form of a dialogue, the current views on controversial questions in metallurgy.

Sauveur's department at Harvard was small in comparison with the metallurgical departments of many universities and colleges; but the quality of its work was excellent, and many of the ablest American research workers in that field received their training there. He had great charm of manner as well as great gifts of exposition, and was revered by metallurgists as one of their leaders. Even in his retirement he continued to be active, and only last year he initiated a movement with the object of simplifying the description of the microscopic constituents of steel, which he considered to have been obscured by unnecessarily complex hypotheses and cumbersome terminology.

Sauveur received many honours from technical societies, including the Bessemer Medal of the Iron and Steel Institute in 1924. He married, in 1891, Mary Prince Jones, of Massachusetts, and had two daughters.

C. H. D.

Mr. Reynold Bray

MR. REYNOLD BRAY, who lost his life by drowning last September, was an Arctic explorer of considerable achievement and much promise. In 1931, he was with the Oxford University Exploration Club's Expedition to Akpatok in Ungava Bay, Hudson Strait. This expedition, on which Bray was nominally photographer, made a complete survey of this hitherto little-known island. The story was told in "The Tale of Auks" by N. Polunin, 1932. In the follow-

ing year Bray, with T. H. Manning, made a winter tramp through Swedish, Finnish and Russian Lapland from Bodo to Murmanak. Bray recounted this fascinating journey, which included trouble on the Soviet frontier, in "Five Watersheds" (1935). In the following year he was again with Manning, in Southampton Island and Melville peninsula mapping much of the eastern shores of those lands as well as the unknown coast of Baffin Island on the east of Foxe basin.

In 1938, Bray planned with P. Baird to continue his exploration of the western coast and the interior of Baffin Island. Ice, however, interfered with the ship's progress and eventually the two men were landed on the south-east of Melville peninsula, whence they set off in their boat last August in an attempt to reach Igloodik Island, 300 miles to the north at the eastern entrance to Fury and Hecla Strait. Some forty miles south of the island, on September 14 last year, Bray was blown out to sea in a canvas boat and lost.

Mr. R. Kanthack

THE late Mr. Ralph Kanthack, who died in his seventy-seventh year at Golders Green, London, on November 12, was chiefly known for his great ability in scientific translations in English and German. He was educated in Hamburg and Lüneburg, Germany, taking an honours degree in engineering. After some period as a marine engineer, he found himself more attracted to scientific and optical studies, and became associated with Messrs. Carl Zeiss, when he had the advantage of intimate association with Abbe, Czapski and others. This led to his establishment as a London agent for Messrs. Carl Zeiss and Messrs. E. Leitz; but in addition to business activities he was known as an authority on various aspects of microscopy.

In later years, Kanthack began the literary work which brought him well-deserved recognition. He translated and revised a German edition of Prof. Heath's work on geometrical optics ("Lehrbuch der Geometrischen Optik". Berlin: J. Springer, 1894), and during the Great War he translated von Rohr's "The Theory of Optical Instruments" at the request of the British Government. Later, he was associated with Messrs. Adam Hilger, Ltd., for whom he prepared a book in two volumes entitled "Tables of Refractive Indices".

Mr. Kanthack was the eldest son of the late Emilio Kanthack, at one time British Consul of Para, Brazil, and brother of the late Prof. Alfredo A. Kanthack, an authority on pathology. He was much respected in optical circles for his outstanding character.

We regret to announce the following deaths:

Prof. A. P. Coleman, F.R.S., emeritus professor of geology in the University of Toronto, an authority on Canadian metalliferous deposits, on February 27, aged eighty-six years.

Prof. Henry Louis, emeritus professor of mining and William Cochrane lecturer in metallurgy in Armstrong College, Newcastle-upon-Tyne, on February 22, aged eighty-three years.

News and Views

Prof. F. J. Cole, F.R.S.

PROF. F. J. COLE will be retiring from the chair of zoology in the University of Reading in September next, after a tenure of thirty-two years. Prof. Cole built up the Zoology Department from very small beginnings; to-day the University can regard with pride the results of his work and inspiration. The Museum of Comparative Anatomy, though small, is without a rival among those of the younger universities, and the preparations, dissections and models have been executed in the Department. Even the printing of the labels is done there. This Museum has justifiably achieved widespread fame; recently a former keeper of zoology in the British Museum (Natural History) referred to it as the "gem" among British museums of comparative anatomy. Although assisted by a very small, but efficient staff, the organization of the teaching side of the Department has always been of the first class. Until comparatively recently, few students entered a university with even the most elementary knowledge of zoology; but those who were fortunate enough to study the subject at Reading soon became infected with the enthusiasm of Prof. Cole and his staff, and by far the majority became sincere students of the subject, not merely candidates reading for an examination.

PROF. COLE's researches on the nervous system and lateral line system of fishes and on the general morphology of the myxinoïd fishes are well known. In recent years his strong literary bent, scholarly mind and acquisitive love of books have combined to interest him in the history of zoology. He has lectured and written on the biologists of the past, extending to them the same sympathetic understanding of their difficulties and mistakes that he offers to young people struggling along the paths of original investigation under his care, yet always, after the manner of Gibbon, relieving the tedium of instruction with an apt analogy or an appropriate anecdote. Last year, with the collaboration of Mr. Robert Gibbings, he produced a facsimile reprint of a very rare book—"*Observationes Anatomicae Selectiores. Amstelodamensium. 1667-73*" (see *NATURE*, 142, 235; 1938). His researches into the writings of Leeuwenhoek and Swammerdam have taken him to the old towns and museums of Holland. As a result several papers have appeared in the *Annals of Science* and other journals devoted to the history of science. As Prof. Cole will now be able to devote all his time to his unique collections of early medical books we look forward to more of his delightful studies of the biologists of the past.

Prof. Otto Hahn

ON March 8, Prof. Otto Hahn, director of the Kaiser Wilhelm-Institut for Chemistry, at Dahlem near Berlin, will reach his sixtieth birthday. To mark this event, a special number of the *Zeitschrift für*

physikalische Chemie will appear, in which all the articles will be contributed by members of his laboratory. A celebration of a more intimate nature is also contemplated in the Institute itself. Prof. Hahn's friends in other countries, among whom are many readers of *NATURE*, will wish to join with his colleagues in offering their warmest congratulations. To workers and students in the field of radioactivity the names of Otto Hahn and Lise Meitner are almost indissolubly linked together. Readers of *NATURE* will remember that Fräulein Lise Meitner celebrated her sixtieth birthday last November, and it is most fitting that where one has led the other should not be far behind. Prof. Hahn's first work in radioactivity was an investigation of the activity of thorianite, carried out under Ramsay at University College, London. This work led to the discovery of a new radioactive substance, radiothorium. Attracted by the rapidly growing fame of Rutherford, he then went to Montreal for a year (1905-6). There he discovered a new body, radioactinium, in the actinium series and showed that there were marked similarities between the products of thorium and actinium. On his return to Berlin, there followed the discovery of mesothorium and some striking experiments on the use of the recoil phenomenon as a method of separating radioactive products. It was at this time that his association with Fräulein Meitner began. Together they examined the radiations from many radioelements and later, with von Baeyer, they discovered the presence of homogeneous groups in the β -radiation of some products, the first indication of the now well-known β -ray spectra.

Hahn and Meitner also made investigations on the origin of the actinium series and, in 1918, they discovered, simultaneously with Soddy and Cranston in Great Britain, the immediate parent of actinium, protactinium. Later Hahn prepared this new element in a pure state in quantity sufficient for an atomic weight determination. In pursuing his investigations of the disintegration products of uranium, Hahn found a very curious branching of uranium X_1 , which gave rise to two bodies—uranium X_2 , already known, and uranium Z , a new product of the same mass and charge as uranium X_1 , but with different radioactive properties. This was in fact the first example of a pair of nuclear isomers, many of which have recently been found as a result of artificial transformations. In recent years, much of Prof. Hahn's work has been devoted to a study of the artificial transformations resulting from the bombardment of uranium and thorium by neutrons. Only a few weeks ago he was able to show, on chemical evidence, that one of the products of the disintegration of uranium was not, as previously supposed, an isotope of radium but an isotope of barium, pointing to a really dramatic disintegration of the uranium nucleus. This startling conclusion has been confirmed by very striking

experiments in New York, Paris and other places. It will be evident from this very brief account of his work that Prof. Hahn's contributions to radioactivity have been of outstanding importance. He has also taken a prominent part, with his students and colleagues, in developing methods of studying chemical problems by the use of radioactive indicators.

Dr. C. D. Darlington

DR. C. D. DARLINGTON has been appointed to succeed Sir Daniel Hall as director of the John Innes Horticultural Institution, Merton. Dr. Darlington was educated at St. Paul's School, Hammersmith, where he was a Foundation Scholar, and the South-Eastern Agricultural College, Wye. He went to the John Innes Horticultural Institution in 1923, in Dr. Bateson's time. Here his interest was attracted to chromosome studies by the late W. O. F. Newton. As the importance of this kind of work in relation to breeding became recognized, it was considerably extended at the John Innes Institution, and in 1937 Dr. Darlington was appointed head of the Cytology Department. In 1929, he travelled to Persia and Transcaucasia to investigate the origin of cultivated forms of *Prunus* and *Tulipa*. During 1932-33, he worked in the United States for eight months as a Rockefeller Foundation Scholar, visiting Japan and India on his way home. In the winter of 1937-38, he was a delegate to the Indian Science Congress jubilee meeting. He is at the present time acting as recorder to the Cytology Section of the International Genetical Congress. Dr. Darlington, who is well known for his work in the field of genetics and cytology, has published "Chromosomes and Plant Breeding" (1932), "Recent Advances in Cytology" (1932; second edition 1937), "The Evolution of Genetic Systems" (1939), together with numerous scientific communications. He is a collaborating editor of the new journal *Chromosoma* (see p. 372 of this issue). The appointment takes effect from October 1, 1939.

Mr. James Henderson

THE Iron and Steel Institute has awarded the Bessemer Gold Medal to Mr. James Henderson. The Bessemer Medal was founded by Sir Henry Bessemer, and is awarded annually for distinguished merit in promoting the technical and metallurgical development of the iron and steel industry; it is the highest honour which the Institute can give. Mr. Henderson was associated for forty-five years with the technical development of the Frodingham Iron and Steel Co., Ltd., in North Lincolnshire and held all positions from chief metallurgist to managing director. During that period, the works became one of the most important in the country, and were associated with such important developments as the introduction of the Talbot direct metal process, the use of blast-furnace gas in blowing and power engines, and the installation of modern plate mills. Mr. Henderson is now deputy chairman of the renamed Appleby-Frodingham Steel Co., Ltd., and a director of the United Steel Companies, Ltd.; he is past-president of the British Iron and Steel Federation and of the Lincolnshire Iron and Steel

Institute. He is one of the only two Englishmen whose services to the industry have been recognized by nomination to honorary membership of the Verein deutscher Eisenhüttenleute.

Ludwig Mond, F.R.S. (1839-1909)

LUDWIG MOND, patron of the arts and sciences, was born on March 7, 1839, and the commemoration of his centenary is a convenient opportunity to recall something of what we owe to him. Originally German and later a naturalized British subject, he perfected and established in Great Britain the ammonia-soda process which brought into being the firm of Messrs. Brunner, Mond and Company, the nucleus of Messrs. Imperial Chemical Industries, Limited. He also devised satisfactory processes of nitrogen recovery and for the manufacture of producer gas, which latter process is the property of the Power Gas Corporation. No less well known is Ludwig Mond's process for the production of pure nickel, in which a newly discovered and unique compound immediately found important technical application. Throughout his life, he was pre-eminent as a chemist and investigator. His amassing great wealth was the result and not the object of his work.

SOME of Ludwig Mond's public benefactions for the encouragement of scientific investigation may be recalled. During his life he gave £100,000 for the founding and endowment of the Davy Faraday Laboratory of the Royal Institution, and £16,000 for the continuance and improvement of the catalogue of scientific papers of the Royal Society. He bequeathed £50,000 to the Royal Society "for the endowment of research in Natural Science more particularly but not exclusively in Chemistry and Physics". He also bequeathed a similar sum to the University of Heidelberg and £25,000 to Cassel, his native town in Germany. He gave to the nation, together with an endowment for its maintenance, the Mond Collection, chiefly of early Italian paintings, now well known as an important part of the National Gallery. This, and his bequest of £20,000 to the Munich Akademie der bildenden Künste, are memorials to Ludwig Mond's own appreciation of art and to the care he took that others should benefit by it. Truly, this was a great man.

Frederick Howard Marsh (1839-1915)

HOWARD MARSH, an eminent London surgeon and master of Downing College, Cambridge, was born on March 7, 1839, at Homersfield, near Bungay, Suffolk, the son of a gentleman farmer. He received his medical education at St. Bartholomew's Hospital, where he was a contemporary of Alfred Willett (see NATURE, 139, 61; 1937) and qualified L.S.A. and M.R.C.S. in 1861. Five years later he became F.R.C.S. and was appointed surgeon to the Queen Square House of Relief for Children with Chronic Disease of the Joints. In 1868, he was elected assistant surgeon to the Great Ormond Street Hospital for Sick Children, where he afterwards became full surgeon and consulting surgeon. Between 1865 and

1870 he acted twice as private assistant to Sir James Paget, several of whose works he afterwards edited. From 1873 until 1891, when he became full surgeon, he served as assistant surgeon to St. Bartholomew's Hospital, where he lectured on anatomy, practical surgery and orthopaedics. In 1903 he was appointed professor of surgery at Cambridge in succession to Sir George Murray Humphry, who had died in 1896, and in 1907 succeeded Dr. Alexander Hill as master of Downing College. He was the author of "Diseases of the Joints" (1886), which went through three editions and was translated into German, "Clinical Lectures and Essays" (1902) and numerous contributions to *St. Bartholomew's Hospital Reports*. Besides the distinctions already mentioned, Marsh was an honorary fellow of the Royal Academy of Medicine in Ireland, president of the Clinical Society of London and a corresponding member of the Orthopaedic Society of New York. He died on June 24, 1915. A sympathetic obituary notice by Sir D'Arcy Power, accompanied by his portrait, appeared in *St. Bartholomew's Hospital Reports* (51, 1; 1915).

The Bastardy (Blood Tests) Bill

It is to be hoped that the Bastardy (Blood Tests) Bill, which was given its second reading after a debate in the House of Lords on February 8 (NATURE, Feb. 18, 1934), will duly pass into law. The use of blood group tests has already become a common practice in several other countries, notably Sweden, Germany and the United States. The Bill provides that the Lord Chancellor may make rules under the Act, governing the taking, identifying and posting of blood samples, the form of certificate to be given, the qualifications of the 'approved persons' who make the tests, and the scale of fees payable. It may be pointed out that the *M* and *N* tests require much more skill in determination than the *A* and *B*. It would therefore seem desirable for a local practitioner to take the samples as arranged and send them to one of a very limited number of experts who would make the actual tests. The Galton Laboratory is one of the very few places where the *M* and *N* as well as the *A* and *B* tests are constantly being made as a routine operation. In Denmark, a Government laboratory has been established for the purpose, where the tests are made for a small charge. Probably a similar arrangement would be best for Great Britain.

Television in Cinemas

THE practical application of television moved a step forward on February 23, when a view of the whole progress of the British light-weight boxing championship was transmitted from the Harringay arena. On this occasion, for the first time, the television programme was relayed to three cinema theatres in the West End of London, where the public had paid for admission. A report in *The Times* states that two of these theatres used Baird apparatus, while the third used the Scopophony system. These cinemas became in effect overflow meeting places, where those unable to watch the fight in the arena could still follow its progress in black and white

pictures; and the view so provided on a fifteen foot screen was the equivalent of a ring-side seat. At the transmitting end, two cameras were used, one giving a general view of the ring with the spectators scarcely visible in the surrounding darkness, while the other gave a close-up view of the two boxers. The latter was used most of the time and enabled viewers to watch the detailed progress of the contest. With the exception of one or two occasions, when there appeared to be a loss of synchronism in the transmitted pictures, the apparatus worked quite satisfactorily, and the accompanying running commentary was up to the usual high standard for sound broadcasting. The successful transmission of this fight demonstrated that such an event is very suited to television, and that the inevitable technical difficulties of relaying the programme to cinemas have been largely overcome. As a result, according to a further announcement in *The Times*, Baird television apparatus is to be installed in some 350 cinemas controlled by the Gaumont-British Picture Corporation.

University of Birmingham: Annual Report

IN the report of the Council which was presented to the Court of Governors at its annual meeting on February 23, reference is made to two recent benefactions, namely, one of £10,000 by Sir Charles Hyde and the other of £2,000 by the Pro-Chancellor and Mrs. Barrow. These were given as peace thank-offerings. Sir Charles Hyde's gift, to be applied to a purpose chosen by the Prime Minister, is to be known as the Neville Chamberlain Physical Fitness Fund, and the income is to be used towards the maintenance of the University's scheme for physical education. The contribution of Mr. and Mrs. Barrow is to be added to the Medical School building fund. Mrs. Ellen M. Parrott has given £500 in memory of her late husband, to be known as the T. H. Parrott Geological Research Fund, for 'advancement of research in Geology'. Dr. and Mrs. Edward Cadbury, who recently provided funds for the building of the St. Francis Hall, have given a further sum of £3,000, the income of which is to be used for the maintenance of the Hall. As part of the scheme for physical education, a gymnasium (with ancillary rooms and three squash courts and one fives court) is to be built at a cost of £15,000, of which £10,000 has been promised by the University Grants Committee and £5,000 by a private benefactor. Funds for the establishment of a department for research into mental diseases in the new building of the Medical School have been guaranteed for a number of years. The laboratories are now occupied, and Dr. Stanley Barnes has been appointed honorary director of mental diseases research, with Dr. F. A. Pickworth as senior research officer. Several investigations into cancer, financed by the Local Committee of the British Empire Cancer Campaign, are being carried out in the new Medical School. The Poynting Memorial Lecture is to be given on March 7 in the Physics Department by Dr. H. B. G. Casimir, of Leyden, on "The Approach to the Absolute Zero of Temperature, and the Properties of Matter at the

Lowest Attainable Temperatures". The Huxley Lecture is to be given on March 16 at the University, Edmund Street, by Sir Albert Seward on "Aspects of Evolution in the Plant World".

Vocational Rehabilitation of the Physically Disabled

A STUDY of the vocational rehabilitation of the physically disabled has been prepared for the Advisory Committee on Education by Lloyd E. Blanch (U.S. Government Printing Office, Staff Study No. 9). The study reviews the development, status and problems of the rehabilitation service inaugurated in July 1920 by the Federal Government, under which up to June 30, 1937, 98,690 persons had been rehabilitated. In the year ended June 30, 1937, vocational rehabilitation was completed for 8,691 men and 2,400 women, about 60 per cent of whom received some training. Maintenance was provided or secured for 948 while they were undergoing rehabilitation. Of those rehabilitated, 64 per cent were less than thirty-one years of age and only 8 per cent were more than fifty. Most of those rehabilitated (61 per cent) were without dependants, but 26 per cent had two or more dependants. Orthopaedic disabilities handicapped 75 per cent of those rehabilitated. The study suggests that 150,000 persons each year acquire permanent disabilities sufficiently serious to prevent them from returning to work without assistance. About 50,000 of these can be employed normally after rehabilitation; 75,000 can be employed only in sheltered workshop conditions, while the remaining 25,000 can only be employed, if at all, in their homes. Accordingly the present programme only rehabilitates about 20 per cent of the physically disabled who need such assistance. The study concludes that a permanent Federal programme is required and insists on the importance of Federal administration and of the co-ordination of Federal services which affect vocational rehabilitation. Reference is also made to special services for the blind and to the need for an extended programme, including the provision of living expenses during rehabilitation.

The New Deal in the United States

In *Fact* of October 1938, under the title "Roosevelt and his New Deal", Stephen K. Bailey gives a concise account of the achievements of the New Deal up to the end of September, which indicates not merely the problems which faced Roosevelt but also the background of social and economic conflict against which they have to be assessed. In successive chapters, the attempts made to meet the needs of the farmer, under the Agricultural Adjustment Administration and the Farm Credit Administration, etc., the industrialist, under the National Industrial Recovery Act and the Public Works Administration, as well as the needs of labour and the unemployment situation by the Federal Relief Administration, are surveyed. The complexity of the situation is clearly indicated as well as the way in which the conflict between big business interests and labour has been intensified, the difficulties which the Federation has to overcome in the direction of social reform, the establishment of a really sound banking system, and the problem

of the Supreme Court. Mr. Bailey hazards no guess as to the outcome of the present situation: the successes and failures of the New Deal are impartially indicated as well as some of the reasons for the vagaries of American foreign policy; but his account, whether or not it is used as an introduction to further study, should at least contribute to the sympathetic understanding of the American situation, although the rather sombre picture he gives of the relation between employers and employees and of the attitude of the former to social reform does not encourage optimism.

Selection of Sizes of Timber Beams

THE determination of the suitable breadth and depth of a timber beam to carry a given load involves consideration of strength, of stiffness, and of the capacity of the material to withstand the horizontal shear forces induced in it by the transverse loading. The calculations which these considerations necessitate can, however, be entirely eliminated by making use of a set of three charts recently published under the title "Charts for the Design of Timber Beams". These charts have been prepared by V. D. Limaye, officer-in-charge of the Timber Testing Station, Forest Research Institute, Dehra Dun, United Provinces. The first of them is designed to ensure that a beam of adequate strength is chosen. In it two nomographs are provided which, from the given load per square foot, span, and spacing, ascertain the total load carried by the beam. Then, by the drawing of four horizontal and vertical lines terminated by suitably placed diagonal lines which are embodied in the chart, the breadth and depth of a sufficiently strong beam are obtained. In most cases in which timber beams are used, it is necessary to restrict the deflection under load to certain specified limits, and stiffness has therefore to be arranged. This is done by means of the second chart, which enables the correct amount of adjustment to be made in the sizes already determined so that the required degree of stiffness is assured, and the process involves only the drawing of another set of horizontal and vertical lines. In the third chart a third series of horizontal and vertical lines leading to a final nomograph either confirms the horizontal shear strength as adequate or shows the correction required so that, in the end, the section evolved is suitable for its purpose from all points of view.

Magneto or Coil Ignition for Motor-Cars

F. R. HAIGH has recently compared the relative advantages of magneto and coil ignition used for generating the explosions which occur in motor-car engines (*Students' Quart. J. Inst. Elec. Eng.*, Dec.). Coil ignition was prominent on the early types of petrol engines, but magnetos appeared on the market and for a number of years prior to 1914 a Bosch magneto was regarded as the acme of perfection. About ten years ago coil ignition systems came to the front. The magneto is of great importance in aero work and is popular on racing-cars, but in motor-vehicles it has been almost entirely replaced by coil ignition. Modern coil ignition systems are

very trustworthy. The causes of the failure of the ignition system are almost always due to battery and wiring faults; they are very rarely due to the ignition apparatus itself. The contact breaker, coil and ignition switch are generally mounted at different points and thus their action is dependent on the soundness of the wiring between them. Loss of magnetism which used to cause trouble with magnetos is absent in coil systems. Ease in starting up an engine is a prominent feature in coil ignition; at whatever speed the engine is turning, a good spark is always obtained at the plug points. The contact breaker is usually the first component to be examined following an ignition failure, and hence its accessibility and ease of adjustment are of great importance. In this respect, coil ignition has nearly always the advantage. A clear view of magneto contact breakers can rarely be attained without the aid of a mirror. Coil ignition is also greatly superior to the magneto so far as the rapid replacement of faulty parts is concerned.

Scandinavian Museums

AN article by J. A. Sidney Stendall on museums in Scandinavia (*Museums J.*, 38, 397, Nov. 1938) should prove of value to museum curators in Great Britain. The author selects for special description details of exhibition technique. His diagrams of methods of showing specimens, of artificial lighting, and of construction of exhibition cases for straightforward display or for the building up of pictorial dioramas, show how carefully and successfully these aspects have been considered in the museums of Sweden. There are suggestions here the adoption of which would add interest to many museums in Great Britain.

Chromosoma

THE development of the chromosome theory of heredity during the last twenty years has led to the publication of some thousands of papers devoted to a study which is at once genetics and cytology. These papers have been published partly in the special genetical journals—*Genetics*, *Bour's Zeitschrift*, *Genetica*, *Hereditas* and the English and Japanese *Journals of Genetics*—and partly in the special cytological journals—*La Cellule*, *Cytologia* and *Messrs. Springer's Zeitschrift für Zellforschung und mikroskopische Anatomie*. Many also have been published by the older zoological, botanical and general scientific journals. *Messrs. Springer* have now divided their journal into two parts, which will appear separately this month, marking not inappropriately the centenary of the cell theory. Part A, *Allgemeine Zellforschung und mikroskopische Anatomie* will continue to deal with the physiological and histological side of cell-study with which the old journal was largely concerned. Part B, under the short title of *Chromosoma*, will be in effect a new journal. It will deal with the chromosomes in their twin aspects of cell mechanisms and organs of heredity. Dr. Hans Bauer, of the Kaiser Wilhelm-Institut für Biologie in Berlin-Dahlem, is the general editor. He has secured the collaboration of Dr. Lothar Geitler of Vienna,

Dr. T. Caspersson of Stockholm, Dr. A. Müntzing of Lund, Dr. W. v. Möllendorf and Dr. J. Seiler of Zurich, Dr. O. L. Mohr of Oslo, Dr. C. D. Darlington of London, Dr. F. Schrader of New York, and Dr. Th. Dobzhansky of Pasadena. The balance of zoology and botany, chemistry and genetics in this group should ensure a competent discrimination as well as a new point of view in furthering this youngest of the sciences.

Sixth Pacific Science Congress

THE sixth Pacific Science Congress will be held in Berkeley, Stanford and San Francisco, California, during July 24–August 12 under the auspices of the National Research Council of Canada, on the invitation of the U.S. National Research Council. The programme is so constituted as to emphasize the discussion of comprehensive scientific topics of general interest to the peoples living within the Pacific basin, and the theme of the Congress will therefore be “the present stage of knowledge of Pacific scientific problems and methods by which that knowledge may be most profitably enlarged”. For this reason, the programme is arranged as a series of symposia rather than a collection of independent papers. Forty-two countries have been invited to take part. Further information can be obtained from Dr. R. E. Clausen, Room 205, Hilgard Hall, University of California, Berkeley, California.

Study Meeting on Magnetism

A STUDY meeting on magnetism, to be held in Strasbourg during May 21–25, is being organized by the Institute of Intellectual Co-operation in collaboration with the Service Central de la recherche scientifique de France. The following subjects will be discussed: (1) paramagnetism, very low temperatures, relaxation and nuclear magnetism; (2) optics and paramagnetism, low temperatures and moderately low temperatures; (3) ordinary paramagnetism; (4) ferromagnetism, (a) atomic and molecular moments, (b) ferromagnetism and the crystalline network, (b') interaction and its relationship to thermodynamics, (c) Curie points, (d) gyro-magnetic phenomena. A number of papers have already been arranged, and it is expected that about thirty eminent authorities on the subject will attend the meeting. The papers and a report of the discussions will be published in the fifth volume of the “Scientific Collections” of the Institute. Further information can be obtained from the International Institute of Intellectual Co-operation, 2 Rue de Montpensier, Paris, 1^{er}.

Physics in the Textile Industries

THE annual general meeting of the Manchester and District Branch of the Institute of Physics is to be held in the Physics Department of the University of Manchester at 7.30 p.m. on Friday, March 17. Immediately after the conclusion of the business of the meeting, Dr. F. C. Toy, chairman of the Branch, will speak on “The Physicist in the Textile Industries”, and will attempt to give some idea of the vast scope in textile research for the employment of theoretical

and applied physics, and for the application of physical methods. In view of the Institute of Physics forthcoming Conference on Textile Physics it may be expected that Dr. Toy's lecture will be of special interest to members of the Institute, and to others connected with the textile industries.

Conference on Industrial Physics

THE third Conference on Industrial Physics is being arranged by the Institute of Physics to take place in Leeds during March 23-25 under the presidency of Prof. R. Whiddington. The subject of the Conference is to be "Physics in the Textile Industries". An exhibition of instruments, apparatus and books cognate to this subject is being arranged and will be held in the Physics Laboratories of the University of Leeds. A section of the Exhibition, intended to be of special interest to non-technical persons, will be devoted to popular applications of physics in the textile industries. Addresses will be given by the president of the Institute of Physics, Dr. C. C. Paterson, on "Colour and Colour Rendering" and by Dr. C. G. Darwin, director of the National Physical Laboratory, on "Heat Effects in Fibres and other Systems". In addition, the following lectures, to be followed by discussions, have been arranged: "The Physics of Humidity" by Prof. R. Whiddington; "Industrial Humidity Control and Measurement" by Dr. Ezer Griffiths; "The Contribution of Physics to the Development of Industrial Process Control" by Dr. M. C. Marsh; and "Automatic Regulators for the Textile Industries" by Mr. D. Harrison. Visits to local works and research laboratories will be included in the programme, and a Conference dinner is being arranged. There will be no Conference fee, and membership is open to all interested. Further particulars can be obtained from the Secretary, Institute of Physics, 1 Lowther Gardens, Exhibition Road, London, S.W.7.

Announcements

THE following awards have recently been made by the Royal Academy of Belgium: Charles Lemaire prize to E. Franchimont; François Deruyts prizes to P. Burniat and F. Rozet; Léo Errera prize to A. Daleq; Joseph Schepkens prize to R. Steysert; Adolphe Wetremis prize (natural sciences) to C. Stevens; Albert Brachet prize to L. Sven Horstadius. The Paul Fourmarier prize to L. Cayeux. Prof. H. N. Russell, of Princeton, and Prof. A. Pietet, of Geneva, have been elected associates of the section of mathematical and physical sciences of the Academy.

COSTANTINO GORINI has been elected *correspondant* for the Section of Rural Economy of the Paris Academy of Sciences in succession to the late L. Ravas.

THE following awards have been made by the Council of the Royal Aeronautical Society: *Silver Medal*: Major R. H. Mayo, for his work leading to an advancement in aeronautical design; *Taylor Gold Medal*: Squadron Leader H. P. Fraser, for his paper on "High Wing Loading and Some of Its

Problems from the Pilot's Point of View"; *Wakefield Gold Medal*: Mr. Leslie L. Irvin, for his work on parachute design, which has led towards safety in flying; *Bush Memorial Prize*: Squadron Leader G. M. Buxton, for his paper on "The Development of Sailplanes", and to Mr. H. F. Vessey, for his paper on "Effect of Wing Loading on the Design of Modern Aircraft with Particular Regard to Take-off Problems"; *Filcher Memorial Prize*: Mr. H. E. H. Roehfort, for his paper on "The Theory and Practice of Stressed Skin Construction for Aeroplanes"; *Usborne Memorial Prize*: Mr. P. H. Rayner, for his paper on "Notes on Aero Engine Research".

THE following appointments and promotions in the Colonial Service have recently been made: R. K. Tremlett, agricultural officer, Uganda; J. N. See, veterinary officer, Leeward Islands; W. M. Rogers, tobacco officer, Agricultural Department, Ceylon; O. J. Voelcker, senior botanist, Agricultural Department, Nigeria; N. R. McHardy (senior inspector of plant diseases), land settlement officer, Jamaica.

THE Leipzig Fair will be held on March 5-13. The Samples Fair will be open during March 5-10; but the Great Engineering and Building Fair will be open for the whole time. Further information can be obtained from the London office of the Leipzig Fair, 426-9 First Avenue House, 45 High Holborn, London, W.C.1.

THE Federation of Medical Societies of North Africa will hold its annual congress on April 3-5 at Oran under the presidency of Dr. Jasseron. The subject for discussion will be brucella infections. Further information can be obtained from the general secretary, Dr. René Solal, 16 Boulevard Maréchal Joffre, Oran, Algeria.

THE Royal Statistical Society is offering the Frances Wood Memorial Prize, value £30, for competition in 1939. The Prize is offered for the best investigation, on statistical lines, of any problem affecting the economic or social conditions of the people. Further information can be obtained from the Honorary Secretaries of the Royal Statistical Society, 4 Portugal Street, W.C.2.

WE are asked to state that all reprints of papers of the late Prof. George Barger have been placed in the Department of Chemistry, The University, Glasgow, and copies can be obtained from there on application to the Secretary of that Department.

THE *Proceedings of the Linnean Society*, Part 4, published on December 30, contain, together with the address of the president, Dr. J. Ramsbottom, abstracts of the papers delivered by invitation at the two symposia held by the Society as part of the 150th anniversary celebrations, upon the subjects of "The Concept of Species from the Time of Linnaeus to the Present Day" and "Geographical Isolation as a Factor in Species Formation" (*NATURE*, 141, 998; 1938).

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 381.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Forbidden Lines of Fe VII in the Spectrum of Nova RR Pictoris (1925)

THE bright line spectrum of Nova RR Pictoris (1925) is characterized in the later stages by a group of lines in the visible region, of which the most prominent, λ 5723 and λ 6087, form with H α and λ 4686 of He II the dominating lines of the spectrum¹. These lines have not been found in any other spectrum and no adequate explanation of them has been given so far.

Some coincidences between lines in Nova Pictoris and forbidden transitions in Fe VII² suggested a search for analogous lines of Fe VII. Extrapolating the position of the multiplet $3d^3\ ^3F - 3d^3\ ^3P$ in Fe VII, one finds a striking coincidence with a group of lines in Nova Pictoris. The significance hereof is strengthened by the exact reappearance of the separation $^3F_4 - ^3F_2$ between λ 5723 and λ 6087, indicating the identification $^3F_4 - ^1D_2$ and $^3F_2 - ^1D_2$. However, due to the uncertainty in the preceding iso-electronic spectra, the location of ^1D could not be predicted by extrapolation, and a previous analysis of FeVII³ is inconsistent with the suggested identifications. Thus a new attempt at locating the $3d^3$ terms of FeVII became highly desirable. This has now been accomplished, and the result confirms and extends the suggested explanation of the Nova Pictoris spectrum, as will be shown below.

The vacuum spark spectrum of iron photographed with a previously described spectrograph⁴ at 0.5 A. per mm., reveals several line groups involving $3d^3$ terms. The group $3d^3 - 3d\ 4f$ at λ 150 A. to 159 A., which is well separated from other transitions and shows strong intercombinations, was chosen as the most suitable for the purpose. It was possible to classify all (42) observed lines of the group with a tolerance of about 0.001 A. and establish in good agreement with the theoretical formulae⁵ all terms of each configuration, which are able to appear in the group. The details of the analysis will be published elsewhere. The $3d^3$ levels thus located are collected in the following table.

$3d^3\ ^3F_4$	0	$3d^3\ ^3P_2$	20037
$^3F_3$	1047	$^3P_1$	20428
$^3F_2$	2327	$^3P_0$	21275
$^1D_2$	17475	$^3G_4$	23616

The calculated wave-lengths (± 2 A.) of the forbidden transitions between these terms are as follows:

$$\begin{aligned} ^3F - ^1G & 3457.3, 3587.2, 3759.9; \\ ^3F - ^3P & 4099.0, 4993.9, 4943.3, \\ & 4989.4, 5158.3, 5376.1; \\ ^3F - ^1D & 5720.9, 6085.5, 6599.7. \end{aligned}$$

The corresponding lines in Nova Pictoris in 1933; some of which are blends, are 3760.0, 4701.2, 4894.8, 4944.7, 4986.1, 5155.3, 5275.6, 5723.4, 6087.5.

From the comparison it is evident that the complete array of [Fe VII] transitions falling in the investigated region recurs in Nova Pictoris. At the same time, all the lines of hitherto unknown origin in the visible spectrum of the late stages of Nova Pictoris are explained.

The following remarks may be added. The strong 'out of focus' line λ 3760, which was previously ascribed to O⁺⁺, is no doubt mainly due to [Fe VII], although O⁺⁺ may contribute, especially in the earlier stages of the nova. The nebular pair of [Oa V] is certainly present, one component being λ 5308 and the other coinciding with λ 6087. The blend of [Oa V] and [Fe VII] in λ 6087 would explain the observed variation in the intensity ratio between λ 5723 and λ 6087, which has been considered as indicating that these lines cannot have a common origin⁶.

I. S. BOWEN.

California Institute of Technology,
Pasadena, California.

B. EDLÉN.

Physics Laboratory,
University, Uppsala.

¹ Jones, H. B., *Mon. Not. Roy. Astro. Soc.*, **94**, 25, 816 (1933-34).

² Bowen, I. S., *Phys. Rev.*, **47**, 924 (1935).

³ Cady, W. M., *Phys. Rev.*, **43**, 323 (1933).

⁴ Edlén, B., *Z. Phys.*, **180**, 631 (1936).

⁵ Condon, E. U., and Shortley, G. H., "The Theory of Atomic Spectra" (Cambridge Univ. Press, 1935), p. 202 and 203.

⁶ See ref. 1, p. 36.

Origin of the Earth's Magnetic Field

THERE is considerable physical evidence that the earth possesses a metallic core¹. Jeffreys² has estimated the viscosity of the core and finds it as low as 10^{19} c.g.s. units. If this value is correct, an intense thermal convection must be maintained in the core by the heat development of radioactive impurities, even if the amount of the latter is exceedingly small compared to their concentration in the earth's crust.

I have developed a tentative theory of the magnetic field based on the assumption that this field is caused by thermo-electric currents in the core which owe their existence to the conditions created by the turbulent convection. The thermo-electric current density is

$$I = \sigma \text{ grad } \omega - B \text{ grad } T, \quad (1)$$

where σ is the conductivity, ω the potential of the space and surface charges, B the thermo-electric constant of the material and T the temperature. σ , B , T are functions of the co-ordinates. If they are given, ω follows as solution of the differential equation $\text{div } I = 0$ together with proper boundary conditions.

It might appear surprising that the local fluctuations of the currents (1) should sum up to yield a resultant magnetic momentum which is approximately parallel to the earth's axis. The reason for this is found in the action of the *Coriolis force* upon the mechanical motions of the fluid mass. A glance at the hydrodynamic equations will show that for small values of the viscosity the Coriolis force is vastly preponderant as compared to all other dynamical effects. This causes a peculiar east-westerly asymmetry of the temperature variations at a given level. The latter variations are, in the usual way, produced by the vertical component of the convective motions.

For the further considerations, we shall confine ourselves to the second term on the right-hand side of equation (1), which presumably contributes the major part of the magnetic momentum. The discussion of the first term is closely analogous. It is readily seen that the magnetic dipole momentum vanishes, if, for a given depth, B is a constant. This means that in a homogeneous mass no temperature fluctuations would produce a magnetic momentum. In addition to the hypothesis of convective motions, we must therefore admit the existence of *inhomogeneities* in the earth's core. Since any particle of the mass undergoes large pressure changes during vertical displacements, the inhomogeneities are best accounted for by phase transformations induced by the pressure changes which are a frequent occurrence at high pressures². Perhaps there are also considerable chemical inhomogeneities present in the core, and while there would be a regular stratification in a state of rest, the distribution of the phases will become irregular under the constant stirring action of the convection.

No additional assumptions have been found necessary. An attempt has been made to estimate roughly the order of magnitude of the thermo-electric currents. Using some simple results of the theory of metallic conductivity, values of σ and B were estimated for iron under the physical conditions of the core. It was found that with temperature differences so low as 10° the current density is of the order of 10^{-4} amp./cm.². This is enough to explain the observed magnetic field as the result of a small one-sided excess in a current system of irregular distribution.

A full account of this investigation will appear shortly in the *Physical Review*.

WALTER M. ELSASSER.

California Institute of Technology,
Pasadena, California.

Jeffreys, H., "The Earth" (2nd ed., 1927, ch. vii).

² Jeffreys, H., *Mon. Not. Roy. Astro. Soc., Geophys. Suppl.*, 1, 371, 416 (1928).

³ Bridgman, P. W., "The Physics of High Pressures" (London, 1931, ch. viii).

The Expanding Universe and the Origin of the Great Nebulae

SIR JAMES JEANS¹, commenting on our recent letter², criticizes the numerical relation between the distances between nebulae and their radii following from our point of view on the formation of nebulae. We should like to emphasize here that, owing to the uncertainty of the observational data, the values used by us can only be taken as representing orders of magnitude.

For the diameter of nebulae we used the value

(2,000 light-years) corresponding to spherical nebulae ($E0$) which seemingly represent the theoretically simplest case. If, however, one uses the most elongated nebulae the *average* diameter will be larger only by a factor 2.5 not seriously affecting the general agreement.

The numerical discrepancy of a factor $8\pi^2/9 \simeq 9$ between the exact formula of gravitational instability as developed by Jeans and the simplified one used by ourselves, is due to the fact that Jeans identifies the square of the critical wave-length λ_c , as given in his book, with the square of the *radius* of condensing matter as given by us. This wave-length should be, however, equal to, or larger than, the *diameter* of the condensing sphere; the discrepancy thus becomes less than a factor of two.

The only important modification proposed by Jeans is that instead of Hubble's value 0.8×10^{-26} gm./cm.³ for mean density of matter, he suggests that a larger value 2.5×10^{-26} gm./cm.³ obtained by Sinclair-Smith and others should be used. It should be indicated, however, that whereas Hubble's value for the average mass of nebulae as used by us was derived from the nebular rotation on the assumption that *the nebulae themselves are in a state of equilibrium*, the proposed new value is based on the somewhat arbitrary assumption that the so-called clusters of nebulae are stable. The question as to the status of such clusters is in fact a rather difficult one, and we hope to discuss it in a later publication. Thus it seems more plausible to use Hubble's value which leads to the velocity of particles of the order 100 km./sec. rather than 20 km./sec.

Assuming particles of mass at least equal to that of the hydrogen atom, a temperature of at least 0.4×10^4 degrees C. is obtained. Of course, a pure gas of free electrons could not be responsible for the formation of nebulae; an equal mixture of free electrons and protons (necessary to secure the neutrality of matter) reduces the temperature only by a factor of two.

A more detailed statement of our point of view and its relation to relativistic cosmology is contained in our longer article soon to be published in the *Physical Review*.

G. GAMOW.

E. TELLER.

George Washington University,
Washington, D.C.

Feb. 7.

¹ Jeans, Sir James, *NATURE*, 143, 168 (1939).

² Gamow, G., and Teller, E., *NATURE*, 143, 116 (1939). Owing to a manuscript error, a phrase was omitted from this letter. After the word "distances" in the eleventh line from the end, the following phrase should be inserted: "which after correction for reddening becomes an apparent increase in density at great distances".

Crystal Structure of Methane at the Transition Point, 20.4° K.

We have made a detailed X-ray investigation of the crystal structure of methane in the transition region, and find, in accordance with previous results¹, that the lattice of methane above and below the transition point is a face centred cube.

In the neighbourhood of the transition point, new lines appear on the photographs apart from those belonging to the face centred cube. We observed as many as five. Some of these lines are quite strong and comparable in intensity with those of the normal lattice. Mooy (*loc. cit.*) has already found evidence of additional lines which he calls parasitic lines.

We have come to the conclusion that these new lines, including the 'parasitic' ones, are essentially connected with the transition and cannot therefore be treated as if they were merely accidental.

A detailed account of this work is to be published shortly.

ALEX. MÜLLER.

ADOLF SCHALLAMACH.

Davy Faraday Research Laboratory,
Royal Institution,
London, W.1.
Feb. 14.

¹ Mooy, H. H., *Comm. Leiden*, 213 d.

Spectrum of Singly Ionized Tellurium (TeII)

AN extensive investigation of the spectrum of tellurium as excited especially in condensed discharges through capillary tubes and in vacuum sparks and photographed in the region from λ 7000 Å. to λ 400 Å. has led me to an elucidation of the analysis of the higher spark spectra of the element¹. A further study of the above data has now revealed the structure of the spectrum of singly ionized tellurium (TeII). The lines $\nu\nu$ 86,096, 82,742, 78,447 are identified as forming the fundamental combination $5p^4S - 6S^4P$ which has enabled the extension of the scheme into the region of longer wave-lengths. It has been possible to set up a related system of doublet and quartet terms through the detection of several intercombination lines. The $5p^3D$ and ^1P intervals are found to be 2,734 cm^{-1} and 4,180 cm^{-1} respectively. The structure is analogous to that of SeII worked out by me previously².

Full details of the analysis are being prepared shortly.

K. R. RAO.

Andhra University,
Waltair.
Feb. 3.

¹ *Proc. Roy. Soc., A*, 123, 230 (1929); 158, 502 (1937).

² *Proc. Roy. Soc., A*, 140, 56 (1935).

Achromatic Lenses employing Lithium Fluoride and Fused Quartz

THE introduction of lithium fluoride in synthetic crystal form (a technique developed by Dr. D. O. Stockbarger¹ and his colleagues at Massachusetts Institute of Technology) has been the means of filling a much-needed want in optical materials. In Great Britain little use appears to have been made of this material. Its chief characteristic is its high transparency from wave-length 1200 Å. up to 20,000 Å.; furthermore, its homogeneity is excellent (even in large crystals) and in this respect is superior to fluoride or quartz.

I made use of this material some two years ago when a vacuum spectrograph² was constructed employing lithium fluoride for the optical components. No deterioration of the surfaces of the prism or lenses of this instrument has been detected during this period.

More recently, I have completed calculations for the design of a lens system (combining lithium fluoride and fused quartz), which gives complete achromatism for a spectral range between λ 5461 Å. and λ 2749 Å. This fact would appear to be of considerable importance, for it means that a lens system designed for use in the ultra-violet part of the spectrum

can be focused in visual light, and no change in focus will be necessary for the ultra-violet. Moreover, a band of ultra-violet wave-lengths may be employed with such a lens system instead of strictly monochromatic illumination, as has hitherto been necessary in the case of ultra-violet microscope lenses.

Lithium fluoride combined with fused quartz achromatic lenses might also be of value for the collimator and telescope lenses of spectrometers used in the ultra-violet region, spectrographs, and possibly photographic lenses.

The suitability of these two materials for achromatizing purposes is clearly indicated in the calculations. The spherical aberration and the offence against the sine condition can also be kept within the permissible tolerances.

The microscope lens system which has been designed is now under construction and the results will be published in due course.

B. K. JOHNSON.

Technical Optics Department,
Imperial College of Science and Technology,
London, S.W.7. Jan. 31.

¹ Stockbarger, D. O., *J. Opt. Soc. America*, 15, 359 (1927).

² Johnson, B. K., *J. Sci. Instruments*, 18, 126 (1938).

Meteoric Falls in the U.S.S.R.

Meteorite at Kuskochin, Nakhin, Tschernigow, Ukraine. This meteorite fell on June 11, 1938, at about 11^h U.T. (2^h p.m.). The place of the fall is 0.9 km. east of the village of Kuskochin, Nakhin district, Tschernigow region (lat. 57° 03' N., long. 31° 50' E.), 25 km. north-west of the town Nakhin. The sky was quite cloudless; but no conspicuous optical phenomena were witnessed. Acoustic phenomena, resembling the roar of distant thunder or gunfire, were heard over an area of 12 km. radius. Their duration was on the average 8 sec. Three shepherds, G. Pivovarov, I. Miroshnikov and I. Mosko, heard, moreover, a noise and whistle and had a glimpse of a grey or bluish body cutting itself into the ground a few metres from them; a cow fell to the earth at a distance of 4.5 m. About one hour later they took the meteorite out of the pit, 30 cm. deep, it had formed. Its top was 2 cm. below ground. The soil is here dried up owing to drought, but is normally swampy and covered with grass. The fallen meteorite, weighing 2,250 gm., of irregular shape, with smoothed angular contours, scattered the earth 5 cm. from the edges of the pit, mostly in the eastern direction.

The Geological Institute of the Ukraine Academy of Sciences, Kiev, was informed of the fall, and on June 29, Souchtchitsky, a scientific worker of the Institute, took the meteorite to Kiev. At the Institute, Pilipenko, analytical chemist, obtained the following results by analysis of the meteorite.

	I	II	III	IV
Composition	Per cent	Relative Numbers	Relative Numbers	Per cent
SiO ₂	44.40	12.43	19.80	39.06
FeO	40.04	86.66	45.79	45.33
Al ₂ O ₃	2.21	0.23	0.62	1.73
MnO	0.003	0.04	0.02	0.05
Cr ₂ O ₃	0.54	0.19	0.20	0.45
MgO	7.89	—	—	6.23
CaO	2.51	—	—	1.61
S	2.68	1.23	2.47	2.77
NiO	traces	13.60	3.20	1.55
TiO ₂	—	0.12	0.06	0.018

The crust was taken off during the analysis (III totalling 1.75 gm.). The inner substance of the

meteorite was pounded in a mortar and the magnetic portion was isolated (II, total 2.46 gm.), as was the non-magnetic portion (I, 1.573 gm.). Column IV of the table shows the mean chemical composition of the meteorite as given by the director of the First Astronomical Observatory of Odessa, R. L. Dreizin, who inspected the place of the fall on August 26-31, 1938. I wish to express my gratitude for information provided by him.

The meteorite has small hollows or piezoglyphs. It is covered with a dull black crust; inside it is grey. The shepherds had broken off a small piece, which is lost, from one of the angles. Its shape is not orientated.

The direction of flight was approximately from south-west to north-east; the geocentric velocity was evidently very small (absence of light phenomena, loud detonations, crushing and deep piezoglyphs). The meteorite obviously fell as one stone. The position of the radiant, $\alpha = S. 30^\circ W.$, $h = 30^\circ$ for $14^h 07^m$ local time gives the equatorial co-ordinates $\alpha = 88^\circ$, $\delta = 2^\circ$, that is, 23° from the sun ($\alpha = 79^\circ$, $\delta = 23^\circ$). The apparent elongation from the apex is $\epsilon = 90^\circ$, the true elongation for a parabola is $\epsilon' = 143^\circ$, and the unperturbed geocentric velocity, $v_p = 10.8$ ($v_p' = 15.6$ km./sec.), which accounts for the weakness of the acoustic and optical phenomena.

The "Zhovtynsky" Meteorite, khutor Pavlovka, Mariinsky District, Stalino region, Ukraine. This stone meteorite fell on October 10, 1938, entering to a depth of 70 cm. into the ground. Its weight is 30 kgm. The fall occurred at night. Some days later it was found by a peasant, Maria Boushna. The meteorite was dragged out of the hole it made and broken into many fragments. At the break it is grey, stony, with metallic spangles. The greatest part of the fragments was taken to the Stalin Museum (at Stalino, Ukraine), four pieces were brought to the Academy of Sciences of the U.S.S.R., Moscow, to the Meteorite Commission. On December 16 another large piece was handed over to the Academy.

This meteorite is the fifth to be found in 1938 in the U.S.S.R. The total number of meteorites of the U.S.S.R.¹ is now (Jan. 1, 1939) ninety-five.

L. S. ASTAPOWITSCH.

University,
Moscow.
Jan. 6.

¹ Astapowitsch, L. S., *J. Roy. Ast. Soc. Canada*, 33, No. 7, 195-196, 1938 (A list of the meteorites of the Soviet Union).

The Helm Wind of Crossfell

OCCURRENCES of 'helm wind' have been tantalizingly few; several have coincided with other engagements, or with serious difficulty in crossing the Pennines. It is established, however, that (a) the characteristic phenomena¹ are liable to occur whenever a well-developed current of air is flowing from a direction between east and north-north-east, that is, within about 30° of a direction at right angles to the trend of the escarpment. With deviations greater than this, considerable modifications are found to occur. (b) The depth of the surface air current up to the summit level of the clouds should be not greater than about 5,500 ft. The observed phenomena then appear to be analogous to those at a submerged weir with faces inclined gently upstream, and more steeply downstream. The 'helm wind' corresponds to the 'rapid' set up in the air-current flowing over the

escarpment; the crest of the downstream 'standing wave' is marked by the 'helm bar'. If the north-easterly current is of greater uninterrupted depth, the 'standing wave' appears to flatten out and the 'bar', with its underlying reverse current at ground-level, is no longer found.

Keen local observers therefore distinguish 'general north-east wind' from 'helm wind', and from the evening 'fell wind', a katabatic flow in quiet weather. As might be expected, the wind at the ground is characteristically very gusty near a point halfway between the 'helm cloud' and the 'bar', sometimes causing structural damage. The desiccating effect in spring near the escarpment may also be serious. With wind of force 8 at Tynemouth, the 'helm wind' may be expected to attain force 9 on open slopes; progress against it is not easy.

It is hoped that a reasonable explanation will soon be given of numerous local sayings and writings based on observation; the continuous record of temperature at 2,735 ft. should also be of interest.

These investigations have been carried out during the past year with the help of a grant from the Leverhulme Trustees.

GORDON MANLEY.

School of Geography,
University of Durham
(Durham Division).
Feb. 13.

¹ Meteorological Glossary, p. 101; Marriott, *Quart. J. Roy. Met. Soc.*, 15 (1889).

Micro Separations by Chromatographic Adsorption on Blotting Paper

THE separation of mixtures on a micro scale by chromatographic adsorption was carried out as long ago as 1910 by Tswett, the discoverer of the process, and by various others since, but the method has not been applied as extensively as its extraordinary power would warrant. The preparation of the adsorbent column and the development of the chromatogram are troublesome and time-consuming operations and the process ordinarily comes under consideration only as a last resort. The purpose of this communication is to describe a simple and rapid method of effecting such separations which avoids entirely the difficulties inherent in the use of Tswett columns, and which, in addition, possesses distinct advantages of its own.

The technique consists essentially in the use of ordinary white blotting paper, or a suitable grade of filter paper, as the adsorbent medium. A sheet of the paper is placed between two pieces of plate glass (6 in. x 6 in. is a convenient size) one of which, the cover plate, has a small hole (3/16 in. or 1/4 in.) at its centre. A solution of the material under investigation is introduced through this hole, either dropwise or by means of a pipette with a capillary tip resting on the paper, and this is followed by the introduction of the developing solvent. Under these conditions, the components of the solution travel outward in concentric zones. The chromatogram is then obtained in a form which is particularly well suited to visual examination if coloured substances are present, or to examination by appropriate chemical or physical methods in the case of colourless substances. In addition, this type of chromatogram possesses the distinctive feature that it may be filed, after drying, for future reference. The paper being readily available, no extensive preliminary preparations are

necessary and the time required for an experiment is from three to five minutes.

The adsorbent characteristics of papers differ somewhat, but the choice of paper for this work will be governed rather more by other factors such as porosity, uniformity, and freedom from impurities. A thin and moderately hard blotting paper is more satisfactory in physical characteristics than filter paper of ordinary thickness, but it should be pointed out that many commercial white blotting papers contain a blue colouring matter which may give rise to spurious zones under certain conditions. The blotting paper made by the Eastman Kodak Co. for photographic purposes is fairly satisfactory in this respect.

It has been found that a surprising number of separations of various kinds can be carried out on paper, for although paper is not a particularly powerful adsorbent, what it lacks in this respect can very often be compensated by a suitable choice of solvents. There are, nevertheless, numerous problems in analysis by chromatographic adsorption which necessitate the use of a more powerful adsorbent. In order to retain the simplicity and convenience of the present method it would be desirable to secure for this purpose an absorbent paper impregnated with suitable adsorbing materials, particularly alumina. At the present time one may adopt the expedient of using a film of the powdered adsorbent between two sheets of filter paper.

As a lecture demonstration experiment the separation of the pigments of green leaves can be recommended. It is carried out most effectively on paper using a carbon disulphide solution of the pigments and using carbon disulphide also as the developing solvent. The brilliant colours of the carotenoid pigments together with the two chlorophyll pigments present a very striking display when resolved in this way.

The new method is not proposed as a substitute for the Tswett column when quantities of more than a few milligrams are to be treated. It is strictly a micro method, and as with the micro Tswett column the difficult problem of identifying the zones is constantly arising. However, it can be recommended as a useful adjunct to the Tswett column, as the task of finding by trial the most favourable conditions for a particular separation is greatly simplified. Attention is directed to the possibility of adapting the method to various problems in quantitative analysis, particularly where coloured substances are dealt with, and also to the possibility of its use, in conjunction with organic reagents, in qualitative inorganic analysis.

WELDON G. BROWN.

Department of Chemistry,
University of Chicago.
Nov. 25.

Lipæmia and Calcæmia in the Cock induced by Diethylstilbæstrol

Rats as well as chickens are transformed into eunuchoid dwarfs by prolonged treatment with oestrogenic hormone¹. During these experiments, a high degree of lipæmia was found in the chickens². The total blood fat can rise to 8,000 mgm. per cent (the normal being 100–200 mgm. per cent). The animals, the blood of which looks like cream, can finally succumb with dyspnoic symptoms to fat thrombosis of the pulmonary blood vessels, in

extreme cases. The internal organs, too, show considerable lipæmia. Thus, for example, the fat content of the liver can rise to 24 per cent of the dry matter (normal being 4.56 per cent). Lipæmia is found physiologically in the hen during the egg-laying season (increase from 100 mgm. to 580 mgm. per cent). In the cock, no spontaneous lipæmia occurs. Oestrogenic hormone, however, can induce lipæmia in the cock as well, dependent on the dose of hormone administered. Oestradiolbenzoate proved to be two and a half times as effective as oestrone. One dose of one mgm. oestradiolbenzoate is ineffective; two days' treatment, however, with 2 mgm. daily, certainly results in lipæmia on the third day (increase to 600–800 mgm. per cent). This lipæmia due to oestrogenic hormone is independent of nutrition, occurring likewise in fasting animals. In rodents (rabbits, rats), as well as in man, even prolonged administration of large doses of hormone does not induce lipæmia. This lipæmia represents the specific effect of oestrogenic hormone, since no effect is obtained either with cholesterol or with sterol-like hormones (we tested progesterone and testosterone).

During recent years, a number of synthetic substances having an oestrogenic effect have been discovered, the most active of which is the 4:4'-dihydroxy- α - β -diethylstilbene (diethylstilbæstrol), which was described by Dodds, Golberg, Lawson and Robinson in 1938³. This substance is able to initiate oestrus in ovariectomized rats, given in doses of 0.3–0.4 γ . Comparative tests show it to be between two and three times as potent as oestrone under similar conditions. After having ascertained that the production of lipæmia in the cock was due to the specific action of oestrogenic hormone, it was obvious that the question of whether this synthetic substance, which differs chemically from the oestrogenic hormone, was able to exert similar effects to those of the hormone, should be investigated.

0.5 mgm. of diethylstilbæstrol does not increase the blood fat, while 1 mgm. gives rise to an increase of 122–517 mgm. per cent. Two days' treatment with 4 mgm. respectively results in enormous lipæmia on the third day, the fat proportion increasing from 196 to 2,380 mgm. per cent. After six days' treatment with 24 mgm. of diethylstilbæstrol it increases from 125 to 5,438 mgm. per cent (cf. accompanying table).

LIPÆMIA AND CALCÆMIA IN THE COCK INDUCED BY DIETHYLSTILBÆSTROL.

Date	Diethylstilbæstrol mgm.	Blood fat mgm. per cent	Blood calcium mgm. per cent	Remarks
Nov. 28	Before treatment	125	11.2	
Nov. 28	4			
Nov. 29	4			
Nov. 30	4	3230	30	After 12 mgm. of diethylstilbæstrol
Dec. 1				
Dec. 1	4			
Dec. 2	4			
Dec. 3	4	5438	41.4	After 24 mgm. of diethylstilbæstrol
Dec. 4				

Calcæmia. The striking changes of the bone structure¹ encountered in eunuchoid dwarf cocks lead to the conclusion that prolonged administration of oestrogenic hormone produces changes of the calcium metabolism. In fact, enormous calcæmia was found in those dwarf cocks². The calcium concentration in the blood of the cock is normally up

to 15 mgm. per cent, while it rises in the hen during the egg-laying season to as much as 26 mgm. per cent. In those cocks which had been treated with oestradiolbenzoate for a considerable period of time we encountered calcium values of so much as 55.3 mgm. per cent on an average. Lipemia and calcaemia follow parallel lines. Riddle and Dotti⁴ succeeded in producing calcaemia in animals through administration of oestrogenic hormone, the values increasing from 10 to 12-14 mgm. per cent. Such an enormous calcaemia as we succeeded in producing through administration of large doses of oestrogenic hormone has not yet been observed so far as we know.

The action of diethylstilboestrol is similar to that of oestradiolbenzoate. After 2 days' administration of 4 mgm. of diethylstilboestrol respectively, the blood calcium, in the cock, rises to 22.6 mgm. per cent. Subsequent to 6 days' treatment with 24 mgm. it is 41.4 mgm. per cent (cf. accompanying table).

The strong action of diethylstilboestrol also results from the fact that only two weeks after the first injection the cock's comb begins to shrivel and becomes anemic, while prolonged treatment produces loss of turgor and makes it drop.

The above investigations, therefore, demonstrate that diethylstilboestrol, like oestrogenic hormone, brings about lipemia and calcaemia in the cock, while being at least as effective as oestradiolbenzoate.

B. ZONDEK.

L. MARX.

Laboratory of the Gynaecological-
Obstetrical Department,
Rothschild-Hadassah-Hospital,
Jerusalem.

¹ Zondek, B., *Lancet*, 10 and 842 (1938); *Folia Clinica Orientalia*, 1, 1 (1937).

² Zondek, B., and Marx, L., *Arch. Internat. Pharmacodynamie and Therapie* (1939) (in the Press).

³ Dodds, H. C., Golberg, L., Lawson, W., and Robinson, R., *NATURE*, 141, 247 (1938).

⁴ Riddle, O., and Dotti, L. B., *Science*, 84, 557 (1936).

Pituitrin Anemia

Dodds and Noble¹ first described the severe anemia occurring in rabbits following parenteral administration of posterior pituitary extract. They considered this action of pituitrin a selective one on the cellular elements of the blood. We² confirmed the anemia caused by pituitary extract, but placed a different interpretation on the mechanism involved, for accompanying the anemia there was a marked fall in the osmotic pressure of the blood. We therefore believed that the dilution in the concentration of extracellular electrolytes resulted in a passage of fluid into the red cell with a subsequent rupture of the cell membrane. The reduced electrolyte concentration of the serum was considered to be the result of the powerful antidiuretic action of large doses of pituitrin. Also, the possibility that pituitary extract may promote the excretion of large amounts of electrolyte was considered.

Dodds, Liu and Noble³ take exception to the above interpretation on the basis of their studies of the water balance of rabbits following pituitrin injection. They observed that, although an oliguria resulted, the water intake of the injected animals also decreased. Therefore, it was concluded that rabbits were not in a positive water balance, and hemolysis could not have resulted from water retention.

The issue resolves itself into the relative value of an accurate determination of serum osmotic pressure versus an approximation of the water balance of a rabbit for determining the electrolyte environment of the red cell. The term approximation is used because the rabbit is a notoriously difficult species in which to determine water balance. The gastrointestinal tract of these animals is always filled with a semifluid chyme. Even if the inhibition of urinary secretion is exactly balanced by the diminished water intake, appreciable dilution of the serum occurs as absorption of fluid proceeds from the gastro-intestinal tract. Also it must not be overlooked that pituitrin causes the excretion of electrolyte as well as the retention of water. These two factors can combine to alter the osmotic pressure of the serum and cause extreme swelling of the blood corpuscles. It is our belief, however, that water retention is the primary cause for the alterations in blood chemistry.

In the experiments of Dodds and collaborators, blood volume determined by a method not mentioned failed to show any increase. We, on the other hand, measured serum osmotic pressure by the vapour pressure method of Hill⁴, one of the most sensitive of analytical procedures. We found the serum of the injected rabbits to be isosmolar with sodium chloride solutions of 0.64 per cent instead of 0.9 per cent which is normal. In one experiment the diminution in the concentration of serum electrolyte was so great that the serum was isosmolar with a 0.56 per cent sodium chloride solution. Dodds and co-workers, however, criticize these figures by an indirect approach which does not take into account the possibility of an internal water shift. We made note of the fact that the food intake and consequently the fluid ingestion of their experimental rabbits were markedly diminished. Nevertheless the reported changes in the serum electrolyte concentration did occur. Until it can be shown that severe pituitrin anemia can be obtained in the absence of any change in the electrolyte composition of the fluid medium of the red blood cell, we believe that the cause of this anemia is erythrocyte hemolysis resulting from water shifts and not the "agglutinating and hemolyzing" property of posterior pituitary extract on red blood corpuscles.

ALFRED GILMAN.

LOUIS GOODMAN.

Laboratory of Pharmacology
and Toxicology,
Yale Medical School,
New Haven, Conn.
Jan. 12.

¹ Dodds, H. C., and Noble, R. L., *NATURE*, 135, 788 (1935).

² Gilman, A., and Goodman, L., *Amer. J. Physiol.*, 118, 241 (1937).

³ Dodds, H. C., Liu, S. H., and Noble, R. L., *J. Physiol.*, 94, 124 (1938).

⁴ Hill, A. V., *Proc. Roy. Soc., A*, 127, 9 (1930).

Phytic Acid and Mineral Metabolism in Poultry

THE possible parts played by phytic acid in the mineral metabolism of poultry have received surprisingly little study. Recently Lowe, Steenbock and Krieger¹ have directed attention to the significance of this subject, and have shown that, with diets where addition of phytin failed to improve calcification, the addition of the same amount of phosphorus as disodium hydrogen phosphate improved calcification.

A series of mineral metabolism experiments with pullets in progress in this laboratory lends strong

support to these observations. It has been found that pullets fail to hydrolyse a considerable proportion of the phytic acid present in their rations. Calcium carbonate supplements appear to lower the proportion hydrolysed, just as in the case of the rat¹. The experiments also suggest that when a ration is supplemented with calcium (a) in the form of carbonate and (b) in the form of tribasic calcium phosphate, a greater proportion of the phytic acid is hydrolysed in the case of the ration supplemented with calcium phosphate than in the case where the supplement is calcium carbonate.

It is also clear from the experimental results secured to date that the conclusions of Knowles, Watkin and Hendry² with regard to the nature of the calcium and phosphorus compounds present in the excreta of the domestic fowl require modification, in so far as a considerable proportion of the phosphorus excreted by pullets on rations similar to those used by these workers is in the form of phytic acid phosphorus. Furthermore, while the rule found by Knowles, Watkin and Hendry³ with regard to the ratio of 'non-carbonate calcium' to total phosphorus in the excreta has been verified in the case of non-laying pullets, it does not appear to hold for the excreta of laying pullets, even when the excreta contain appreciable amounts of carbonate.

It is hoped to publish a fuller account of these experiments at a later date.

R. H. COMMON.

Chemical Research Division,
Ministry of Agriculture for Northern Ireland,
Queen's University, Belfast.

Jan. 26.

¹ Lowe, J. T., Steenbock, H., and Krieger, O. H., *Poultry Sci.*, 18, 40 (1929).

² Lowe, J. T., and Steenbock, H., *Biochem. J.*, 29, 1901 (1935).

³ Knowles, F., Watkin, J. M., and Hendry, F. W. F., *J. Agric. Sci.*, 23, 197 (1933).

A Metabolic Explanation for Irritation and Coma Produced by Rise in Intracranial Pressure

INCREASE in pressure inside the cranial cavity, whether local or general, first produces symptoms of cerebral irritation such as convulsions, contraction of the pupil, vomiting and rise of blood pressure, and is followed by coma, dilatation of the pupil, and other symptoms of paralysis of the nerve centres. The current explanation for this train of symptoms, which is seen in many pathological processes (for example, intracranial hæmorrhage, oedema, tumour, etc.), supposes that irritation is caused by congestion of the cerebral vessels and cyanosis, while further increase in pressure produces profound cerebral anæmia and coma.

The first result of a rise in intracranial pressure is to cause partial collapse of the venous sinuses of the dura mater and of the cerebral veins¹, accompanied by a diminution in the rate of venous return. Accordingly the rate of oxygen supply to the brain is much diminished and approximately anaerobic conditions are realized in some of the cells. Now, it has been shown that under anaerobic conditions the rate of katabolism of glucose by cerebral cortex is enormously increased². Thus the rate of catabolism of glucose by rabbit's cortex has a low value in oxygen ($Q_{O_2} = -8$), whereas in nitrogen this quotient is increased manyfold ($Q_{N_2} = -8$). Recent observations which I have made on the metabolism of human cortex (kindly given to me by Mr. McConnell of the Richmond Hospital, Dublin)

indicate that here anoxæmia has essentially the same effect in increasing metabolism. Thus the Q_{O_2} of human cortex, calculated from measurements of respiration and glycolysis, is -8 in oxygen and -10 in nitrogen. This stimulation of metabolism may well be accompanied by stimulation of the nerve centres, and thus convulsions and other symptoms of irritation are really due to the intracerebral anoxæmia, which is itself the result of rise in intracranial pressure. Still further increase in intracranial pressure causes capillary collapse and so seriously impedes the cerebral circulation as to deprive the brain cells of glucose, their main metabolic substrate. The rate of cerebral metabolism is now substantially diminished even below its normal level, and irritation thus gives place to paralysis. In this manner, a progressive rise in pressure within the cranial cavity may first produce a stimulation of metabolism associated with irritation, and is later followed by diminution or even cessation of metabolism, accompanied by coma and other terminal symptoms of compression.

The convulsions produced by heart block in man and by ligation of the carotids and vertebrals³ in animals have probably the same cause as those produced by rise in intracranial pressure. In these cases also, anoxæmia causes increase in katabolism of sugar by the brain cells with increase in nervous irritability. Further, Loewenhardt, Lorenz and Waters⁴ have found that intravenous injection of sodium cyanide causes stimulation of the respiratory centre and also a remarkable cortical stimulation in stuporous cases of dementia præcox. They suggest that the cyanide, by inhibiting oxygen absorption, stimulates anaerobic metabolism. Stone⁵ also has shown the lactic acid content of brain increased by cyanide convulsions and suggests that convulsions may be associated with increased tissue activity. I have found the Q_{O_2} of rabbit's cortex, as above calculated, to be increased from -2 to -7 by the addition of $2 \times 10^{-3} M.$ sodium cyanide. The respiration is simultaneously diminished by 50 per cent, but the aerobic lactic acid production is markedly stimulated. Here again increased nervous activity is connected with increase in katabolism of glucose.

K. O. DIXON.

King's College,
Cambridge. Feb. 2.

¹ Cushing, *Amer. J. Med. Sci.*, 124, 375 (1902).

² Dixon, *Biochem. J.*, 20, 1479 (1926).

³ Gildes and Cobb, *Arch. Neurol. Psychiat.*, 22, 876 (1930).

⁴ Loewenhardt, Lorenz, and Waters, *J. Amer. Med. Ass.*, 92, 880 (1929).

⁵ Stone, *Biochem. J.*, 22, 1908 (1933).

Proteins of Rattlesnake Venom

RECENTLY, Slotta and Fraenkel-Conrat^{1,2} reported that they have succeeded in separating the whole of the neurotoxin and hæmolysin of *Crotalus-torridus* venom in a crystalline form, and that repeated recrystallization of this substance did not change its physiological properties or its chemical composition. This crystalline substance containing both neurotoxic and hæmolytic activities was considered by them to be a pure substance. In the course of our investigation on the separation of the various active principles of *Crotalus-torridus* venom, we have found that the hæmolysin can be partially separated from the neurotoxin by adopting the following procedure:

100 mgm. of venom was dissolved in 10 c.c. water

and its pH adjusted between 7.0 and 7.2. The solution was then saturated with sodium chloride and left overnight inside a refrigerator at 6° C. The next morning the precipitate formed was separated by centrifuging and washed once with saturated sodium chloride. This precipitate was found to contain 8-10 per cent of the total hæmolytic activity and only 2-2.5 per cent of the total neurotoxic activity of the original venom. Thus the percentage ratio of hæmolysin to neurotoxin has a much higher value, 4:1, in the precipitate we obtained, than it had in the original venom. It is evident, therefore, that the hæmolytic and neurotoxic activities of *Crotalus-t-terriflous* venom are due to two different substances. Hence the crystalline substance which Slotta and Fraenkel-Conrat obtained was not a pure protein, but a mixture of at least two different proteins. In this connexion, it may be mentioned that we have succeeded in separating the hæmolysin completely from the neurotoxin of *Naja Naja* venom as reported elsewhere*.

We wish to thank the Indian Research Fund Association for a grant for continuing this work.

B. N. GHOSH.
S. S. DE.

University College of Science and Technology,
Calcutta, Jan. 18.

* Slotta, K. H., and Fraenkel-Conrat, H., *NATURE*, 142, 212 (1938).

* Slotta, K. H., and Fraenkel-Conrat, H., *Ber. deutsch. chem. Ges.*, 11, 1023 (1938).

* Ghosh, B. N., and De, S. S., *Science and Culture*, 585 (May 1937).

The Prehensile Paw of the Giant Panda

There is little to be said in answer to Prof. Wood Jones's remarks on this subject¹; but I can assure him I overlooked neither of the facts he thinks I did. I gave him the credit for the interesting discovery, previously only an inference from what was known of the skeleton of the foot, that the sesamoid bone in question has a special muscular arrangement whereby it can be moved.

Possibly I should feel gratified by his confirmation of my statement that the grasping method of the panda's fore paw is strictly comparable to that effected by closing the tips of the first and second fingers on the ball of the thumb in the human hand. It is unfortunate that in his first account he conveyed the idea that the method is equivalent to that exercised by the entire thumb. Without reservation and without fear of admonition from anyone acquainted with the undivided paw of this animal, I adhere to my assertion that his description was misleading; and I venture to predict that wisdom will forbid its repetition in his final treatise on the subject.

R. I. Pocock.

British Museum (Natural History),
Cromwell Road,
London, S.W.7.
Feb. 20.

¹ *NATURE*, 142, 246 (1939).

Points from Foregoing Letters

HAVING obtained the vacuum spark spectrum of iron, Dr. L. S. Bowen and Dr. B. Edlén have determined the wave-lengths of the forbidden transitions between the terms of the $3d^2$ levels, and find that these lines correspond to the lines of hitherto unknown origin in the spectrum of Nova RR Pictoris (1925).

Assuming the existence of inhomogeneities and thermal currents in the earth's core, Dr. W. M. Elsasser calculates that temperature differences so low as 10° would give rise to currents whose irregular distribution may result in a small one-sided excess that would account for the earth's magnetic field.

Dr. G. Gamow and Dr. E. Teller, in reply to Sir James Jeans's criticism of their hypothesis of the origin of nebulae, point out that most of the objections raised would not affect the order of magnitude of their calculated result. An important difference in the value for the mean density of matter arises, however, if one accepts Sir James's assumption that the so-called clusters of nebulae are stable, rather than that the nebulae themselves are in a state of equilibrium, as supposed by the authors.

The usefulness of synthetic lithium fluoride crystals as optical material owing to its transparency to wave-lengths from 1200 Å. up to 20,000 Å., is stressed by B. K. Johnson, who states that he has designed a lens system combining lithium fluoride and fused quartz, which should give complete achromatism for a spectral range between 5461 Å. and 2749 Å.

A simple method for the micro-separation of the components in a mixture by capillary adsorption on filter paper is described by Prof. W. G. Brown.

Diethylstilboestrol, like oestradiolbenzoate and oestrone, increases the fat and calcium concentration in the blood of the cock, and eventually causes the loss of the comb, according to Prof. B. Zondek and L. Marx.

Prof. A. Gilman and Prof. L. Goodman claim that their explanation of the anaemia produced in rabbits by administration of posterior pituitary extract, being due to the fall in the osmotic pressure of the blood, are more likely to be correct than the results obtained by Dodds and collaborators based upon the "water balance" of rabbits.

Experiments reported by Dr. R. H. Common indicate that when phytin alone is added to the diet of pullets they fail to utilize it completely. Calcium phosphate, if added, increases the proportion of phytin hydrolysed to a greater extent than does calcium carbonate.

In the absence of oxygen, the katabolism of carbohydrate by both rabbit and human cerebral cortex is increased. Dr. K. C. Dixon suggests that the convulsions and cerebral irritation which follow rise in intracranial pressure and other processes producing cerebral anaemia, are due to this increased metabolism of the brain cells associated with stimulation of the nerve centres.

Dr. B. N. Ghosh and S. S. De describe a method for the partial separation of the hæmolysin in the venom of *Crotalus-t-terriflous* from the accompanying neurotoxin and point out that the crystalline substance prepared by Slotta and Fraenkel-Conrat, possessing both these properties, is probably a mixture.

Research Items

Anthropometry of the Ovimbundu, Angola

IN the course of the Frederick H. Rawson Field Museum Ethnological Expedition to West Africa, measurements were obtained of 53 adult male Ovimbundu, which, though an inadequate sample, are valuable owing to the paucity of material from Angola. There are, it is believed, no other measurements of the Ovimbundu available for comparison. This material has been studied by W. D. Hambly, of the Field Museum of Natural History, Chicago (*Publication 426, Anthropological Series*, 25, 2; 1938). In skin colour all were brown, and only four approached black, which four might be described as 'light brown'. All eyes were dark brown, and the hair was typically Negro. Facial hair was sparse. The standing height averaged 1687.1 mm., just within the tall class. The average length of the head is 187.3 mm. and the breadth 136.8 mm., with an average cephalic index of 73.1. The average head height is 135 mm. The cranial capacity (Pearson's formula) is 1370 c.c. The facial index is 93.7 and the average nasal index 87.9, just within the platyrrhine group. Measurements on the nose show high variability, 35.8 per cent being mesorrhine, 58.5 per cent platyrrhine. Only 5 per cent are hyperplatyrrhine, with an index of 100+. In regard to variation, head-breadth stands first in constancy of measurement, while head-length is almost as constant. The cephalic index also has a low variability. In comparison with other tribes of Angola, the Ovimbundu are not greatly removed in stature from the man of eastern Angola; but they are decidedly more long-headed and mesorrhine. The differences may be due to fixation of type owing to isolation. The Ovimbundu are known to have built up a strong confederacy. Compared with negro tribes outside Angola, the general build and physiognomy, together with the nasal index, suggest a contact, perhaps remote in time, with the north-east African element described as Hamitic.

Cyanide in the Determination of Ascorbic Acid

M. Cushman and A. M. Butler (*Proc. Soc. Exp. Biol. and Med.*, 39, 534; 1938) review the literature and present further evidence concerning the effect of potassium cyanide on 2,6-dichlorophenolindophenol, the stability of ascorbic acid in whole blood, plasma and plasma filtrate, and the question whether potassium cyanide should or should not be used with plasma ascorbic acid determinations. Their conclusions were as follows: The use of potassium cyanide does not necessarily invalidate the results and may cause no error. Certain lots of potassium cyanide may decolorize 2,6-dichlorophenolindophenol, the decolorizing power of a particular lot depending upon the concentration of the salt and the pH of the dye-salt solution. Reduced ascorbic acid is stable in whole blood or metaphosphoric acid filtrates for so long as 24 hours. There is a significant loss of reduced ascorbic acid when plasma stands at room temperature for more than four hours. The loss is not prevented by the presence of potassium cyanide. There is therefore no reason for the addition of potassium cyanide in the determination of plasma ascorbic acid.

pH Stability of Elementary Bodies of Vaccinia

J. W. Beard, H. Finkelstein and R. W. G. Wyckoff (*J. Immunol.*, 35, 415; 1938) determined the pH range of infectiousness of purified suspensions of the elementary bodies of vaccinia in rabbits by titration. The infectiousness was found to be most stable between pH 4.5 and 10. On the acid side, inactivation was immediate below 2.5 and on the alkaline side above 11.5. In the analytical ultracentrifuge, purified active suspensions gave a single fairly sharp boundary with the sedimentation constant $S_{20} = 5400 \times 10^{-13}$ cm. sec.⁻¹ dynes⁻¹. The elementary bodies became lighter and hence were broken down at those pH values at which they were immediately inactivated. The iso-electric point was determined to be between pH 4.3 and 4.6.

Cross-beaked Fowls

THE cross-beak condition is normal in the widely distributed genus *Loxia* and the endemic Hawaiian genus *Loxops*. In *Loxia* a straight beak occurs as a rare abnormality, while cross-beaked specimens have been recorded in many different genera and species of birds. In zebra parakeets the condition occurs repeatedly, and it has frequently been reported in domestic fowls. Dr. Walter Landauer (*J. Genetics*, 37, No. 1) has studied cross-beak in silver spangled Hamburgs, White Leghorns, Rhode Island Reds and Dark Cornish Fowl as well as other breeds. He finds that, in *Loxia* as well as the commonest type of cross-beak in fowls, the beak is normal at hatching and begins to be crossed later. In both, the beak may deviate to the right or the left side; but the condition is more variable in fowls than in *Loxia* and may involve either beak, whereas in *Loxia* it is always mainly in the lower beak. Four different types of cross-bills have been observed in chickens. Type I is associated with eye defects, Type II is found among homozygous embryos of Creeper and Japanese Bantam, Types III and IV are hereditary, the former appearing in the second month of life and the latter before hatching. In these hereditary types the upper beak is generally involved. The breeding results suggest that the genetic basis is complex in both cases. No individuals breeding true for cross-beak were obtained, and crosses between Types III and IV gave only normal offspring. A fifth type of cross-beak appears to be associated with polydactyly.

Relationships of the Fish-Hawk or Osprey

AT various times and by various authors the osprey has been regarded as most closely related sometimes to the eagles and sometimes to the kites; but the linkage has been indefinite because most of the characters used in the classification of the osprey have undergone so much adaptive modification as to be unreliable. Lawrence V. Compton, after a thorough analysis of the feather tracts (pterylosis) of the hawks, concludes that the arrangement of the tracts affords evidence of taxonomic value (*Univ. California Pub. Zool.*, 42, 173; 1938). The characters afforded by feather tracts divide the hawks into three natural groups: the Accipitrid type, the Falconid type, and the Cathartid type. The secretary bird may represent

a fourth group, although it is more closely related to the accipitrids than to the other hawks. The osprey (*Pandion*), according to its feather groupings, is most closely related to *Cathartes*, and not to the falcons, with which it has usually been placed. But its characters are sufficiently distinct to warrant its separation in a family, Pandionidae, equivalent in rank to the family Cathartidae, within the sub-order Cathartae.

Sexual Reproduction of *Ranunculus Ficaria*

It is known that *Ranunculus Ficaria* seldom sets viable seed, and C. R. Metcalfe has shown that of the two forms, namely, those with and those without aerial tubercles, the latter invariably produce a higher proportion of viable seed. The author has recently made a full investigation of this phenomenon (*Ann. Bot.*, New Series, 3, No. 9, 91; 1939). He has shown that lack of viable seeds is due chiefly to certain forms of degeneration in either the embryo-sac or the nucellus. These forms of degeneration are described. It is also shown that ovules frequently become disorganized even when active pollen tubes are present; therefore degeneration cannot be due to the lack of viable pollen. Fertilization is not essential to the formation of endosperm in normal embryo-sacs, and proof was obtained that embryos sometimes arise apomictically from unfertilized eggs. Reasons are also stated why seed which is apparently viable is not always capable of germination.

Floors for Industrial Purposes

AN account of the work done in connexion with the many problems concerning floors for industrial purposes was given by R. Fitzmaurice and F. M. Lea, of the Building Research Station, before a joint meeting of the Institution of Structural Engineers and the Institution of Chemical Engineers on January 26. It was pointed out that comparative test data on the relative resistance of various materials to impact and abrasion are practically non-existent and indeed a satisfactory discriminating test has not yet been devised. The authors gave a rough classification of the usual conditions of abrasion and of the types of flooring materials in common use in the different conditions quoted. When chemical action is added to the mechanical agencies of destruction the case is more serious. There are many substances the action of which on concrete is so slow and so limited that they have been successfully stored in concrete tanks; but when assisted by abrasion on a concrete floor they give a great deal of trouble. The authors also gave details of the floor conditions found in several groups of factories in typical industries. It was pointed out that volume changes caused by variations of moisture content give a good deal of trouble as the cracks allow corrosive liquids to penetrate to the structural floor beneath, and in this connexion the authors gave data of the amount of shrinkage in the principal materials and offered some valuable suggestions for its mitigation. They also dealt with some points in relation to the structure. One of these had reference to the provision of continuous slabs extending over several beams. The reversal of the bending moment requires that the reinforcement be brought to the top. If now a top dressing is applied to the slab, the reinforcement is no longer in the right place to resist the tensile stress, and cracks occur. It is recommended, therefore, that a joint be made in the concrete finish or that additional reinforcement be provided in it.

Isotopes of Uranium and Lead

THE isotopic constitution of uranium and lead has been studied by A. O. Nier (*Phys. Rev.*, 55, 150; using a mass-spectrograph. The positive ions of these elements were produced by vaporizing salts of the metals and bombarding the vapours with electrons. Uranium from several different ores gave the isotopes U^{238} , U^{235} (abundance ratio $U^{235}/U^{238} = 1/139$) and U^{234} (abundance ratio $U^{234}/U^{238} = 1/17,000$). No other isotopes were found. From the abundances of these elements the decay constants of U^{238} (UI), U^{235} (AcU) and U^{234} (UII) were found. The lead from twenty-one sources was similarly examined. The isotopes of uranium lead Pb^{206} , Pb^{207} , of common lead Pb^{208} , Pb^{207} , Pb^{206} , Pb^{204} , and of thorium lead Pb^{206} were found. The abundances of the isotopes agreed in general with the chemical atomic weights which have previously been used to distinguish the proportions of the different leads. The ratio between the abundance of lead from the Ac and U series (Pb^{207}/Pb^{206} corrected for common lead contamination) provides a new method of estimating the ages of minerals, and it is possible that the method would give results more reliable than the well-known determination of the Pb/U ratio in cases where the mineral has been subject to alteration. It is shown that it is very unlikely that Pb^{206} decays to Pb^{204} , as has been suggested.

Testing of Transmission Line Insulators

It is known from the annual reports on atmospheric pollution, issued by the Department of Industrial and Scientific Research, that in London and other large cities, solid deposits settle from the atmosphere at an average rate of about one ton per day per square mile. As a rule, these deposits consist of free carbon and metallic salts in various proportions. Sometimes they settle on high-tension transmission lines and on the insulators supporting them. When dry, such deposits have a comparatively high electrical resistance, but when moist the salts go into solution and the resulting damp deposit is a much better conductor. The outdoor insulators used on overhead power lines are exposed to these deposits and trouble is sometimes experienced with them causing flash-over and dangerous surges of electricity along the wires. Near the sea coast in Great Britain, both salt and industrial deposits present serious problems. In an important paper read by W. J. John, of Queen Mary College, and C. H. W. Clark to the Institution of Electrical Engineers, on February 15, this problem has been very successfully attacked both in the laboratory and in the open air. In the first case, an aeronautical wind tunnel was used through which air was drawn by a fan, the salt-spray formed by an atomizer surrounding the insulator under test, and the way in which dew was deposited on it was noted. A high-pressure supply of 33 kv. was sometimes employed and oscillographic records of the leakage surface currents were obtained. In the outdoor tests, it was found that in average good weather conditions conductance is not a measure of the deposit on the insulators used in practice, as their edges and ribs remain clean and have a high resistance. Bad weather conditions which lead to flash-over in service are fog, mist, dew and frost. On several occasions rain was accompanied by mist, and this constituted as a rule the most serious weather conditions.

The Widmanstätten Structure of Octahedral Meteoric Iron

By Prof. S. W. J. Smith, F.R.S., and J. Young

THE effect known as the Widmanstätten structure is shown most clearly in those meteoric nickel-iron alloys in which the percentage of nickel lies between certain limits, roughly, from 7 to 14. When the percentage of nickel is less than about 6.5, there is no Widmanstätten structure—the single component is known as 'kamacite'. With higher percentages of nickel, there is always an additional component—known as 'taenite'. Attempts to find its percentage composition by chemical methods led to very different results, ranging from about 25 to 37—although in one isolated case a percentage of about 47.8 was recorded. These widely varying results are due to the difficulty of isolating the taenite from the kamacite with which it is so intimately mixed and indeed often encloses. It was for this reason that it occurred to one of us to attempt to determine the composition of the taenite *in situ* by means of 'thermo-magnetic' analysis (*Phil. Trans.*, A, 1908).

For various reasons these early efforts were not so successful as they might have been. Later it was possible, in Birmingham, to repeat these experiments with more suitable meteorites than that originally examined and to add micrographic and X-ray measurements to this method of attack. For the results obtained by the latter (*Proc. Roy. Soc.*, A, 1926, etc.), one of us (J. Y.) has been almost entirely responsible; while Mr. A. A. Dee gave valuable help in the development of the former.

Of the various octahedrites examined, the Butler meteorite, containing about 10 per cent of nickel and relatively free from impurities such as phosphorus, gave the most satisfactory results. It showed in the clearest possible way that the taenite has a reversible magnetic transition temperature at about 500° C. and therefore contains approximately 50 per cent of nickel. From the way in which it forms (see below), it is unlikely that a taenite band is of uniform composition. It may be sensibly less rich in nickel at its centre than at its boundaries. In any event, the thinnest bands are most likely to be of nearly uniform composition and to give the closest approximation to the equilibrium percentage of nickel in the γ phase alloy.

In agreement with this consideration, X-ray analysis shows that the narrowest taenite bands contain the highest percentages of nickel—about 55 per cent in these and about 50 per cent in the broader bands. It does much more than this. It shows that kamacite and taenite are, apart from impurities, solid solutions of nickel and iron—the former having a body-centred and the latter a face-centred cubic lattice. The lattice parameters confirm the inference from the thermomagnetic experiments regarding the composition of taenite. Other results are particularly significant. They show that the majority of the taenite crystals have a single orientation throughout the meteorite, their {111} planes lying nearly parallel to the kamacite-taenite lamellae. The kamacite crystals show small random deviations from the twenty-four orientations of the type; (110) kamacite parallel to (111) taenite, [001] kamacite inclined at 4° to [011] taenite. These relationships

hold in both band and plesitic structures; but the deviations are greater in the latter than in the former.

A significant feature of the taenite bands, revealed by micrographic investigation, is that only the narrowest of these consist entirely of γ -phase alloy. The central regions of the broad bands often show that an independent γ - α transition, sometimes described as 'plesite', has developed there. A characteristic feature of this development occurs where it meets the inner boundary of its taenite envelope. This boundary has a 'jagged' or serrated appearance—due no doubt to the conditions under which the last of the γ - α transition occurs. It exhibits the traces on the surface of rational planes of the taenite containing a [110] axis, such as {111}, {100}, {110} and {211}.

One of the most interesting problems presented by the results is the magnetic behaviour of the taenite, which would have shown little, if any, magnetic evidence of its existence during the first heating experiments if a step-by-step method of heating to successively higher temperatures had not been used. X-ray analysis provides an explanation of this phenomenon. It reveals the existence in the meteorite 'as received' of a transition layer at the taenite-kamacite boundary in which the lattice spacings of planes parallel to that boundary vary continuously from that of the {111} plane of the taenite to that of the {110} plane of the kamacite. This transition layer is that at which the last of the γ - α conversion occurs as the temperature falls. It would seem that it is the effect produced by the heat treatment upon this layer that enables the taenite to exhibit its ferromagnetism.

Very suggestive results were obtained from a study of an artificial nickel-iron alloy containing 10 per cent nickel cooled slowly from the molten state. Magnetic and X-ray analysis of this alloy showed that it consisted entirely of body-centred crystals. When, however, the alloy was heated progressively to, and annealed at, a temperature of 580° C., its subsequent behaviour indicated the presence of a γ -phase alloy containing about 30 per cent nickel. X-ray examination confirmed the presence of γ -crystals having a strongly preferred orientation, in which their {111} planes were parallel to the Widmanstätten figures in each grain, as in the meteorites. The α -crystals also exhibited twenty-four orientations differing little from those found in the octahedral meteorites. Although cooling in liquid air transformed some of the γ -phase into α , this is the nearest approach we have yet made to a reproduction of the essential features of an octahedral meteorite. Recent experiments by others support the view that a much closer reproduction would have been made by exceedingly slow cooling.

An interesting effect of the heat treatment of meteoric iron is the formation of slip planes in the taenite. These can be produced, for example, by heating to 650° C. followed by cooling in liquid air. Slip planes of the forms {111}, {100} and {110} are common and the direction of slip, when identified,

is [110]. There can be little doubt that such slip planes arise as a result of the differential contractions of the constituents when cooled and of the expansion associated with the γ - α -transformation when it occurs.

Finally, it may be of interest to summarise our views regarding the origin of the Widmanstätten structure in meteorites. It seems highly probable now that the kamacite lamellae are the result of a γ - α -lattice-mechanical transformation. This is shown by the relationship between the orientations of the kamacite crystals and the single orientation of the taenite, and is confirmed by the fact that approximately the same relationship is found in the 10 per cent artificial alloy in which the γ - α -transformation is known to have occurred.

As is commonly held, it is quite probable that

meteorites have originated during extremely slow cooling inside some massive heavenly body. In these circumstances, the lattice-mechanical transformation may have taken place so slowly that almost perfect equilibrium has obtained. From this point of view the parameter measurements of the taenite are significant—showing that the narrowest taenite bands are always richer in nickel than the broader ones. It would seem that the latter, owing to their thickness, cannot attain complete equilibrium at the lowest temperature at which effective diffusion is possible.

Acknowledgment of the contributions of many postgraduate students to the work, here outlined very briefly, will be made elsewhere. It is the fault of one of us (S. W. J. S.) that it is so much overdue.

Dimensions of Some Organic Molecules

THE forty-fourth Bedson lecture was delivered by Dr. J. Monteath Robertson to the Bedson Club at King's College, Newcastle-upon-Tyne, on January 27.

Under the title "The Dimensions of Some Organic Molecules", Dr. Robertson dealt with advances in this field, which have occurred mainly as a result of X-ray crystallography. A crystal may be regarded as a periodic structure of units containing electrons, which diffract X-rays, and from a consideration of the direction of diffracted beams, it is possible to determine the distance between these units. By a more involved analysis of the intensities of the beams, something may be learnt about the distribution of the electrons within the diffracting units, and from this, the structure of organic molecules can be investigated. The results are worked out as a two-dimensional graph of electron density, and although in general there is foreshortening owing to the molecule lying at an angle to the plane of projection, it is possible, by taking a series of projections, to obtain a true picture of the molecule in space. Upon such graphs, atoms, except hydrogen, the scattering power of which is insufficient for separate resolution, are clearly seen as circular regions of high electron density, and the peak values enable the separate atoms to be named. As a general rule, it is not possible to obtain the electron density graph without some assistance from chemical evidence, although in some cases the assistance is slight.

The results obtained may be classified under two heads; first, the qualitative confirmation of organic structures, and the refinement offered by the actual measurement of bond distances, and secondly, the information obtained with regard to the relative orientation and distance apart of the separate molecules in the crystals.

Bond measurements of organic compounds which can be represented by a unique structural formula show certain definite regularities. Both single and multiple bonds are constant in length, the atoms being nearer in multiple-bonded compounds than in single, and nearer in the case of nitrogen atoms than in the case of carbon. Bond distances between carbon and nitrogen atoms are the mean of the corresponding carbon-carbon and nitrogen-nitrogen distances. These regularities are not found where resonance is possible.

In such cases, the length of a single bond may have any value intermediate between those normal for single and double bonds. In some of the simpler cases it is possible to estimate bond distances by wave mechanics, and their actual measurement provides a very important check upon these highly involved theoretical calculations. Such measurements also played a very important part in the development of the theory of resonance.

With regard to intermolecular distances in crystals, we may also distinguish two groups, normal and abnormal. In the first, typified by the hydrocarbons, the molecules appear to be arranged in the most convenient manner, without any particular order, and the distances of nearest approach are of the same order for a great many compounds. In such substances as benzoquinone, as might be expected, the dipole causes some approximation of oppositely charged atoms, but the distance of nearest approach is not greatly reduced. In the second group (abnormal), the approach distances are less by nearly an angstrom unit, and this applies generally to those compounds which are known to be associated in the liquid or gaseous states. In the case of resorcinol, for example, very drastic changes are found. The molecules are orientated so that the hydroxyl groups come much nearer to each other than is normal. The structure itself, however, remains open, as is shown by the fact that resorcinol is less dense than benzoquinone. This indicates the strongly directive power of the intermolecular hydroxyl 'bonds', which can maintain such an open arrangement. However, when resorcinol is heated above 74° C., thermal agitation destroys this structure, the molecules are arranged without reference to the affinities of the hydroxyl groups, and the density rises. The higher temperature form takes several weeks to revert to the other, and can be studied in the usual way, when it is found that the molecules are arranged in much the same way as in a hydrocarbon crystal. The close approach of hydroxyl groups is very common, and in the case of hydrated oxalic acid, for example, it is thought that intermolecular resonance occurs.

In conclusion, Dr. Robertson said his intention had been to show that the newer developments of X-ray crystallography enable a definite and accurate picture of the molecular structure to be obtained.

Meridian Astronomy

ON February 10, Dr. H. Spencer Jones delivered his presidential address at the Royal Astronomical Society on "Meridian Astronomy". He pointed out that the purpose of meridian astronomy is to provide a fundamental system of reference, and this is defined by the positions and proper-motions of a network of stars distributed with reasonable uniformity over the whole sky, together with the numerical value of the constant of precession. There are difficulties in the exact determination of the equator—the plane of reference—and also of the equinox—the zero point—because observations of the sun, which are used to fix these, are liable to personal errors of a systematic nature.

These latter have been reduced very considerably by the use of the impersonal micrometer in place of the hand-tapping method. A moving wire is traversed across the field at such a rate that it moves with the object under observation, and contacts are automatically closed when the moving wire reaches certain positions in the field. Personal errors in the observation of stars by the hand-tapping method could amount to a few tenths of a second, but the impersonal micrometer has reduced these to a few hundredths of a second.

Although the bright inner planets can be used for fixing the equator and equinox, the perceptible diak and phase present difficulties, and the results are unsatisfactory. The suggestion of Sir Frank Dyson that Vesta should be used to determine corrections to the equator point and equinox has much to commend it, as this minor planet has a star-like image and is observed at night, and, in addition, is sufficiently bright for observation with the impersonal micrometer. Plans have been developed for utilizing a large number of minor planets to control not only the equinox and equator point, but also errors of a systematic nature.

It is remarkable that, in spite of great improvements in the design and construction of instruments, modern catalogues of stars still show systematic differences, especially in declination, and some interesting light is thrown on the problem by the new reversible transit circle, recently provided at Greenwich. A full description of certain discordances is given, and these were sufficiently large to enable the source of the trouble to be detected. One defect, *inter alia*, may be referred to. The guiding rod, along which the frame carrying the moving wire was constrained to move, was slightly convex to the eyepiece, and the guiding slide of the tailpiece which prevented motion in a direction perpendicular to the plane of the frame formed a constraint. The removal of small amounts of metal rectified these defects, and the lag of the moving wire behind the micrometer screw is now negligible.

Determinations of the precessional constant have usually involved the assumption of random distribution of stellar motions, but the existence of two star-streams, postulated by Kapteyn, Lindblad and Oort's theory of a rotating galaxy, and Schwarzschild's view of a preferential direction of motion, are not in accordance with the assumption. In consequence, the value obtained for the precession will depend upon the assumptions that are made, and, to avoid this difficulty, it has been suggested that the distant galaxies should be used as a system of reference. If the positions of a large number of the distant galaxies were determined with reference to neighbouring stars, the positions of the latter being directly related to the fundamental star system, a means would be provided for correcting and controlling that system and also for determining the constant of precession more exactly. Here is a work for the future that promises to be of assistance for meridian astronomy.

Brittany and Britain: Prehistoric Relations

DR. R. E. MORTIMER WHEELER'S lecture on his exploration of archaeological sites in Brittany last summer, which was delivered before the Society of Antiquaries of London on February 23, gave details of an investigation of which the results have been awaited with no little interest.

It will be remembered that the expedition which he described was undertaken on behalf of the Society of Antiquaries, with the support of the Leverhulme Trust and the University of London, and with the co-operation of the French authorities; and that it had as its specific object to probe the origins of the civilization, which Dr. Wheeler's excavations at Maiden Castle in Dorsetshire, and recent evidence from other sources, had shown makes its appearance with some abruptness in south-west Britain, evidently from foreign sources, in the century immediately preceding the Christian era. One of the more striking characteristics of this civilization is the adoption of what is here a new method of defence on a fortified

site—multiple lines of outworks, instead of the single line of ditch and rampart universal hitherto on the Wessex Downs, and manifestly designed to meet a new weapon of attack, the sling, to the use of which the multitude of sling stones for attack and defence now bears witness.

In seeking the place of origin of this innovation, the natural line of inquiry is directed towards the opposite shores of Brittany; but Dr. Wheeler found to his surprise, on making a survey of the material of the period both in northern Brittany and in north-west Normandy, that two camps only were at all comparable to Maiden Castle. Of these one is at Huelgoat, near Morlaix, the other Le Petit Cailand, near Avranches, on the Bay of Mont St. Michel. At the former, the work known as Le Camp d'Arthus was found to be of two closely related periods, dating approximately from the middle of the first century B.C. The 'Gallo' method of construction of the rampart, as described by Caesar, and the infertile

country around point to a military or political occupation, rather than one of economic significance. It was, Dr. Wheeler concludes, a military rallying post for the peoples of the surrounding country, the Oesimii, at the time of the Roman conquest. This conclusion is supported by the examination of the camp at Le Petit Celland, where the Gallic ramparts were never completed, but were destroyed by military action at a date indicated by coins of local type to coincide in time with Caesar's campaign.

Interesting as were these discoveries, they had provided the expedition with no analogy with the complex forts of the Wessex Downs; and its activities accordingly were then directed to southern Brittany. Here on the jagged cliffs, the bays, and wooded estuaries from Douarnenez to the mouth of the Loire, the home of the Veneti, Caesar's strenuous and

troublesome opponents by land and sea, are situated more than three fourths of the fortified works of this period in north-western France. Wherever in this region digging has taken place, multiple ditches and quantities of sling-stones have appeared. "Here, and here only", to quote Dr. Wheeler, "are the true forerunners of those tumultuous defences of South-Western Britain, in which the present research originated"; and in the name of the type camp excavated, Kercaradec, he is reminded of the familiar Shropshire Caer Caradoc. Dr. Wheeler goes on to suggest that as a result of the defeat of the Veneti in Caesar's campaign of 56 B.C., a remnant escaping from Roman vengeance for rebellion may have escaped to settle in Britain, following the earlier route already familiar to traders and prospectors who, there is evidence to show, had made their way to Cornwall.

Forest Types in India and Burma

IN a prefatory note to his monograph entitled "A Preliminary Survey of Forest Types in India and Burma" (*Ind. For. Rec.*, N.S. 1, No. 1, Govt. Press, Delhi, 1936), Mr. H. G. Champion, sylviculturist at the Dehra Dun Forest Research Institute, defines the purpose of the work. From the point of view of the average forest officer in India, Gamble's "Manual of Indian Timbers" and Brandis' "Indian Forest Trees" fulfilled ordinary requirements, to which Troup's "Sylviculture of Indian Trees" and Stamp's "Vegetation of Burma" afforded additional information. Mr. Champion's objective was different from that of forest botany pure and simple. As he correctly states, "The need of a standard classification for the important forest types of India has long been felt in connection with sylvicultural work, particularly in its application to forest management under working plans, and this need has led to the adoption of local standard types in some provinces".

In temperate Europe the forest types are comparatively few in number, and for the purposes of the working plans officer easy to define without danger of misapprehension. In the tropical and sub-tropical forest regions, the position is far more complicated. This problem had come up previously at sylvicultural conference meetings held at Dehra Dun; one of the puzzling undefined types, for example, being the term 'tropical evergreen'. Mr. Champion solicited the assistance of the provincial research sylviculturists, and as a result a certain amount of a variable material was sent in. This, with such information as had been already published, was utilized in conjunction with his own recorded observations made in all parts of India during the preceding twenty years in the compilation of the publication under review.

As the author says, working plans generally include a description of forest types with which they are concerned, and give lists of the characteristic plants of each. In the present reviewer's opinion, working plans should always include a description of the forest types, etc. But it is essential that the forest officer carrying out the provisions of the plan should know exactly the forest type or types to which the working plans officer is alluding. Herein lies the value of Mr. Champion's work. It is by no means

to be regarded as complete. "The account of the Peninsular and Burma sub-tropical forest types is outstandingly incomplete", he tells us; and there are other parts in the monograph where further information is required, and the author adds that criticism of the classification adopted will be welcomed. The work is illustrated by some typical photographs, for the most part taken by past and present forest officers, also by an informative coloured diagrammatic map showing the distribution of climatic types.

The monograph comprises some 286 pages and may be regarded as a valuable aid to the forest officer engaged upon important work in forest management and working plans. A brief résumé only can be attempted here.

A classification of the forest types in India is attempted, based on four climatic zones from the point of view of temperature—tropical, subtropical, temperate and alpine. Each zone is subdivided on available moisture as reflected by the relative importance of evergreen, deciduous and thorny trees. Whilst the form of the tropical forests is similar on both sides of the Tropic of Cancer, the author considers that the flora is sufficiently different to render subdivision into northern (quasi-subtropical) and southern variations advisable. Omitting moist and dry alpine scrub, thirteen formations are distinguished, seven of them subdivided into northern and southern variations.

The six tropical formations are sub-divided into thirty-three forest types, most of which are admittedly composed of several associations, these being indicated where possible; important edaphic variants (twenty-four) are listed and successions are discussed leading to the recognition of twelve primary and ten secondary important seral types. Subtropical and temperate forests are dealt with in a similar fashion. For each type a general description of the forest and the locality factors is given, with plant lists for typical examples, and ecological notes.

The author stresses the lacunae to be filled up; but in even its present form his monograph should be of considerable use, not only to India but in the forests of the world where similar problems are being faced.

Science News a Century Ago

The Royal Society

At a meeting of the Royal Society on March 7, 1839, William Hopkins read the third part of his paper "On the phenomena of Precession and Nutation, assuming the Interior of the Earth to be a Heterogeneous Fluid". The objects of researches of this kind, said the author, were not merely to determine the actual state of the globe, but also to trace its past history through the succession of ages, in which the matter composing it has probably passed gradually through all its stages between a simple elementary state to that in which it has become adapted for the habitation of man. In this point of view the problem was not without value, as demonstrating an important fact in the history of the earth, presuming its solidification to have begun at the surface—namely, the permanence of the inclination of its axis of rotation, from the epoch of the first formation of an exterior crust. This permanence had frequently been insisted on, and was highly important as connected with the author's speculations on the causes of that change of temperature which had probably taken place in the higher latitudes.

A Royal Institution Conversation

On March 8, 1839, a conversazione was held at the Royal Institution. In its report of the meeting the *Mechanics' Magazine* said: "Mr. Read exhibited what we think to be a very important application of his patent instrument, commonly called the 'stomach pump', namely to the restoration of suspended animation. Besides extracting noxious gases in other cases, and the naturally vitiated state of the air in the lungs of drowned persons, the apparatus is competent to keep up an artificial breathing, the supply of air being both warm and pure, and rendered more exciting if thought proper, by a mixture of oxygen with it. . . . The Royal Humane Society will assuredly hasten to add this to their other means of recovery. We would advise Mr. Read to furnish with the apparatus, air tight bags, which being supplied to the extremities, and the air exhausted by the same instrument, would tend to relieve congestion of blood in the head and other parts, and facilitate its circulation."

Niepce, Daguerre and Talbot

In its column of weekly gossip, the *Athenaeum* of March 9, 1839, said: "During the discussions which took place in Paris respecting the priority of the discovery of M. Daguerre and Mr. Talbot, the name of M. Niepce was incidentally mentioned as the person to whom the former was indebted for the first idea of fixing the images represented in a camera obscura. Subsequently M. Niepce's claim to honour has been more fully admitted; and this has been singularly confirmed by Mr. Bauer, in a letter published in the *Literary Gazette*. Mr. Bauer therein states that, in 1827, he became acquainted with M. Niepce, then on a visit to his brother at Kew; that M. Niepce made known to him, and others, that he had discovered a means of 'fixing permanently, the image of any object by the spontaneous action of light', and exhibited several specimens. That by the advice of Mr. Bauer, he, M. Niepce, drew up a memoir on the subject, dated 8th December, 1827, which he forwarded to the Royal Society, but which was subsequently returned, because it is contrary to

the rules of the Society, to read a paper referring to a process which is not disclosed. . . . Thus, then, the question of priority, as between England and France, is settled beyond all dispute: at the same time we must observe that the processes of M. Daguerre and Mr. Talbot are manifestly different."

Specimens of Niepce's work belonging to Mr. Bauer and to Mr. Cussels were submitted to the writer of this notice, who said that they were all on pewter, apparently covered with a very thin coating of transparent varnish, "but whether this varnish was applied before receiving the impressions, or subsequently, to fix them, is not obvious; we incline to the latter opinion".

University Events

CAMBRIDGE.—The Rockefeller Foundation has allocated £650 as a grant to the Cavendish Laboratory for the purchase of instruments and for assistance in connexion with researches carried out by the Cavendish Professor on the application of X-ray technique to the study of crystals of biological importance.

F. J. Scrase, of Trinity Hall, has been approved for the degree of doctor of science.

At Trinity College, Dr. A. L. Bowley, emeritus professor of statistics in the University of London, and Sir Henry Dale, director of the National Institute for Medical Research, have been elected honorary fellows.

Dr. L. Wittgenstein, formerly fellow of Trinity College, has been appointed to succeed Prof. G. E. Moore, professor of philosophy, who will retire at the end of the current academic year.

LEEDS.—The following appointments have recently been made: W. G. France, demonstrator in anatomy; Eustace A. Horne, demonstrator in pathology and bacteriology; H. S. Shucksmith, surgical tutor; Donald A. McKenzie, lecturer in agricultural bacteriology.

LONDON.—Dr. P. H. Himsforth has been appointed, as from April 1, 1939, to the University chair of medicine tenable at University College Hospital Medical School. Since 1936, he has been deputy director of the Medical Unit at University College Hospital.

The title of professor of physics in the University has been conferred on Mr. Gilbert Stead, in respect of the post held by him at Guy's Hospital Medical School, and the title of reader in physics in the University on Mr. O. T. Archer, in respect of the post held by him at the Imperial College of Science and Technology.

The following doctorates have recently been conferred: D.Sc. on Miss Irma I. Andersson-Kottö, of the John Innes Horticultural Institution; F. M. Haines, of Queen Mary College; William Pugh, of King's College; Isaac Schapera, of the London School of Economics; R. B. Cattell and S. H. Straw.

OXFORD.—In Congregation on February 27, the honorary degree of D.Sc. was conferred on Don Pio del Rio Hortega, director of the National Institute of Cancer and of the Laboratory of Normal and Pathological Histology in Madrid.

Societies and Academies

Paris

Academy of Sciences (C.R., 208, 313-396,
Jan. 30, 1939).

A. CHEVALIER: Future of cotton in the [French] possessions and organization of scientific researches on this crop.

P. LÉVY: A problem of M. Marcinkiewicz.

C. EHRENMANN: The variety of plane generators of a real quadric and the topology of an orthogonal group with n variables.

L. DIEHOUSSE: A differential equation for which the point $x = y = 0$ is a focus.

H. PAILLOUX: The movement of a thread on which a small ring slides.

G. SARTORY: Formation of thermal convection ascending currents above a region uniformly heated by radiation.

J. VIGNAL: Character of errors affecting levellings.

G. BECK: A theorem on the structure of the proton and of the neutron.

M. PABODI: A phenomenon of wave propagation in a line of magnets.

L. and E. BLOCH: Extension of the spectrum of tellurium into the extreme ultra-violet.

G. UNGAR: Theory of photo-dichroism.

M. E. NAHMIAS: Probable emission of mesons in certain nuclear disruptions.

F. JOLIOT: Experimental proof of the explosive disruption of the nuclei of uranium and thorium under the action of neutrons. The radio-elements formed in uranium and thorium, identified by chemistry as barium or rare earths, are due to nuclear disruption with large release of energy.

Mme. I. CURIE and P. SAVITCH: Radio-elements formed in uranium and thorium irradiated with neutrons. At least three radio-elements similar to the rare earths are produced, and also an alkali body of period 18 min.

A. PORTVIN, P. BASTIEN and L. GUILLET, JUN.: Nature and stability of some special cementites.

Mlle. M.-L. JOSSEN: Formation of bromous acid by the action of bromine on silver nitrate.

P. DUMANOIS, G. REICHENAUER and M. PRETTER: Combustion of mixtures of hydrocarbons: mixtures of decahydronaphthalene and tetrahydronaphthalene.

A. KIRGMANN: The ethylenic frequency in vinylic esters.

Mlle. B. TCHOUBAR: Action of magnesium bromide etherate on dimethyl-1.4 epoxy-1.2 cyclohexane.

A. LEHMAN: Estimation of phenolic and naphtholic hydroxyl by means of benzoic anhydride.

R. PAUL and G. HILLY: Application of Raney nickel to the hydrogenation of some acids with the furanic nucleus.

A. BOUILLIER: Reversible transformation in the copper-aluminium alloys containing between 7 parts and 16 parts in a hundred of aluminium.

F. D. LA TOUR: Dilatation and polymorphism in the fatty acids.

R. SOYER: The fallen cliff at Ivry-sur-Seine (Seine).

M. LAFÈVRE and P. BOURELLE: Stability of ornamentation in species of the genus *Pedicularis* Meyen.

L. EMBREGER: Structure of the flower of the Polygonaceae.

H. HUMBERT: An aberrant type of *Casalpinia* of Madagascar.

R. HENRI: Existence of a group of *Boletus* [fungi] with free tubes.

A. DE OUGNAC and H. BELVAL: Nature of the glucide of a hybrid [between two genera of Gramineae] differing in their glucidic reserves.

R. DUGHI: Domain of stability of lichen symbiosis: emantioxy [resistance to drought].

P. DE BERRIDO-CARNERO: Curarization and chronaxy.

L. LAPICQUE: Observations on the preceding note.

F. RATHERBY, M. DIBOT and P.-M. de TRAVERSE: Consecutive hypoglycemia with digestive absorption of insulin. Effects were obtained, but not proportional to the quantity of insulin used, by limiting the action of proteolytic ferments with an antidiastase.

Mlle. M. HAMON: Chemical constituents of the envelopes of cephalopod spermatophores.

L. LESOUBE: Variations of the formol and phthalein acidities in the urine: interpretation by the graphic method.

L. LUTZ: Soluble ferments secreted by hymenomyces fungi: conjugated antioxygen action.

A.-R. PRÉVOT: Increase of the toxigenous power of a stock of *Plectridium tetani* by passage in acid brain broth at moderate temperature.

Budapest

Hungarian Academy of Science, January 23.

J. BARTA: Uniformly stretched and optionally loaded plates.

J. BARNÓTHY and M. FORRÓ: Influence of meteorological factors upon the intensity of cosmic ray showers. From the material measured during a year, the barometric, temperature and magnetic effects are determined as well as the phase and amplitude of the daily and sidereal wave. The differences between these values and those obtained with a corresponding vertical arrangement can even be quantitatively explained with the help of the meson disintegration hypothesis.

Prague

Czech Academy of Sciences and Arts, January 21, 1938.

K. HRUBÝ: Development of the embryo-sac in *Erythronium dens canis* F.

March 11.

J. MILBAUER: Prolonged action of concentrated sulphuric acid on acetylene in the cold. The solutions turn yellow to dark. This change is catalysed positively by HgSO_4 , SeO_3 , CuSO_4 , V_2O_5 , Ag_2SO_4 , MoO_3 ; practically inert are As_2O_3 , SiO_2 ; negative catalysts are Sb_2O_3 , PbSO_4 , HCl , ZnSO_4 , SO_2 , K_2SO_4 , $(\text{NH}_4)_2\text{SO}_4$.

J. PETEREK: Historical evolution of the bay at Neeber.

A. VELICH: Effect of essential oils on the germinating grain and bacterial growth.

May 20.

J. MILBAUER: New behaviour of mannitol as a negative catalyst. It retards the oxidation of hydrogen or ferrous sulphate by hot sulphuric acid, but not that of carbon monoxide.

V. TRKAL: A fundamental equation of the electron theory.

ZD. KÖCHER: Experimental studies of the resorption of K-strophantidin and convallamarin.

ZD. KÖCHER: A contribution to the study of the accumulative effect of some cardiacs.

R. RÖHLKA: A contribution to the recognition of Barrandian trilobites. (2).

K. KOUSKÝ: Some modifications of given topology.

ZD. ROTH: Geological conditions around Lučivná below High Tatra.

October 21.

J. MILBAUER: Dissociation of urea nitrate in aqueous solution.

J. MILBAUER: Application of Bunsen's photometer in enlargements.

J. MILBAUER and ZD. MILBAUER: The investigation of some relationships in the action of acetylene on sulphuric acid, at room temperature. The factors influencing this reaction. Concentration of sulphuric acid, of the positive catalyst, HgSO_4 , and of the negative catalyst $(\text{NH}_4)_2\text{SO}_4$ are expressed by empirical mathematical formulae.

J. MLÁKOVSKÝ: Registration of the reaction of frog's iris to light.

J. PETRBOK: Stratigraphic chronology of non-marine layers of the Black Sea quaternary in Bulgaria.

K. KAVINA: Antholysis in *Cerastium Cespitosum*.

P. ČERH: The electromagnetic field of a dipole between two parallel planes.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Monday, March 6

UNIVERSITY OF LONDON, at 5.15.—Prof. E. D. Adrian, F.R.S.: "Manifestations of Activity in the Nervous System".*

UNIVERSITY COLLEGE, LONDON, at 6.—Prof. A. Frey-Wyssling: "The Submicroscopic Morphology of Protoplasm and its Derivatives (succeeding lectures on March 7 and 9)."

Tuesday, March 7

WILLOWAY RESEARCH INSTITUTION, at 5.30.—Prof. W. Schlemmer: "Chemotherapy" (succeeding lectures on March 8 and 9).*

Friday, March 10

ROYAL INSTITUTION, at 9.—Dr. W. H. Hatfield, F.R.S.: "New Researches in Steel Metallurgy".

INSTITUTE OF METALS, March 8-9.—Annual General Meeting at the Institution of Mechanical Engineers.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

TEACHER OF SCIENCE OR ENGINEERING in the Luton Technical College—The Director of Education, Shire Hall, Bedford (March 6).

PROFESSOR OF PHYSICS AND ELECTRICAL ENGINEERING in the Royal Naval College, Greenwich—The Director, Education Department, Admiralty, London, S.W.1 (March 16).

LECTURER IN PHYSICS in the University of Sydney—The Registrar (May 1).

ASSISTANT in the Intelligence Section of the Mineral Resources Department of the Imperial Institute—The Establishment Officer.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Two Lectures on the Development of the Chemistry of Commercial Synthetic Dyes (1866-1938). By Dr. Frederick Maurice Rowe. Pp. 106. (London: Institute of Chemistry.) [7s]

Proceedings of the Royal Irish Academy. Vol. 45, Section A, No. 1: A Small Scale Differential Analyser, its Construction and Operation. By H. S. W. Massey, J. Wylie, B. A. Buckingham and R. Sullivan. Pp. 23+5 plates. 2s. Vol. 45, Section A, No. 2: Note on Group Theory and Kinematical Relativity. By W. H. McCrea. Pp. 23-30. Vol. 45, Section A, No. 3: Long Range Forces between Hydrogen Molecules. By H. S. W. Massey and R. A. Buckingham. Pp. 31-46. 1s. Vol. 45, Section A, No. 4: Diffusion and Fall of Atmospheric Condensation Nuclei. By J. J. Nolan and P. J. Nolan; with an Appendix by P. G. Gormley. Pp. 47-64. 1s. Vol. 45, Section B, No. 3: The Local Glaciers of Mount Leinster and Blackstairs Mountain. By A. Farrington. Pp. 65-72. 1s. Vol. 45, Section B, No. 4: The Shurian Inlier of Liffelaw, County Fermanagh, with a Note on the Age of the Fintona Beds. By J. O. Harper and J. J. Hartley. Pp. 73-88+plates 13-16. 2s. 6d. Vol. 45, Section B, No. 5: Reports from the Limnological Laboratory. 4: The Phytoplankton of the River Shannon and Lough Derg. By R. Southern and A. O. Gardiner. Pp. 99-124+plates 17-21. 3s. Vol. 45, Section B, No. 6: On the Identity of *Monileptera Nicholsoni* and *Nicholsoni*, 1879, with *Chelodactylus* McCoy, 1847. By Dorothy Hill and L. B. Smyth. Pp. 125-128+plates 22-23. 1s. 6d. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [7s]

The College of the Pharmaceutical Society. Annual Report of Research Work, 1938. Pp. 41. (London: Pharmaceutical Society.) [8s]

Report for 1938 (No. 51) of the Marine Biological Station at Port Erin, Isle of Man. Drawn up by Dr. R. J. Daniel. Pp. 36. (Liverpool: University Press of Liverpool; London: Hodder and Stoughton, Ltd.) 1s. 6d. net. [8s]

Other Countries

Indian Forest Records (New Series). Silviculture, Vol. 3, No. 2: An Investigation into the Best Date of Stump Planting Teak (*Tectona grandis*) at Begur (Wynaad Division), Dhoni (Palghat Division), and Topalip (South Combaratore Division). By A. L. Griffith. Pp. 111+17-45+2 plates. (Delhi: Manager of Publications.) 1.8 rupees; 2s. 3d. [6s]

University of California College of Agriculture: Agricultural Experiment Station. Circular 847: The Water-Culture Method for Growing Plants without Soil. By Prof. D. B. Hoagland and D. I. Aron. Pp. 40. (Berkeley, Calif.: University of California.) [7s]

Bulletin of the Bingham Oceanographic Collection. Vol. 6, Art. 6: Further Observations on Penaeids of the Northern Gulf of Mexico. By Martin D. Burkenroad. Pp. 62. (New Haven, Conn.: Yale University.) [7s]

Proceedings of the American Academy of Arts and Sciences. Vol. 73, No. 1: Poetry and Music; Musical Interpretation; and some Remarks about American Orchestras. By Serge Koussevitzky. Pp. 4. 35 cents. Vol. 73, No. 2: American Polkaes in the Far East. By W. Cameron Forbes. Pp. 5-23. 70 cents. (Boston, Mass.: American Academy of Arts and Sciences.) [7s]

U.S. Department of the Interior: Office of Education. Bulletin, 1937, No. 88: Vocational Education and Guidance of Negroes; Report of a Survey conducted by the Office of Education. By Ambrose Caliver. Pp. x+127. 20 cents. Bulletin, 1938, No. 5: Bibliography of Research Studies in Education, 1936-1937. By Ruth A. Gray. Pp. xiv+573. 35 cents. Vocational Education Bulletin No. 166 (Home Economic Series No. 22): Homemaking Education Program for Adults. By Mary S. Lytle and Rosa Van Horn. Pp. vi+125. 15 cents. (Washington, D.C.: Government Printing Office.) [7s]

Smithsonian Miscellaneous Collections. Vol. 97, No. 12: The Spence Shale and its Fauna. By Charles Elmer Resser. (Publication 3490.) Pp. 29+6 plates. (Washington, D.C.: Government Printing Office.) [7s]

Western Australia. Annual Progress Report of the Geological Survey for the Year 1937. Pp. 24+5 plates. (Perth: Government Printer.) [7s]

Fondation Universitaire. Dix-huitième Rapport annuel, 1937-1938. Pp. xxviii+159. (Bruxelles: Fondation Universitaire.) [7s]

Indian Academy of Sciences. Sir Chandrasekhara Venkata Raman, 1888-7th November-1938: Jubilee Volume of Original Papers presented in commemoration of his Fiftieth Birthday. Pp. 11+242-566+14 plates. (Bangalore: Indian Academy of Sciences.) [7s]

Havaförkningsinstitutets Skrift. No. 112: Vattenståndsvärden 1935 och 1936. Av S. M. Stenij. Pp. 62. No. 118: Järsnadsförloppet i den kemiska och biologiska faktorer i Mälaren vid Hango i år 1935. Von Kurt Buch und Sina Grisenberg. Pp. 26. No. 119: Havaförkningsinstitutets verksamhet under år 1937. Av Gunnar Granqvist. Pp. 16. No. 120: Reguler Observations of Temperature and Salinity in the Seas around Finland, July 1936-June 1937. By M. Palmén. Pp. 44+vi. No. 122: Zur Kenntnis der Temperatur und des Salzgehaltes des baltischen Meeres an den Küsten Finnlands. Von Gunnar Granqvist. Pp. 166+xxiii+8 plates. Havaförkningsinstitutets Temperatur och Salinitet i Finlands Kustvattnen. Pp. 64. (Helsingfors: Havaförkningsinstitutet.) [7s]

U.S. Treasury Department: Public Health Service. Changes in the Types of Visual Refractive Errors of Children: a Statistical Study. By Antonio Occeco. (Reprint No. 1960 from the Public Health Reports, Vol. 53, No. 35.) Pp. 8. (Washington, D.C.: Government Printing Office.) 5 cents. [6s]

Publications of the Kapteyn Astronomical Laboratory at Groningen. No. 40: Spectroscopic Absolute Magnitudes of Mount Wilson Contributions No. 511 and their Probable Errors. By Prof. Dr. P. J. Van Rhijn. Pp. 11+31. (Groningen: Hottelma Brothers.) [8s]

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The Unity of Knowledge

IN his anniversary address to the Royal Society, Sir William Bragg has treated a subject which, as he said, seems to exhibit a greater importance the more closely it is examined. The very great increase in the output of the records of research has placed scientific societies in a difficult position. There is correspondingly more to be published and, at the same time, publication costs have increased. The long rows of periodicals on the shelves continue to grow, the annual volumes increase in size and divide into two or four. Still the papers come pouring in, and even the rate of flow increases. It is a healthy growth, which we do not wish to check; but the practical difficulties need to be solved.

The principal reason for the publication of the results of research is that they may be of service to mankind. The preparation and presentation of these records so that they may be sufficiently appreciated and can be incorporated with understanding into every activity, scientific, intellectual and physical, to which they may apply; is one of the essential duties of a society. In Sir William Bragg's own words, "We are, at least, bound to see that our acquired knowledge is rightly stated so that it can be rightly used." Because the results of research have become so voluminous and so important, the manner of stating them, of arranging them and of storing them, has also become important.

The proper appreciation and application of new discoveries is being hindered at present by increasing specialization, employing a terminology and a mathematical apparatus which are intelligible only to a few specialists in some one subject. Anyone who has completed a piece of research may think it necessary to set out his facts in detail for the use of the expert who is working in the same

subject, and is familiar with the technical terms and the hidden difficulties. Yet such writings make dull and difficult reading for the great majority of those who are interested in scientific discovery. The number of those who can study critically a paper of a certain type is distressingly few. The difficulty even of finding referees capable of judging its merits is known only too well. The paucity of attendance and the lack of good discussion, when such papers are read, is so disappointing that an increasing number of papers are taken as read.

The publication in advance, in the *Proceedings of the Royal Society*, of summaries of papers received has been appreciated, as providing both an earlier announcement of discovery, as well as giving a general idea of the trend of research to those who are not specialists. Such summaries are the expression of a natural reaction to the increasing difficulties due to growing specialization, which tends to take discoverers out of sight of each other and of the main body of scientific workers. Summaries indicate the recognition of a principle, which demands acceptance, namely, that discovery must be accompanied by exposition.

The summaries required are more than mere digests of papers. They differ from the papers themselves in being addressed to a wider circle of readers, a circle that may include the experts, but which contains also many others, who should, in fact, receive the principal attention. Such a summary may be more difficult to write than the paper, because it must take into account the interests and modes of thought of those who may be unable to read the paper itself, but will gladly absorb its meaning, especially if there is a connexion with their own work. When the summary is written with this wider view it becomes literature,

though the paper itself may be no more than a record. The only way to facilitate the growth of a sound general opinion is to insist that a general account shall be given that is intelligible to a sufficient number.

Now, if the scientific worker is required, not merely to observe and to record, but also to share his knowledge with the world, he needs certain qualifications and a certain education, which are less necessary in the more restricted field. He is dealing not merely with facts, but also with men: his work enters the humanities. As Sir William Bragg points out, this is really a great matter. Its importance arises from the tremendous consequences, which are now obvious, of the increase of knowledge of Nature. To charge scientific men with the responsibility for the evil uses sometimes made of their discoveries is absurd. But this responsibility is theirs, that they shall explain what they find so that it may be properly understood; and none but themselves can rightly describe it.

This problem, urgent as it is, cannot be fully solved while school and college still maintain an artificial division between two forms of teaching, respectively described as 'science' and the 'humanities'. If Plato was right in defining science as knowledge of what eternally exists and not what comes for a moment into existence and then perishes, science and the humanities are one. The "Principia" is an item of literature, as the discovery of radium is an event in history. The artificial separation of science from the humanities in education tends to the division of the adult into two distinct classes, whose minds are complementary, the one to the other, but each essentially incomplete and incapable of comprehending truth as a whole. Mutual distrust may result in after-life. The seeds of social strife are sown at school. May not present international disputes be traced in large measure to defects in national systems of education? The existence of this evil is too evident to need examination. Steps must be taken to eradicate it now. The basis of education must be broadened. The humanist must learn to understand the inner working of the common things of life. As Pope would teach him:

"Go, from the creatures thy instruction take.
Learn from the birds what food the thickets yield;
Learn from the beasts the physics of the field;
The art of building from the bee receive;
Learn of the mole to plough, the worm to weave;
Learn of the little nautilus to sail,
Spread the thin oar, and catch the driving gale."

Likewise the man of science should learn from the same poet that:

"True expression, like th' unchanging sun,
Clears and improves whate'er it shines upon;
It gilds all objects, but it alters none."

Specialization there must be, of course—a divergence in study at later stages. But men of different types of mind must be kept together more than at present, so that, when they meet in the affairs of the world, they can understand each other. Practical difficulties can be surmounted, now that the need is clear. The sharp distinction must disappear. Education must be founded on the unity of knowledge.

Already the humanities and science have joined hands in the service of mankind. Scientific societies can contribute towards the needed reform by insisting on the publication of adequate summaries of original contributions to knowledge. When a new departure in experiment or theory is made, or a new fact is discovered, a careful and complete explanation must be made. If the novelty leads, as often, to a steady output of observation, extension, confirmation and illustration, there must come a time when complete publication to the world becomes unnecessary and even tiresome. Summaries, properly written, of such continuation material should be enough. For the benefit of the comparatively few experts who need them, photographic reproduction of the complete material could be made at a fraction of the cost of printing. The proceedings of societies would thus become more handy, interesting and useful, and their cost would be reduced.

The so-called micro-film, the use of which is discussed in an article on pp. 393-395, offers one means for the photographic reproduction of bulky reports. Complete copies of lengthy documents can be prepared on cinematograph film at the cost of a penny or so a page, and these can be read, in libraries or the private home, by means of optical projectors that enlarge the pictures to full size. The method has now well passed the experimental stage. Already it is being used extensively for the reproduction of articles in periodicals, rare and out-of-print books, manuscripts and documents of all kinds. The United States has taken the lead in the exploitation of the new process. The time is ripe for the creation in Great Britain of a centre, where micro-films and other photographic reproductions of material for the use of scholars can be produced with economy and efficiency.

Documentary Photography and Research

By Dr. S. C. Bradford

RECOGNITION of the document, manuscript or printed, as an instrument of research, demands intensive study of the processes of collecting, classifying and distributing documents. Prominent among the subjects considered during the past twenty years, in the circles concerned with this endeavour, has been the photographic reproduction of documents, and especially the application of the micro-film to this end.

The value of the method is now recognized alike by historians and scientific men. Recently its importance was emphasized by Sir William Bragg in his anniversary address to the Royal Society. Photography has become the most suitable means of reproducing books and manuscripts, of which a comparatively small number of copies is required. It may be employed to serve the needs of a particular student, or, as a means of publication, alternative to the issue of a printed text. It is suitable as a method for the preservation of material, whether in print or manuscript, which is perishable in nature, or of considerable bulk in its original form.

Of the various photographic processes available for the reproduction of documents, collotype and photolithography have already taken their place as everyday operations of printing. It is time to consider how best to make use of the facilities offered by photography for the production of a smaller number of copies of documents. This is a matter of considerable moment, in which the scientific public is intimately concerned. It is important that the public should be cognizant of the relevant facts, which shall be stated succinctly.

The photostat and its various modifications are too well known to need description. Two other processes are specially notable, namely, reflection copying and microphotography. Perhaps the former is of greater theoretical interest. In this method, sensitized paper is pressed into contact with the material to be copied, so that light may pass through the photosensitive layer to the surface of the document, whence it is reflected back again through the sensitive layer. The difference in the amount of light reflected from the dark and light portions of the document is utilized to form the photographic image, which is produced in continuous tones, though with rather greater contrast. Silver bromide paper may be used in the process, giving a full-size reversed negative image, from which positive 'prints' must be made. Such are the Ruthurstat and Rectophot processes.

Perhaps the most intriguing, and at the same time most valuable, method is the so-called Retocooe process, of recent introduction, and using thin sheets of 'Cellophane' coated on one side with a diazo compound. After exposure to an arc light, mechanized treatment with a suitable solution immediately develops a full-size positive image by the formation of a dye-stuff. The picture becomes dry instantaneously and is made ready for delivery by pressing the tissue on to a sheet of tacky white paper to show up the image. The complete operation occupies three minutes. Should a number of copies be required, they can be printed at the rate of perhaps three or more a minute, in black on white paper, from a brown-toned transparency, at a cost of a farthing a piece, for octavo size. Neither lens nor shutter is needed in the apparatus, which can be operated by any member of the staff in full daylight. At present, the cost of the materials for making a single positive copy by this method is very slightly more than that for a negative copy by the photostat method, or scarcely more than half the cost for a positive copy; the difference being negligible in comparison with the labour and overhead charges involved, which may amount to half a crown for each order of an average of four pages. The apparatus itself, of course, is much cheaper, while the cost of producing a number of copies is remarkably low. Now that typewriters are available with a double shift, giving three characters to a key and a range ample for typing scientific papers, this method is very suitable for the reproduction of such papers, of too limited an interest to justify printing.

The microphotographic process, which, on account of its cheapness, the small bulk of the copy, and the need for the production of grainless films and the design of new types of apparatus, has stimulated so much interest in documentary photography, was first described in 1907 by an eminent Belgian, Prof. Robert B. Goldsmidt, and M. Paul Otlet, who is well known as one of the founders of the International Federation for Documentation. Their invention was published in the Belgian *Journal des Brevets*, in an article entitled "Une forme nouvelle du livre—Le livre micro-photographique". The process consisted in the microphotographical reproduction of documents on standard cinematograph film and their enlargement for reading by the projection of an optical image. The term 'photoscope', given originally by Prof. Goldsmidt to his reading apparatus, can scarcely be improved. Complete mechanization of the method has

enabled exposures in a continuous run to be made at the rate of three or four hundred an hour, with a corresponding speed of processing the film and a resulting cost for material of about a halfpenny per exposure. The design of a perfect photoscope has presented the greatest difficulty, and although tolerably efficient instruments are now on the market, room for improvement still remains. As an alternative method, the micro-negative may be enlarged into a full-size positive photograph. But this method, involving two exposures, cannot compete in cost with methods that produce positive copies directly. Necessarily the same overhead charges apply, as with other methods. These completely swamp the cost of materials, when only a few pages are ordered, so that the cheapness of the process is fully realized only when applied to the reproduction of a large number of pages at a time.

Thus, as was foreseen by its inventors, the great value of this method lies in its application (1) to the reproduction of bulky material, such as complete manuscripts, rare books and newspapers, and (2) as a potential means for the publication of records, reports and other documents of too limited an interest to bear the cost of printing.

The microphotographic method is suitable for the reproduction of works of considerable length, whether in a few or a comparatively large number of copies. By its means, masses of historical material could be made available or more readily accessible to the student. The method can be used to supply individual students with copies of otherwise unprocurable books, or to relieve the librarian of anxiety caused by the too frequent handling of rare originals. It may have greater value as a means of reproducing large works of reference, such as the Statutes of the Realm, or of assembling complete texts from widely scattered originals. The process makes possible the study, in the reader's own home, of the foreign press, in a manner which can be achieved at present only by prolonged visits abroad. Film photographs can be used for the preservation of records otherwise likely to be destroyed. Microphotography of newspapers facilitates the collection of complete files of the rarer journals at small cost and provides a method of preservation of such as are liable to disintegration. It relieves libraries of costs for storage and binding. Thus a bound file of the *New York Times* requiring 59 cubic feet of storage space, occupies, in film form, only $1\frac{1}{4}$ cubic feet. The method offers also means of avoiding inter-library loans of rare books.

In adopting photographic methods as a means of publication, the editions produced fall naturally within the scope and protection of the copyright laws. Arrangements must, therefore, be made to

satisfy the holders of any copyright in the originals reproduced, as would be done for works published in any other way. No difficulty arises from this fact. But, it is important to discriminate between the use of photography for the publication of a considerable edition of a work, and its utilization as a convenient means of copying an extract from a volume for the purpose of private study, or research. In the past, photographic copies of more or less inaccessible scientific papers have been of much service to research workers, on occasion. This facility should not be limited.

Fears have been expressed that the unrestricted sale of micro-photographs of articles in periodicals might 'kill' the journals. Let us be clear upon this point. In library experience, rarely is a second request received for a photograph of the same article. After the passing of the period when a discovery is first made known, by the publication of an article in a scientific magazine, references to that article are usually confined to single consultations, made by one, or occasionally a few, experts working on a cognate subject, or subjects. Such experts need to refer, not merely to one article, but to a number of articles, published at different times and in different periodicals. For the rapid performance of the bibliographical survey, which must usually precede the commencement of a new laboratory investigation, it is essential that comprehensive libraries should be available, where the experimentalist may find ready to hand the original literature bearing on his work. It is not an assistance, but a hindrance, to have to wait while photographic copies are being made of articles urgently needed for consultation. This applies, whether only one example of the original document exists, or whether a number of copies have been made and deposited in other libraries.

Photographic reproduction will be of service as a new means of publication; copies of periodicals so published will be deposited in libraries; but photography will not take the place of libraries, or kill the journals. Only when a library does not contain a copy of a paper needed by a research worker, is he glad to avail himself of the possibility of obtaining a photograph from another library. He would soon complain, if his library should cease to take periodicals, in the hope of satisfying him with photographs obtained from other sources.

A single photographic copy of an extract, whether of microscopic or legible size, becomes useful when the work itself is not available for consultation. The supply of such copies is not publication, in the sense of making available to the general public. It has not restricted the continual growth in number of new periodicals, nor does it appear to have diminished their circulation. Publishers have

not objected to the practice, and authors are concerned rather to make their discoveries better known. The making of a single copy of an article, by any means, is not a trespass upon the moral rights of the holder of any copyright. Carried to the extreme, such an idea must prevent the loan of books, or even the establishment of libraries for general use. It would be an ill service to science, if the advent of microphotography should be the cause of the suppression of a useful aid to research.

In order to take full advantage of the facilities offered to research workers by the various methods of documentary photography, the organization of the service would require to be placed in the hands of a central institute, which would be in a position to study the many problems involved, to choose the best means of tackling individual cases and to

bring about the standardization of apparatus and material. The present tendency to leave the making of photographs of documents to individuals, commercial firms, and miscellaneous institutions, working independently, is both wasteful and a source of confusion. Expensive apparatus is used intermittently, overhead charges are increased and experience wasted. Moreover, the lack of agreement upon standard measurements creates the possibility that microphotographs made by one agency may prove to be unreadable upon apparatus available in another place. Already the United States has led the way by the foundation of the American Institute of Documentation. A similar centre is needed in Great Britain, where production may be organized and the fullest efficiency and minimum cost achieved.

Josiah Wedgwood and his Portraits of 18th Century Men of Science*

By Dr. John Thomas

THE eighteenth century gave birth to some remarkably interesting personalities in the realms of both industry and science. From the Midland manufacturers in the persons of Wedgwood, Boulton and Watt, there can be singled a trio who became fellows of the Royal Society. In science, the Midland men of fame include Joseph Priestley and Erasmus Darwin. The spirit of inquiry of the age, with its zest for experiment, led Wedgwood to convert his manufactory into an industrial "elaboratory", as he termed it. He was determined to convert crude clays into artistic ceramic products. He had to wrestle with all the four familiar elements of philosophers in the pre-scientific age—fire, air, earth and water. His "Trial Books" now in the Etruria Museum justify his claim to be considered a man of science.

Josiah Wedgwood was elected a fellow of the Royal Society in 1783, and made several contributions to the *Philosophical Transactions* in 1782, 1784 and 1786. His pyrometer, which was the subject of his Royal Society papers, was the result of experiments extending over a period of six years. It is a very simple instrument marked and graded to indicate the shrinkage of clay bodies when inserted in the potter's oven. At first, Wedgwood placed small cylinders of clay at the wide tapering end, but later he made cylindrical balls or marbles of clay, which he called pyrometrical

pieces. These "contraction bits" have been used regularly in potteries the world over since the invention of the pyrometer by Wedgwood.

This thoroughness in scientific exactness was not confined to the firing of the ware, but it permeated the earlier stages of preparing the clay. The potter's mill, like "the mills of God", is expected to "grind exceeding small"; hence Wedgwood's anxiety to replace the wind- or water-mill with the more reliable source of power found later in Watt's steam engine. The Boulton and Watt archives* contain ample evidence of Wedgwood's faith in the new scientific inventions of James Watt. At Etruria, the last steam engine installed by Watt in 1800 worked continually until dismantled in 1912. We thus see a powerful link between Etruria and Soho.

There were earlier links between Wedgwood and Boulton when Fothergill was his partner. In the earlier days of his pottery career, Wedgwood sent small cameos and pottery trinkets to Soho to be mounted in metal before being sold by jewellers. Arising out of this kind of trade, where pottery was a subsidiary of the metal trades, we get a further commercial link, where Boulton and Fothergill often acted as wholesale merchants for Josiah Wedgwood until he later set up his own sales room in London. Like the Prince of Potters,

* From a Friday evening discourse at the Royal Institution delivered on December 16. A small selection only of the many medallions by Wedgwood mentioned during the discourse are reproduced here.

* The Soho order book for steam engines sold to Staffordshire shows orders from Etruria in 1782, 1784, 1793 and 1800. In 1793 Wedgwood drafted a document for Boulton and Watt stating the performance he expected of the steam engine in his pottery.

these two Soho manufacturers, Matthew Boulton and his later partner James Watt, were elected fellows of the Royal Society, in 1785. But as the versatile Watt was in his way more or less a skilled artist and sculptor, another link was forged between Watt and Wedgwood. When the former retired from the Soho factory, he carried on his experiments in his garret at Heathfield. Here he invented his now famous mechanical sculpturing machine for producing enlarged or reduced cameos or busts, "made," as Watt wrote to his friends, "by a young artist just entering on his eighty-third year." The moulds and pottery models for this work were supplied to Watt by his bosom friend, Wedgwood.

Sir Humphry Davy, in a discourse introductory to a course of lectures on chemistry at the Royal Institution in 1802, remarked that the knowledge of chemistry has improved the art of pottery, but he rightly emphasized also that the pottery industry has provided much of the apparatus used in scientific research. Many of these pottery implements Wedgwood supplied freely to his friend, Dr. Joseph Priestley, and even after his death his sons, Josiah and Thomas, provided Davy with porcelain and other apparatus for chemical experiments and demonstrations at the Royal Institution. In fact, Josiah Wedgwood II, when this Institution was founded in 1799, became one of the first proprietors by subscribing one hundred guineas to its funds.

WEDGWOOD PORTRAYS MEN OF THE 18TH CENTURY

With his love of science and association with scientific men, it is not surprising that Wedgwood devoted his energies to portraying the features of some of his famous scientific contemporaries by means of his "jasper" ware. This triumph he was enabled to achieve through the medium of his new and perfect pottery "bodies". The soul of

Wedgwood ware lay to a large extent in its "body". One body, used for black busts, he called "basalt-tes". Later he discovered a body called "jasper", generally blue, green or lilac, which he used for the base or background of his portrait medallions, using white jasper for the raised faces or heads and shoulders. This body, while plastic and unfired, is pressed into a mould, which has been cast or made in plaster of Paris, usually from a design by some artist.



ERASMUS DARWIN.



JOSIAH WEDGWOOD.



JOSEPH PRIESTLEY.



SIR JOSEPH BANKS.

SOME WEDGWOOD MEDALLIONS.

Photo.: E. Harrison and Son.

THE MAKERS OF THE MEDALLIONS

The three partners associated in the production of most of the medallions [a large collection was on view in the library of the Royal Institution] were Josiah Wedgwood, Thomas Bentley, his first partner at Etruria, and after the latter's death, Wedgwood's nephew Thomas Byerley.

Bentley was a cultured Liverpool gentleman who, while in the North, was one of the founders of the famous Warrington Academy, which was the training ground of so many fellows of the Royal Society, for example, Joseph Priestley, Thomas

Pennant, and others. When Bentley removed to Chelsea his artistic temperament delighted in the company of a neighbour, Sir Joseph Banks. Bentley was a regular subscriber to the Royal Society of Arts, and he it was who spotted young Flaxman, at the age of twelve years, as a premium winner, and recommended him to the notice of Wedgwood. Until his death in 1795, Wedgwood made his nephew Byerley his partner, after giving him a good training in his own business methods at Etruria. In addition, Wedgwood had his two sons, Josiah and Thomas, as active partners from 1793. For some strange but presumably good reason, Wedgwood never made a medallion of any of his children. He was content to leave them to the skill of the artist George Stubbs, R.A., in his well-known painting of the Wedgwood family.

There was a host of artists engaged by Wedgwood for the designing and modelling of many of his medallions. From the artistic point of view the best was undoubtedly the master sculptor Flaxman.

LEARNED SOCIETIES IN THE PROVINCES: THE STAFFORDSHIRE LUNAR SOCIETY

Long before Wedgwood became a fellow of the Royal Society, he had been introduced to the circle of Midland men of science or philosophers calling themselves the "Lunar Society". It was an informal club or association of scientific men formed about 1766 by Erasmus Darwin and Matthew Boulton. The "Lunar Society" was later joined by new and brilliant recruits, like Joseph Priestley and James Watt. The members met at each other's houses every Monday nearest to the full moon, "in order to have the benefit of its light in returning home," stated Priestley. Hence its name, "Lunar Society". The members were accustomed to dine at 2 o'clock, and parted company at 8 p.m., after exchanging views on scientific topics. Wedgwood made two excellent medallions of Darwin and Priestley.

Members of the Lunar Society were allowed to introduce friends, and thus many distinguished guests were present at these philosophical and scientific banquets. Among these were fellows of the Royal Society from London and sometimes from abroad. Wedgwood made medallions

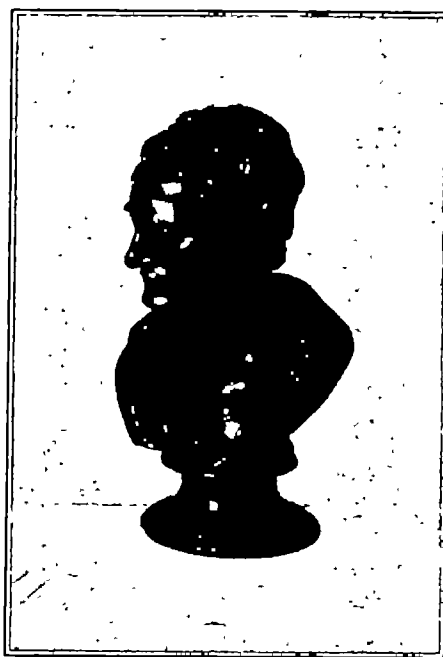
of several of them, including Sir Joseph Banks, Dr. Solander, Sir William Herschel, and Dr. Peter Camper. Some writers place Wedgwood among the visitors to the Society, but judging from his correspondence, I would be inclined to rate him as a member.

The Lunar Society in the Midlands was only one of many provincial learned societies. Spalding's Gentlemen's Society, of which Sir Isaac Newton was a member, goes back as far as 1710. In Liverpool, Bentley, Roscoe and Currie formed a scientific group. At Warrington, Dr. Aikin and, later, Dr. Priestley, before he removed to Birmingham, had been the scientific centre of another active coterie. Later, at Bristol, we had Dr.

Beddoes, with his young assistant, Humphry Davy, the centre of a scientific circle. At Norwich a scientific group centred round the Taylors and the Martineaus.

Wedgwood made medallions of several presidents of the Royal Society, and there are in existence two by him of Sir Christopher Wren and Dr. Martin Folkes. Of the Royal Society medallists portrayed by him, I will comment upon two only, although all are worthy of passing note.

Dr. Joseph Priestley was awarded the Copley medal in 1772 for his experiments and paper on soda water. Then, when Priestley resigned his post with Lord Shelburne to reside in Birmingham, Wedgwood generously afforded him



WEDGWOOD BLACK BASALTES BUST OF NEWTON.

an annual allowance of 25 guineas, a sum continued after Josiah Wedgwood's death by his son until Priestley died. In addition, Wedgwood readily came forward with generous gifts of money and goods to Priestley when the rioters burnt down his laboratory and house in Birmingham. In addition to his medallions of Priestley, Wedgwood made a fine black basalt bust.

The Wedgwood medallion of Captain James Cook is a fine one, showing the courageous face of the circumnavigator. The portrait is a replica of the Cook medal by Pingo, specially struck by the Royal Society at the instigation of Sir Joseph Banks in 1779. Though Captain Cook died on his third voyage to the South Seas, he immortalized himself, and the two fellows of the Royal Society who accompanied him, Sir Joseph Banks and Dr. Solander, naming parts of the land discovered in

New South Wales after them; they also insisted on naming a river Cook's River. The name "Botany Bay" was a special tribute by Captain Cook to his scientific companions.

Naturally, Banks was lionized on his return with Cook. Wedgwood made a medallion of Banks and his wife, fine studies by Flaxman himself. It resembles the features of Banks as a young man in Reynolds' painting. There is a Wedgwood medallion of Sir Joseph Banks, as a much older man, probably based on a portrait when in his prime, as president of the Royal Society.

Banks visited the Lunar Society, while Wedgwood was a frequent caller, when in London, at 32 Soho Square, where Sir Joseph and Lady Banks kept open house for scientific inquirers. Wedgwood supplied the historic plaque, "The Offering to Flora", symbolic of his regard for Banks as a botanist and founder of the Linnean Society, for the Adam mantelpiece in its library.

Sir Joseph Banks had the services as librarian of Dr. Carl Solander, F.R.S., a pupil of Linnaeus. Solander was responsible for Banks's botanical collection, and was his boon companion on Cook's first voyage, and on Banks's voyage to Iceland. This latter trip was undertaken in 1772, when difficulties arose with the Admiralty concerning his accompanying Cook on his second voyage to the South Seas. It is interesting to note, in passing, that had Banks joined Cook on his second voyage, he would have chosen Priestley to accompany him as official astronomer. But the Board of Longitude, as the Admiralty was then called, showed no "latitude" regarding Priestley's unorthodox religious opinions.

Banks's party to Iceland visited the Western Isles of Scotland. The Isle of Staffa, with its geological interest, was discovered by Banks, and Wedgwood promptly decorated one of his famous Catherine II plates with the Isle of Staffa scene as a tribute to his friends, Banks and Solander. The latter was also engaged by the Dowager Duchesses of Portland as her librarian in charge of her rare collection of plants and rare antique vases. Among the latter was the now famous Barberini vase, which Wedgwood reproduced so perfectly in pottery.

In dismissing the many-sided connexions of Wedgwood with these three world voyages to the Antipodes, it will be interesting to study the famous Sydney Cove medallion specially executed by Wedgwood in 1789 to commemorate the founding of Sydney in 1788. It was made from clays from Sydney Cove, originally obtained through the good services of Sir Joseph Banks from Captain Phillip, first Governor of New South Wales. The subject of the medallion is "Hope addressing Peace and Plenty, Art and Labour".

The medallion inspired Dr. Erasmus Darwin to poetry in his "Botanic Garden".

Dr. Erasmus Darwin, the poetical and philosophical physician of Lichfield, was the subject of one of the finest portrait medallions in the group of Staffordshire fellows of the Royal Society. By his side is Dr. Johnson, his one-time fellow-resident of Lichfield. At one of the famous meetings of these two Staffordshire literary giants, Darwin, who stammered badly, was asked by Johnson: "Don't you find it very inconvenient stammering, Dr. Darwin?" "No, sir," replied Darwin, "because I have time to think before I speak and I don't ask impertinent questions."

Two Staffordshire peers figure among Wedgwood's portraits: Admiral Lord Anson, who circumnavigated the world in 1744, and was a neighbour of Wedgwood, as also was the Marquis of Stafford, better known as Earl Gower, and the illustrious ancestor of the present Duke of Sutherland.

Leaving these Staffordshire celebrities, we can study a few of the medical fellows of the Royal Society, who are portrayed in the medallions. Many of them were leading lights of the Royal College of Physicians. Among those of whom medallions were made by Wedgwood were John Woodward, famous as a geologist, Henry Pemberton, a physician employed by Newton to superintend the third edition of the "Principia" in 1726, and John Freind, brother of the equally famous Robert Freind, headmaster of Westminster School. The former was physician to Queen Caroline. Two other notable men were Dr. Ingenhousz and Dr. Peter Camper, both of whom were guest lecturers to the Lunar Society. Wedgwood made a fine medallion by Flaxman of Dr. John Fothergill, reputed to have had one of the finest botanical gardens in Europe. Another fine but smaller medallion is that of Richard Mead, physician to George I., Sir Isaac Newton and Sir Robert Walpole.

Two very interesting medallions depict the secretaries of the learned societies of which Wedgwood was a fellow; one is of William Stukeley, secretary of the Society of Antiquaries, the other is of Samuel Horaley, secretary of the Royal Society, who later became the Bishop of St. Asaph. It is a proof of Wedgwood's impartiality in the choice of subjects for his medallions that Horaley, who led the abusive personal attack on Sir Joseph Banks, when president of the Royal Society, is included in his collection. Not unconnected with this incident was the violent and protracted attack on another of Wedgwood's personal friends, Priestley, by the virulent pen of this politically minded prelate. He personally attacked Priestley and his views in his famous

theological work, entitled "Seventeen Letters to Dr. Priestley". In his fight with Banks, this pugnacious priest was completely routed, along with his second, Prof. Charles Hutton, who had to beat a hasty retreat in their assault on the august and dignified president of the Royal Society.

ARTISTIC AND LITERARY FELLOWS OF THE ROYAL SOCIETY

One of the foremost of these was Sir Joshua Reynolds, P.R.A., the most famous British artist of the eighteenth century, if not of all time. He was a personal friend of Banks and Wedgwood, both of whom he painted from life. The Wedgwood portrait medallion of Sir Joshua Reynolds is by Flaxman, who also modelled Reynolds' intimate friend Warren Hastings.

Another personal friend of Sir Joseph Banks was Thomas Pennant, the antiquary and naturalist, and author of the famous books "Tours in Wales" and "Tours in Scotland". He was a constant companion of Banks and Solander on their botanical excursions through Wales, a favourite haunt of Wedgwood also.

Last but not least famous in this group was Edward Gibbon, the author of "The Decline and Fall of the Roman Empire". It is from Gibbon that we have a pen picture of Sir Benjamin Thompson, later known as Count Rumford, the founder of the Royal Institution. In a letter to Lord Sheffield, dated September 17, 1783, writing before a vile crossing which he had to France from Dover, Gibbon says: "Last night the wind was so high that the vessel could not stir from the harbour. . . . What a cursed thing to live in an island! . . . The triumvirate of this memorable embarkation will consist of the Grand Gibbon, Henry Laurens . . . and *Mr. Secretary, Colonel, Admiral, Philosopher Thompson*, attended by three horses, who are not the most agreeable fellow-passengers" (*italics mine*).

I have been unable to trace any Wedgwood portrait medallion of the illustrious founder of the Royal Institution. The explanation is quite simple. Wedgwood discovered that Sir Benjamin Thompson had sat for his portrait to James Tassie, who made several paste medallion portraits of him. A magnificent Tassie medallion of Count Rumford is in the possession of the Royal Institution. Maximilian, the Elector of Bavaria, the patron of Count Rumford, is the subject of another interesting Wedgwood medallion.

My search for a medallion of Sir Humphry Davy has been a barren one. Both Count Rumford and Davy, of course, were connected with the Royal Institution long after the death of Wedgwood in 1795, although Josiah had met young

Davy in Cornwall on one of his many visits there. Through his sons Josiah and Thomas, in later years, Wedgwood had close connexion with Humphry Davy and the work of the Royal Institution.

JOSIAH WEDGWOOD PASSES THE TORCH OF SCIENCE TO HIS DESCENDANTS

Wedgwood's youngest son Tom is recognized as the father of photography. He was in his way a remarkable scientist and chemist. He had studied at the University of Edinburgh, but through chronic ill-health he had to retire from active business. After this he endeavoured to seek health and strength, through travel and association with cultured persons, among whom were counted Coleridge, Southey, Poole and Davy.

Tom Wedgwood, in an indirect way, was responsible for the training and early discovery of Humphry Davy. Count Rumford found Davy installed at the Pneumatic Institution of Dr. Beddoes at Clifton, but it was Tom Wedgwood who made a donation of £1,000 to enable Beddoes to establish his Institution and employ Davy as an assistant. When Davy was later engaged at the Royal Institution as a lecturer and professor, he became a firm friend of Tom Wedgwood. The elder Josiah Wedgwood had also contributed substantially towards the erection of the Pneumatic Institution, in which his friends Darwin, Watt and Dr. James Black had such faith, because of the enthusiasm of Beddoes. Davy recorded in the *Journal of the Royal Institution* (1, 171, 1802) some of the chemical experiments of Tom Wedgwood. The paper was entitled: "An Account of a Method of Copying Paintings upon Glass and of making Profiles by the agency of Light upon Nitrate of Silver. Invented by T. Wedgwood. With observations by H. Davy."

The female descendants of Josiah Wedgwood made their due contribution to science. Susannah ("Sukie") Wedgwood, a favourite of her father, married Robert Waring Darwin, the son of Erasmus Darwin.

The Wedgwood-Darwin pedigree shows the contribution to the realms of science made by these two illustrious families. The issue from this first Darwin-Wedgwood marriage gave to the nineteenth century no other than Charles Robert Darwin. He further embraced the Wedgwood family by marrying his cousin Emma, the daughter of the second Josiah Wedgwood. The fertile mind of Charles Darwin showed that in the nineteenth century he had inherited the remarkable scientific spirit and genius of his two grandfathers, both outstanding eighteenth century philosophers. The descendants of the Prince of Potters have preserved the remarkably fine features of their

illustrious ancestor Charles Robert Darwin in a fine plaque which now hangs in his room in Christ's College, Cambridge.

In conclusion, may I apply to the Prince of Potters who has inspired this discourse, words once spoken of Sir Humphry Davy by Samuel

Taylor Coleridge, Thomas Wedgwood's bosom friend, who said: "If Davy had not been the first Chemist, he would have been the first Poet of his Age." We can equally declare: "If Josiah Wedgwood had not been the first Potter, he would have been the first Scientist of his Age."

Obituary Notices

Prof. Victor Grégoire

THE death of Prof. Victor Grégoire on December 12 removes one who was not only a leader among the cytologists of his time but was also one who, as a botanist, was deeply concerned with problems of plant morphology and applied essentially cytological methods to their solution. Especially in the pre-War period, his influence in cytology was wide and many of his contributions were of fundamental importance. He was essentially an observer rather than a theorist, and although many of his best observations were on chromosome structure and behaviour he did not follow cytology far into its later intimate relations with genetics, although his pupil and colleague, Janssens, was the founder of the theory of chiasmata.

In more recent years, Grégoire became deeply immersed in problems of floral morphology, and an extensive memoir on the carpel (*La Cellule*, 47, part 3) which is the result of ten years of research, has recently appeared. This was intended to be the first of a series of contributions setting forth his views, based on extensive investigations of floral structures.

Grégoire was born at Anderlues, Belgium, on December 5, 1870. From 1887 until 1894 he studied philosophy and theology in Rome. The following year he returned to Belgium and studied science at Louvain for three years under Carnoy. In 1897 he became assistant in botany and in 1899, after two further years of foreign study, he was appointed extraordinary professor of botany, succeeding to the professorship of cytology and botany at the Carnoy Institute in 1903. The rest of his life was spent as a professor in the Catholic University of Louvain. He always adhered to his priestly robes, and he showed outstanding courage during the occupation of Louvain in the Great War. In 1925, the twenty-fifth anniversary of his professoriate was celebrated and two jubilee volumes of *La Cellule* (of which he became co-editor in 1928) were published. These consisted of contributions from his former students, many of whom had visited his laboratory from foreign countries in Europe and the United States.

Grégoire spoke with great clarity of diction and taught with vigour and enthusiasm. A man of very gentle disposition, he lived a very quiet life in a quaint old house of eighteenth-century Flemish style, completely absorbed in his scientific work. In some respects he might be regarded as the counterpart of Mendel in modern life; but in his view, as expressed

in 1925, he limited Mendelian behaviour to varieties and held that specific differences were non-mutational in origin and non-Mendelian in inheritance.

Nearly all the more important publications of Grégoire appeared in *La Cellule*. His first paper (1899) was an extensive memoir on the pollen meiosis in Liliaceae. He concluded that the spireme thread (peloton) divides first longitudinally into two interlaced threads and then transversely into twelve chromosomes, which are therefore constituted of two longitudinal halves. But this is not the place to enter in any detail into the intricate history of the development of ideas regarding meiosis.

In 1903, in collaboration with his pupil Wygaerts, Grégoire made a careful study of the events of telophase in root-tips as regards the history of the chromosomes and their transformation into the resting nucleus. These papers immediately gave him a deservedly high reputation as an observer. The phenomena of meiosis shortly reclaimed his attention, and a series of memoirs followed until 1916 on various aspects of mitosis and meiosis in plants and animals. Several of these were extensive critiques of the current literature. In 1905 he concluded that if there was a real reduction division of the chromosomes it must be the first division. In 1907 he introduced the term zygotene for the stage in which the threads pair longitudinally to form a thick spireme or pachytene nucleus. (Dr. C. D. Darlington's suggestion in *NATURE* of February 4, p. 206, that my first paper (1907) was responsible for the conception of the continuous spireme in pollen mother cells is therefore erroneous, because the conception was current if not universal for some years before my work was begun.) By 1910 he had clearly adopted parasynaptic pairing at the zygotene stage as characteristic of meiosis in plants and animals generally.

In the post-War period, Grégoire transferred his main interest to other fields of botany. He published several text-books dealing with general botany, anatomy and the systematics of angiosperms, only once returning to cytology, in a paper on chromocentres in plants, although many cytological papers continued to appear from his laboratory.

In recent years, the nature and origin of the carpel has been the subject of much investigation, and many diverse views and theories of its morphology have been propounded. Grégoire's extensive memoir on this subject adds a different view. Having discarded the classical theory of its leaf-like nature, he also

disagrees with all the views recently propounded. He concludes from a detailed comparison of stem-tips and floral receptacles in many plants that the vegetative cone and the floral apex are independent structures, carpels not arising from the latter in the way that leaves arise from the former. He held the view that the carpel, as a reproductive structure, was an organ *sui generis*, not to be homologized with any purely vegetative structure such as a leaf. His work will doubtless lead to further discussion of this intricate problem.

During his relatively uneventful but scientifically active life Grégoire received many honours. He was a member of the Royal Academy of Belgium, the Paris Academy of Sciences, the Pontifical Academy of Sciences and the Royal Irish Academy, and had received honorary degrees from various universities. He was elected a foreign member of the Linnean Society in 1917 and an honorary fellow of the Royal Microscopical Society in 1931.

I am indebted to Profs. Martens, Robyns and McLean Thompson for several of the facts here recorded relative to the life of Grégoire.

R. RUGGLES GATES.

Dr. C. J. Gahan

DR. C. J. GAHAN, who died on January 21, the day after attaining his seventy-seventh birthday, was for thirteen years keeper of the Department of Entomology of the British Museum (Natural History) and was in charge of the enormous collection of insects at South Kensington from 1910, when he succeeded the late Charles Owen Waterhouse as assistant-keeper in charge of that section of the Department of Zoology, until his retirement from the Museum in 1926. Increasing recognition of the importance of entomology led to the creation of a separate Department of Entomology in 1913 and Gahan was appointed its first keeper.

Charles Joseph Gahan was born at Roscrea, Tipperary, in 1862, the son of Michael Gahan, master of Erasmus Smith's School in that town. He was educated first in his father's school and afterwards at Queen's College, Galway (later of the National University of Ireland), from which he obtained the degree of M.A. and afterwards D.Sc. In 1884 he went to London and for two years studied science at the School of Mines (now the Royal College of Science), then presided over by Huxley. In 1896, he was appointed to an assistantship in the Department of Zoology of the British Museum (Natural History), which only six years previously had been removed to South Kensington. Although until that time he had made no special study of insects, his inclination having been chiefly in the direction of botany, it was the rapidly growing entomological collection, and especially the immense order of Coleoptera, to which he was to devote himself during the thirty years spent in the service of the Museum. In 1899 and 1900 he was secretary, and in 1917 and 1918 president, of the Entomological Society of London.

Of Gahan's numerous published writings most are upon the timber-destroying family of beetles, the

Cerambycidae, upon which he became the leading authority. He also devoted considerable attention to the problem of dealing with the depredations of the death-watch beetle and the closely related furniture-beetles, and was the author of a valuable booklet published by the Museum on the subject. Other subjects to which he made original contributions were mimicry in insects and the vocal and auditory organs of the Coleoptera. Although never a keen collector, he was by no means an arm-chair naturalist, but took the greatest delight in the study of living creatures. He was also an enthusiastic horticulturist and, being cut off by persistent ill-health from the means of continuing his former pursuits, he devoted much of the last twelve years of his life to the cultivation of a large garden at Aylsham, in Norfolk, where he lived from the time of his retirement. He leaves five sons and two daughters.

GILBERT J. ARROW.

Prof. M. W. Pavlova

PROF. M. W. Pavlova (Marie Pavlov), professor of palaeontology in the University of Moscow, died on December 20 at the age of eighty-four years.

A pioneer of the progressive movement among women of old Russia, she was educated abroad. She was a pupil of the French palaeontologist Albert Gaudry, and introduced the principles of his school into her native country and trained several generations of Russian palaeontologists, particularly women.

After Woldemar Kowalevsky, whose chair she held in the University of Moscow, Marie Pavlov was the founder in Russia of palaeontology as a biological science. Full of energy and activity, she frequented the museums of her country and described in her valuable monographs the collections of fossil mammals hidden in these museums. Similar fossils were studied by her abroad in various European and American museums. She was thus able to draw the generalized conclusions in her "Études sur l'histoire paléontologique des ongulés" for the various groups of ungulates, namely, horses, rhinoceroses, artiodactyles and proboscidea. Having worked a great deal in foreign museums she made friends with the foremost palaeontologists of the world. Her name was one of the best known among foreign naturalists.

Marie Pavlov considerably extended the palaeontological material left by W. Kowalevsky in the University of Moscow, and together with her husband, the late professor of geology, A. P. Pavlov, created one of the best palaeontological museums in the U.S.S.R., which now forms part of the Moscow Geological Institute.

A. BORISSIAK.

We regret to announce the following deaths:

Dr. L. H. Dudley Buxton, fellow and bursar of Exeter College and reader in physical anthropology in the University of Oxford, on March 5, aged forty-nine years.

Mr. Howard Carter, known for his work in Egyptology, especially in connexion with the tomb of Tutankhamen, on March 2, aged sixty-five years.

News and Views

Prof. E. H. Minns, F.B.A.

PROF. ELLIS HOVELL MINNS will retire shortly from the Disney professorship of archaeology in the University of Cambridge, which he has held since 1927, when he succeeded the late Sir William Ridgway. Prof. Minns has been a fellow of Pembroke College, Cambridge, of which he had been an undergraduate, since 1899, and became president in 1928. After taking his degree at Cambridge he studied Oriental languages in Paris, and spent three years in Russia, studying its languages, history, art and antiquities. On his return to Cambridge in 1901 he was appointed librarian and lecturer in Russian in his college, and in 1906 became University lecturer in palaeography. As an archaeologist he is best known for his pre-eminence as an authority on the peoples and cultures of ancient Scythia, upon which his "Scythians and Greeks", published in 1913, is of outstanding value. His services to this branch of archaeological studies was recognized by his election in 1925 as a corresponding member of the Russian Academy for the History of Material Culture. Prof. Minns is a fellow of the British Academy; and during the Great War his linguistic abilities were recognized by his appointment to the censorship of uncommon languages, which he held from 1915 until 1918.

New Autogyro for Army Service

A DEMONSTRATION of vertical take-off and landing by the new type C.40 Autogyro, referred to as the 'jumping gyro', was given recently at the Army Staff College, Camberley. Mr. Brie made several successful take-offs and landings on the Owl's cricket ground, which measures only 150 yards by 100 yards and is almost entirely surrounded by buildings and high trees. In addition to making vertical rises from the ground of 8-10 ft., the machine was put through a series of evolutions in the air illustrating its control and ease of handling in a confined space. The most outstanding of these was an entirely unintentional one at the close of the display, when the pilot, judging that he had not sufficient margin to clear some trees, throttled his engine back and put the machine down almost exactly upon the spot from which he had started. Such a manoeuvre would have been impossible with the more conventional type of aeroplane. This display, given on a bad day with intermittent rain causing inevitable air currents and eddies near the ground, is considered to be a much more searching test of the machine's controllability than was the recent test of a direct-lift helicopter made in a big hall in Berlin. Although flying in a building gave an appearance of complete control in a very confined space, actually the steady performance of the machine would be materially helped by the perfect calmness of the air indoors. It is considered that this type of machine will facilitate the work of Army communication by reason of the fact that, requiring practically

no horizontal run, it is independent of the condition of the landing surface. Not only will it not need a specially prepared aerodrome, but it should also be able to operate from land where even shelling or bombing has been experienced. It is also obviously suited to operating from the deck of a ship.

Leopold Gmelin and his "Handbuch"

To commemorate the hundred and fiftieth anniversary of the birth of Leopold Gmelin, the Deutsche chemische Gesellschaft has issued a sample booklet with lengthy extracts from the "Handbuch" and an illustrated brochure with Gmelin's portrait and historical notes on the growth of this monumental treatise. Gmelin belonged to an ancient Swabian family of apothecaries established in the seventeenth century at Tübingen, where his grandfather held the University chair of chemistry, one of the oldest in Germany. His father became professor of botany and chemistry at Göttingen, where Leopold was born on August 2, 1788. After graduating in the faculty of Medicine at Göttingen, he studied chemistry at Tübingen and in Vienna. Later he travelled in Italy, where he interested himself in the geology of the volcanic rocks, but his chief interest lay in chemistry, and he decided to complete his training in Vauquelin's laboratory in Paris and at the same time make personal contacts with Gay-Lussac, Thenard and Haüy. In 1817, he was appointed to the chair of chemistry at Heidelberg, where he began to write his treatise, the first edition appearing in three volumes in 1817. It met with immediate success, and several editions had to follow. In 1830, Berzelius praised it in glowing terms. The fourth edition was translated into English by the Cavendish Society in 1846, and included organic chemistry for the last time. Gmelin was occupied with the organic part until his death in 1853. The eighth edition, begun in 1922, is at present being compiled by no fewer than seventy experts, who expect to finish their task by 1943 and to secure a lasting future for this valuable documentation. Both the sample booklet and the brochure may be obtained free on application to the Gmelin-Redaktion, Berlin W.35, Tiergartenstrasse 10.

Ornithological Library for Australia

It has recently been announced that Mr. G. M. Mathews has presented his ornithological library to the Commonwealth of Australia, and that it will be housed in the National Library at Canberra. Mr. Mathews, who is the author of twelve large volumes on the "Birds of Australia", has been collecting books on ornithology for the last forty years, and his library consists of some four thousand works and pamphlets. Although many ornithologists may not agree with Mr. Mathews' systematic work as a whole, all will admit that he has done more than anyone to elucidate the early history of ornithology in Australia. He has

specialized in the works of early voyagers to the southern hemisphere in which there is any mention of birds, and his collection includes a copy of that very rare book published in 1701 by William de Vlaming, a "Journal of a Voyage to the Unexplored Southland . . . in 1696 and 1697". Of books on Australian birds, there is a complete set of all the editions of Lewin's "Birds of New Holland", starting with the first, published in 1808, of which there are only six known copies. Gould's great folio-work is of special interest, since it includes the two parts published before the author went to Australia and afterwards withdrawn and replaced, after his return.

SINCE Mr. Mathews takes a great interest in nomenclature, his library naturally includes many rare and little-known general works. Among these may be mentioned Vroeg's "Catalogue" (1764), and Boddaert's "Table des Planches Enluminées" (1783), the former not included in the British Museum's (Natural History) library, and the latter only represented by a photostat copy and a reprint. Other rare and interesting books include Rafinesque's works (1814-22), Berthold's edition of "Natürliche Familien des Thierreich" by Latreille (1827), and Moehring's "Avium Genera" (1752). There are complete sets of certain periodicals such as the *Isis*, and more particularly of local journals published in Australia, including the first volume of the Queensland Philosophical Society, which is said to be unique. After having completed his "Birds of Australia", Mr. Mathews brought out an additional volume of bibliography, and, with a few exceptions, all the books mentioned therein are in his possession. The acquisition of this library should now enable students in Australia to study ornithology independently of the libraries in Europe and elsewhere.

Nutritional and Allied Aspects of Milk

It has already been announced that the new Division for the Social and International Relations of Science of the British Association is arranging a meeting for the discussion of this subject to be held on March 28 at the University of Reading. Representatives of a number of interested public bodies and institutions will be present. The meeting will be divided into two sessions, lasting from 2.15 to 4.15 and from 5.15 to 7.0, with an interval for tea. At the first session the chair will be taken by Sir Richard Gregory, chairman of the Division. Dr. Harriette Chick will open the discussion, dealing with deficiencies in present-day diet, the total amount of milk needed, etc., Prof. J. O. Drummond will discuss health aspects, and Dr. A. W. Scott will speak on the implications of compulsory pasteurization. At the second session, Sir Daniel Hall will be in the chair. Mr. J. MacKintosh will discuss agricultural aspects of milk production, with special reference to increase of production, and Mr. J. Cripps will speak on the distribution, cost and the economic and social implications allied with the subject. The meeting will be preceded, in the morning, by a visit to the National Institute for Research in Dairying at Shinfield, near Reading. Arrangements will be made for

lunch, tea and dinner to be served in the University so far as accommodation permits, and accommodation for the night preceding the meeting may be arranged if a sufficient number desire it. Admission will be free, by ticket. A limited number of tickets will be obtainable from the Secretary, British Association, Burlington House, London, W.1.

The Institute of Chemistry

At the sixty-first annual general meeting of the Institute of Chemistry held on March 1, Sir Robert Pickard, the retiring president, directed attention to the fact that the membership now consists of more than 7,200 qualified chemists. The Council is endeavouring to obtain the consent of the fellows and associates to a petition for a supplemental charter embodying a scheme for the registration of those chemists whose qualifications are the same as those required for admission to the Institute, but who do not wish to become fully associated with its work. It is, in Sir Robert's view, a scheme proposed in the best interests of the Institute, of the profession as a whole, and of the State. Sir Robert referred to the possible utilization of the services of chemists in any national emergency. The position of the country, so far as the supply of chemists and the condition of the chemical industries are concerned, is very different from that of twenty-five years ago; but war usually brings unexpected demands, and chemists will be glad to know that an organized effort is being made which will direct their skill and willingness to serve the country into the most advantageous channels. The Institute is fortunate that, in times like the present, less than 1.2 per cent of its members are known to be without employment, and only a small proportion of those has been unemployed for any long period. Sir Robert directed attention to the third annual report of the Chemical Council, recently published. This body, on which the Institute is represented, has under consideration a scheme the object of which is to distribute the burden of the cost of publications of the Chemical Society and the Society of Chemical Industry more equitably over the membership of all three chartered chemical bodies. The Meldola Medal, the gift of the Society of Maccabaeans, has been awarded to Dr. William Charles Price. The following officers for 1939-40 have been elected: *President*, Mr. W. A. S. Calder; *Vice-Presidents*, Dr. H. V. A. Briscoe, Dr. F. H. Carr, Dr. T. P. Hilditch, Mr. G. Roche Lynch, Dr. C. Ainsworth Mitchell, and Sir Robert Pickard; *Hon. Treasurer*, Mr. B. F. Howard.

Society of Public Analysts and Other Analytical Chemists

At the annual general meeting of the Society of Public Analysts and Other Analytical Chemists held on March 3, the following officers were elected for the year 1939-40: *President*, Prof. W. H. Roberts; *Vice-Presidents*, E. B. Anderson, J. R. Nicholls, W. H. Simmons, T. P. Hilditch (chairman, North of England Section), T. Cockburn (chairman, Scottish Section); *Hon. Treasurer*, E. B. Hughes; *Hon. Secretary*, Lewis Eynon. Following the annual

general meeting, a lecture was delivered by Sir Henry Dale on "Biological Standardization". Sir Henry outlined the history of the establishment of standards for the biological assay of preparations of physiologically active products such as antitoxins, hormones, vitamins, etc. Attempts to set up units in terms of physiological effects under particular experimental conditions ('rat units', 'mouse units', etc.) have led to wide discrepancies and great confusion, owing largely to the difficulty of reproducing the conditions under which the proposed units were first determined. Following the pioneer work of Paul Ehrlich, the systematic establishment of international 'units of activity' based on stable standard preparations of the active substances was begun under the auspices of the Health Organisation of the League of Nations in 1921, and a number of these standards have been prepared at the State Serum Institute, Copenhagen. Standards for a still larger number of products have more recently been prepared in Great Britain at the National Institute for Medical Research, Hampstead. A general account was given on these developments and some particulars of the standard preparations now available.

A Bird-watcher's Experiences

In a lecture to the University of London Animal Welfare Society, at Bedford College on March 8, Mr. Eric Hardy, of the British Empire Naturalists' Association, spoke of his experiences as a bird-watcher in various parts of Great Britain. He mentioned how a day-by-day census and survey of the sparrow population of the Liverpool Cathedral Birds' Sanctuary, in the heart of city slums eight miles from open country, failed to prove any great migration out of the city to country harvest fields as is often supposed, although many other migrants, chiefly warblers, passing over the city, use the sanctuary as a resting-place. This famous little sanctuary is to be reconstructed and re-equipped this year by the Merseyside Branch of the British Empire Naturalists' Association, which will be its custodian in the future. Mr. Hardy gave his experiences of the increasing numbers of buzzards and ravens in Wales, how swifts and tawny owls are among the birds adapting themselves to life in growing towns, even in the industrial north. The annual May shooting of baby rooks in the nest is a cruel sport, he said, and even apart from that question, field-studies show that unless rooks are in abnormal numbers, they do more good than harm on the land. The habit of taking regular censuses of bird numbers in various areas has added considerably to our knowledge of bird movements and migrations, especially with shore birds.

Archæological Excavations in Cornwall

RELICS obtained from excavations on a Late Bronze and Iron Age site in the Great Gear Field at Carwarthen, St. Just-in-Roseland, Cornwall, are now on exhibition in the museum of the Royal Cornwall Polytechnic Society at Falmouth. These excavations have been carried out during the past year

under the direction of Mr. S. A. Opie of Redruth. The site, it would appear from an account of the excavations in the *Royal Cornwall Gazette and County News* of February 22, was occupied from 1000 B.C. onward. In the earlier phases of its occupation, it is the first to be identified in Cornwall as dating from the important Late Bronze Age period, to which belong the earliest classical references to the Western tin trade. The site is thus of unusual interest and importance; while in view of the small area as yet explored, it is the richest and most productive of the period of its later occupation as yet examined in Cornwall. A fair amount of bronze age pottery, some with cordon and finger-tip impressions, has been recovered; but as yet no traces of structural remains of the early period have been found. A small circular fortification belongs to a later occupation, being of a usual iron age type. Of this, the position of the circular ditch has been established at six points where it is from six to ten feet deep. Stone revetments of the inner face of the ditch have been found at five points. The ramparts, much damaged by ploughing, afford evidence of several periods of construction. At the best preserved section, there are three successive stone revetments, and clear evidence of an interior wall walk. The iron age pottery is mostly late, being attributed to the first century A.D. or at oldest to the first century B.C. None of the fine decorated pottery of the second century B.C., such as has been found at Glastonbury or Castle Dore, has appeared. The site was extensively occupied in Roman times down to the fourth century. Native pottery betrays Roman influence, while two pieces of Samian of the second century A.D. and two of New Forest wares of the fourth century A.D. have been unearthed. Coins, numerous fragments of iron implements, perforated slate disks and a waisted stone hammer have also been found. The excavations are to be continued.

Electric Generators at Boulder Dam

DURING 1938, *Engineering* published a series of articles dealing with the remarkable work being carried out at Boulder Dam, Arizona. This project has a three-fold purpose—flood control, storage of water for irrigation and domestic and industrial use, and the generation of electric power. There are two power-houses, the Nevada wing and the Arizona wing, and the series of articles referred to is brought to a close by a description of the electrical equipment being installed in these. The two articles on this subject are by Mr. L. N. McClellan, and were published in *Engineering* for February 10 and 24. There will ultimately be eight large units of 82,500 k.v.a. in the Nevada wing and seven similar units and two units of 40,000 k.v.a. in the Arizona wing; the hydraulic turbines driving the larger units being of 115,000 h.p. Each of the 82,500 k.v.a. generators is 40 ft. in diameter, 32 ft. in height above ground-level and weighs approximately 900 long tons. The stator frames are constructed entirely of steel plates and structural shapes electrically welded together. The rotors are 25 ft. in diameter, 8 ft. deep at the rim, and are carried in shafts 38 in. in diameter and

36 ft. long. Each weighs approximately 580 tons. One group of machines will furnish power for the pumping plants on the Colorado River, supplying the Metropolitan Water District, a second group will supply the cities of Los Angeles, Burbank, Glendale and Pasadena, a third the Southern California Edison Company, and a fourth will supply power to the States of Arizona and Nevada. With the service station generators the ultimate capacity of the plant will be 1,323,500 k.v.a.

The Indian Journal of Pharmacy

SOMEONE has proceeded apace in India, especially since the Great War, and this progress has seen marked improvement in India's scientific publications and the initiation of new journals of international importance. Now, we are pleased to welcome another addition to the list, namely, the *Indian Journal of Pharmacy*, the official publication of the United Provinces Pharmaceutical Association (1, No. 1, Jan.-March, 1939. The Secretary, U.P. Pharmaceutical Association, Department of Pharmaceutics, Benares Hindu University. Rs. 3s., India; Rs. 4s. abroad annually). The *Journal* is being edited by Prof. M. L. Schroff with the help of a strong editorial board. It has a format similar to that of most other Indian scientific periodicals, and this number contains fifty pages. It opens with an editorial explaining the aims of the U.P. Pharmaceutical Association and its *Journal*, which leads on to a review of pharmacy in other countries. Then follows an article on "Diet in Relation to Copper for Infants" by Dr. U. P. Basu; another specialized article, by Prof. M. L. Schroff and M. Lal Dhir, deals with the "Assay of Kurchi and Kurchi-Bismuth-Iodide". More general articles deal with the medicinal, aromatic and allied plants of Egypt, the medicinal plants of Kashmir and the treatment of burns. Notes and news, abstracts, reviews and proceedings of the Association complete the number. It would be ungracious to point out ordinary slips in the printing of the *Journal*, but the typography might well be improved. We sympathize with the *Journal's* plea for the establishment of an Indian Pharmacopoeia.

An Educational Co-operative Colony

ON the initiative of Sir Akbar Hydari, the Chancellor of the Osmania University and President of the State Council, Hyderabad (Deccan), an attempt is being made to demonstrate the suitability for adoption on a large scale of a plan for part-time education in association with co-operative production for use. This enterprise is being conducted under the auspices of the Hyderabad State Co-operative Department and is under the management of Captain J. W. Petavel, who has for many years devoted his energies to the advocacy of similar schemes in connexion with the University of Calcutta, propaganda inaugurated by the late Sir Asutosh Mookerjee for educational colonies. For the new scheme, buildings and twelve acres of land belonging to the Osmania University have been made available, and it is hoped that undergraduates will take advantage of

the opportunity to train for educational colonies work. It is intended to establish another and much larger colony in an irrigated tract. The general idea of the educational colony is to form the children and adolescents for educative employment in colonies organized for co-ordinated production of food and other necessities of life. The child's day would be divided between "really good production work, good games and class work" in approximately equal shares. Special features of the new scheme are to be: employment of well-trained adolescents under the guidance of a few adults to supervise the children, co-operation between capitalists and workers for production for use, and an extensive use of labour-saving methods.

Earthquake in the Solomon Islands

AN earthquake of sufficient intensity to affect seismographs in all parts of the world occurred on January 30 at 2h. 18m. 31s. G.C.T. No news of any earthquake damage was reported from any place at this time, and by instrumental records from thirty-two stations alone E. Peterschmitt, at Strasbourg, has determined a provisional epicentre at latitude 6° S., longitude 156° E. This is near the Solomon Islands, a well-known seismic centre. It was from an epicentre to the south-east of this, namely, 9° S., 159.5° E., that a very severe earthquake occurred on January 25, 1926, ruining the catholic church at Visale, doing very severe damage to property and causing severe casualties. In October 1931, again, earthquakes with epicentres 14° S., 160° E., and 8° S., 160° E., did severe damage on several islands. At San Cristoval two villages were razed by the first earthquake and eighteen villages on the southern coast were afterwards swept away by a sea wave 30-40 ft. high. For the 1939 shock the seismogram at Stuttgart included e_2P , 2h. 34m. 24s., i_2P' , 2h. 37m. 39s., (dilatation), $iPKS$, 2h. 41m. 2s.; eL , 3h. 16m. ($T = 50s.$); MQ , 3h. 26.5m. ($T = 22s.$) and MR , 3h. 38.5m. ($T = 20s.$) all in G.C.T.

Central and South American Earthquakes

ON the basis of reports from the seismographic stations at Georgetown, Fordham, Huanacayo and San Juan, the U.S. Coast and Geodetic Survey in co-operation with Science Service and the Jesuit Seismological Association has determined the epicentre of the earthquake of February 9, 1939, at 15h. 30.5m. G.C.T. to be provisionally latitude 11.5° N., longitude 88° W. This epicentre is in the Pacific Ocean to the west-south-west of Managua, the capital of Nicaragua, which was almost completely destroyed in the earthquake of March 31, 1931. The epicentre nearest to the present one in recent years was on February 15, 1926, when the epicentre was 11.7° N., 89.8° W. No damage has been reported in the present instance. Following recent shocks, the town of Cumbaya, near Quito, was strongly shaken during the night of March 2, by an earthquake which cracked many buildings, and caused apprehension amongst the inhabitants. No casualties are reported. It was on February 7, 1797, that Quito was destroyed by earthquake with the loss of 40,000 lives. On

October 2, 1938, another part of Ecuador, namely, the Santa Elena Peninsula, was strongly shaken by an earthquake. Weak local shocks often occur in the area.

Michael Scot: Pioneer of Science

PROF. J. READ has contributed an interesting study of "Michael Scot: a Scottish Pioneer of Science" to *Scientia* (Oct.-Nov. 1938). Michael Scot lived in the early part of the thirteenth century and worked as a translator of Arabic writings in Spain and Sicily, where he was court astrologer and philosopher to the Emperor Frederick II. In later times he acquired the reputation of a magician and necromancer, and many legends have gathered around his name. Although our knowledge of him is fragmentary, Prof. Read shows that Michael Scot was a man of genuine scientific interests. His views on alchemy are interesting, since it is significant that he mentions neither transmutation nor the philosopher's stone, so that he followed the Greek-Egyptian sources rather than the later authors of western Europe. Of his other works, Scot's "Physionomia" had an extensive circulation in manuscript for 250 years and afterwards in several printed editions. He also wrote on astronomy, astrology and the art of prediction, and stands out as the most eminent Briton to secure a place in the history of medieval Italy.

The Imperial Institute

THE annual report of the Imperial Institute (South Kensington, London, S.W.7) for 1938 shows that an important side of the work of the Institute lies in the research departments which answer an increasing number of inquiries from all parts of the Empire. Queries concern both seeds and roots of economic value and various mineral samples. The Mineral Resources Department was particularly active and reported on samples from various colonies. Special interest attaches to the demand for high grade quartz crystals for both piezo-electric and optical purposes, but so far the search for new sources of this material has had little success. The oxide of titanium known as rutile which is used in the coating of electric welding rods has been found in various parts of the Empire. Many other examples of the usefulness of the Institute are recorded in this report.

A Virus Disease of the Elm

AMERICAN elm trees in the Ohio valley are subject to a new and deadly virus disease which is briefly described in a mail report from Science Service, Washington (Feb. 4, 1939). Leaves upon infected trees first shrivel and become brittle, then the roots and inner bark of the trunk rot away, and the tree dies within a few months. This is the first known instance where a virus disease has caused a fatal epidemic among trees. The outbreak appears to be even more serious than that of the so-called Dutch elm disease which has decimated elm trees in the neighbourhood of New York. It is reported that more than 1,000 out of about 1,800 elms in one particular locality have been killed by the virus

during three years. Means of dissemination of the pathogen have not yet been found, but the United States Division of Forest Pathology is taking energetic measures to trace the extent of the infection, and to limit it to one district, if possible.

Use of Electricity in Coal Mines

ON the recommendation of the Royal Commission on Safety in Coal Mines, the Secretary for Mines has appointed a Committee with the following terms of reference: "To be a committee to consider, in the light of experience and modern practice, what amendments are required in the General Regulations governing the use of electricity below ground and above ground at mines under the Coal Mines Act, 1911, taking into consideration the report of the Royal Commission on Safety in Coal Mines and the evidence on the subject submitted to that Commission". The following are members of the Committee: Prof. W. Cramp, Department of Electrical Engineering, University of Birmingham (chairman); Mr. J. A. B. Horsley, H.M. Electrical Inspector of Mines; Mr. A. M. Bell and Mr. A. B. Connell. The secretary to the Committee is Mr. R. Crawford, Mines Department, Mill House, 87-89 Shaftesbury Avenue, London, W.1.

Chemical Society Anniversary Meetings

THE anniversary meetings of the Chemical Society this year are to take place in London on March 29-31. On March 29 the Rutherford Memorial Lecture will be delivered by Sir Henry T. Tizard at the Royal Institution at 5 p.m., and fellows and guests will be entertained at a reception and dance at Imperial Chemical House from 8.45 until midnight. On Thursday, March 30, visits have been arranged in the morning to Bedford College for Women and to the Wellcome Research Institution, to view the laboratories and museums. The annual general meeting will be held at Burlington House at 2.30 p.m., and at 4 p.m. the presentation of the Longstaff Medal and of the Harrison Memorial Prize will be made and Prof. F. G. Donnan will give his presidential address. The anniversary dinner of the Society will be held at Grosvenor House the same evening at 7 for 7.30 p.m. On Friday, March 31, visits have been arranged in the morning to The British Drug Houses, Ltd., and to the Central Laboratories of the Shell Marketing Co., Ltd., and in the afternoon to the Research and Development Department of the Distillers' Company, Ltd. at Epsom, and to the laboratories of the Research Association of British Paint, Colour, and Varnish Manufacturers.

Royal Society of Edinburgh: Elections

AT the ordinary meeting of the Royal Society of Edinburgh, held on March 6, the following ordinary fellows were elected: Prof. Arthur B. P. Amies, Australian College of Dentistry, Melbourne; Dr. William G. Annan, Clinical Medical Officer, Durham County Council, Darlington; Prof. J. H. Baxter, Department of Ecclesiastical History, University of

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SUPPLEMENT

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No. 3619

REVIEWS

Arthur Young, F.R.S. : Farmer

Sheep and Turnips

Being the Life and Times of Arthur Young, F.R.S., First Secretary to the Board of Agriculture. By Amelia Defries. Pp. xviii+235. (London: Methuen and Co., Ltd., 1938.) 7s. 6d. net.

ANALOGIES between the agricultural conditions in the later years of the eighteenth century and those of to-day render opportune the publication of this study of Arthur Young. Agriculture at both periods was depressed. Countrymen were flocking to the towns, and the land was being neglected and allowed to become derelict. A revolution in farming practice, coupled with the introduction of new crops, is to be contrasted with possible methods to-day, very different in that no new bulk-feed or other crops are being advocated. There was a fight to combat the food-shortage and high taxes of the Napoleonic period, as there was in the Great War—and must be in all future wars. The enclosure of lands—twenty-two million acres during Young's period—allowed the development of arable farming for corn, while the growth of winter feed, especially turnips, encouraged the carrying over of stock from year to year and eliminated salt meat from our dietary. The introduction of cabbage, the popularization of potatoes and the regular use of clover assisted in producing an alternation of crops and were thus of importance. To-day, in contrast, we have a huge manufacturing population to be fed, while much land has gone out of cultivation, and many farms show increasingly depleted and weedy soils which only an evolution in scientific practice or a revolution in the attitude of the State can rectify.

The change-over of the eighteenth century was mainly due to three men, Coke, Sinclair and Young, aided by the interest of King (Farmer) George. Coke carried out vast enterprises in Norfolk with

financial success; coupled with these was a great improvement in the social life of his region, enclosure and high farming increasing its population threefold. Sinclair opened up his large estate in Scotland by roads, enclosing where he could—and statistically examined his country's agriculture in respect to population.

Young, born in 1741, son of a Suffolk vicar, who was also a fashionable clergyman in London, being chaplain to the Speaker, was the dominant influence. His mother was a Jewess. His 'polite' education was scanty, the extravagance of his father temporarily reducing him to the lower social grade of a farmer. By his pamphlets, often political, he procured money to buy books and soon took charge of one of his mother's farms in Suffolk. After four years, he recounted his experiences in a series of 'Farmer's Letters to the People of England', also meditating on the ways to harmonize agriculture and manufacture. "What vast employment the Enclosing gives . . . constantly keeping fences, ditches, gates, styles, bridges, in order, and . . . converting the wastes into arable farms . . . the numbers requisite for tillage . . . the numbers of manufactures . . . hides increasing amazingly . . . causing cheapness of bread".

In the next five years, Young published 'Farmer's Tours through the South, North and East of England', meantime cultivating a new farm which showed little profit as it was used for thousands of experiments. He was ever in want of money, though at times his writing, at ten shillings a page, was considerable—later as farmer-journalist to the *Morning Post* at five guineas a week. His fame was growing, and in 1774 he was elected to the Royal Society. As a diversion, he made a highly successful Irish tour. A legacy relieved him, and he commenced his great undertaking, 'The Annals of Agriculture', to which that

great "Briton"—he coined the word—Ralph Robinson (Geo. III) contributed, advocating clover, turnips and rye as fallow crops, more than paid for by the dung of the cattle which fed on them. Then in 1787–89 succeeded a series of French tours in two volumes, which with all his works was published by the Directory in twenty volumes, these forming the basis for all subsequent agriculture in France. Young was now famous, the revolutionist-reviver of land prosperity, and his methods were being universally studied. George Washington was his regular correspondent, and the Empress Catharine sought his advice. In 1793, Pitt created the Board of Agriculture of which Young became secretary, thereafter to be concerned mainly with the provision of food in times of war. He died in 1820, this father of modern agriculture, still a poor man, blind but happy in the revival that farming was showing after twenty terrible years.

Historians (Trevelyan, Green and Rose) pay high tribute to this great Englishman—he was

also the founder of the Yeomanry—but we are rather concerned with his methods. That Humphry Davy was appointed by him to lecture on "The Connection of Chemistry with Vegetable Physiology", the following year becoming professor of chemistry to the Board, is indicative of his views. His experiments on the use of turnips, potatoes, carrots, onions, etc., were numerous, and he introduced chicory and "nursed" the cabbage. He was all this time trying out rotations of crops in relation to soils, also the production of manuring by natural methods *per head of stock*. There are studies on soils, the absorbing properties of earths and the considerations of air in the soil. All experimentation, even if of no immediate practical value, is "necessarily useful . . . a spur that instigates abler heads. . . ." Enough of this charming personage, a great writer and thinker, student of the world, its society, its politics, its pleasures and its pains. A story to be recommended for our shelves.

J. S. GARDINER.

Air Raid Precautions

(1) A.R.P.

By J. B. S. Haldane. Pp. 296. (London: Victor Gollancz, Ltd., 1938.) 7s. 6d. net.

(2) Air Raid

The Technique of Silent Approach; High Explosive; Panic. By John Langdon-Davies. Pp. 142 + 32 plates. (London: George Routledge and Sons, Ltd., 1938.) 2s. 6d. net.

(3) Report of the Committee of the Institution of Structural Engineers on Air Raid Precautions

Pp. 48. (I.S.E., 1938.) 1s.

(4) A.R.P.

A Report on the Design, Equipment and Cost of Air-Raid Shelters. (Reprinted from *The Architects' Journal* for July 7, 1938.) Second edition. Pp. 15–48. (London: Association of Architects, Surveyors and Technical Assistants, 1938.) 1s.

THE disastrous effect of the gas attacks by Italian aircraft on the defenceless Abyssinians made such a profound impression on the equally unprepared people of Britain that the first air raid precautions in this country were heavily biased towards anti-gas measures. Then Japanese incendiary bombs on the inflammable areas of Chinese cities emphasized the importance of the fire-fighting services. But it is only recently that the deadliness of high explosive, as exemplified

in Spain, is being given its due weight. That this should be so seems strange, as there are still many men in England who have had first-hand knowledge of high explosive shells. A bomb only differs from a shell in that, weight for weight, it contains a greater percentage of explosive, and a heavy howitzer shell comes down from a height equal to that of Mount Everest. Given gas masks, the men who have faced it would infinitely prefer an attack by gas to one of equivalent weight of high explosive. For this reason, these two books, which deal with the general question of A.R.P. and the effect of high explosives in Spain, and the two professional reports on practical measures of protection, come as a useful corrective to our first obsessions.

(1) As might be expected from a man of his eminence, Prof. J. B. S. Haldane's is a masterly book, marred perhaps for some people by the political ingredient mixed with the main theme; and at times unworthy of his high level, as when jeers are made at the Home Office for its alleged solicitude for the pekes of Berkeley Square because in the "Householders' Handbook" people were advised to remove their pets. But whatever political opinions we hold, it is a book well worth reading. Clear, intensely interesting and with much of practical value.

On the subject of gas and bacteria, Prof. Haldane is reassuring. Most of the possible types of organic

compounds with small molecules have already been made. Mustard gas was discovered in 1886 and nothing worse had been produced by 1918. Since a poison gas must have small molecules, it is unlikely that more effective poison gases will be found. In theory, microbes might be used, but their general application is well-nigh impracticable and their use would probably be limited to producing panic fostered by rumour. With regard to the effect of gas, the casualties in the Hamburg disaster of 1928 are illuminating. A tank containing eleven tons of phosgene, one of the most deadly of war gases, burst without warning on a totally unprepared and unprotected population. Ten people were killed and about fifty made seriously ill. Prof. Haldane calculates that high explosives would be perhaps fifty times more deadly than gas. He therefore strongly advocates deep tunnels and shelters for the whole population of the target cities, at the huge cost of £400,000,000, and bases the need on the experiences of Barcelona.

It is difficult to arrive at the number of people in Barcelona for whom deep bomb-proof shelters have been provided. But on p. 40 Prof. Haldane mentions one-sixth of the population, and on p. 164 quotes Mr. Skinner that in May "there was shelter for about 240,000 people in brick-lined tunnels"; Prof. Haldane goes on to say, "I do not of course include trenches, cellars, underground railways or any of the types of shelters which are considered good enough for Londoners by our government". On the other hand, Mr. Langdon-Davies, writing in *The Times* in January 1939, states that Señor For, who was responsible for the A.R.P. in Barcelona, gave 30,000 as the maximum number of people who had protection against any type of existing bomb.

Complete protection, not only for people, but also for all vital plant, against bombs may be the ideal solution, but the money and time required are prohibitive. Splinter-proof protection gives a very large measure of security, and deep tunnels and concrete bomb-proof shelters are probably only practicable for certain essential-workers and vital plant.

(2) Mr. Langdon-Davies in his book "Air Raid" gives a very vivid picture with excellent photographs of the damage that has been done by high explosive bombs in Barcelona, and emphasizes the moral effect of terror and the material effect of blast. The terror was largely produced by the lack of warning and the terrific noise of the explosions. By applying the "Technique of Silent Approach", that is, the shallow dive from a great height with engines off, bombs were dropped on the city before the aircraft were detected and warning given. From this he deduces that similar attacks could be made on London.

It all sounds very creepy. The stealthy silent approach. The blow before you are aware of it. The gliding away in the darkness. But the shallow dive is a well-known method of attack. For places on or near the coast, like Barcelona or Hull, in the face of purely aural detection and in the absence of alert fighting aircraft, the manoeuvre is a definite menace. But there are three factors which must be taken into consideration when assessing its danger. The comparatively steep gliding angle of modern fast bombers with their small wing surface necessitates great initial height. To attain this, bombs or fuel must be sacrificed. Bombers must forgo their fighter escorts, and with their engines shut off they are easy prey for the defending fighters. London, with a balloon barrage to keep hostile aircraft up, is more likely to be troubled by an excess of warnings than by a lack of them. The 'silent approach' attacks on Barcelona soon ceased, and it is difficult to believe that the Nationalists would have given up this method if it was so successful, merely because the German and Italian airmen wanted to keep the manoeuvre secret for future and more important objectives.

On the effect of blast, Mr. Langdon-Davies is most interesting. Both the pressure and the suction waves caused great damage to windows, doors and the less substantial walls at a considerable distance. Historic monuments were being cased in outer walls which will not only protect them from splinters, but also in the event of a bomb falling nearby, the force of suction will be expended on the protecting wall.

(3 and 4) For detailed advice and practical measures of protection the two professional reports are very valuable. The Institution of Structural Engineers has published the first two parts of its A.R.P. Committee's report. These deal with the published information and the Committee's recommendations for protecting existing buildings. The remaining two parts, on air raid shelters and new buildings, are to follow. The A.A.S. and T.A. report gives diagrams, tables of resistance and cost of both splinter and bomb-proof shelters. In suitable soil, tunnels appear to be the cheapest form that is bomb-proof. The need for accessibility is, however, stressed, and where this is essential, as in a factory of national importance, or where the cost is prohibitive, splinter-proof shelters give a very large measure of protection. With regard to basements, both reports tend to favour the Swiss standard for strengthening the floor directly above the basement against the collapse of the building. This is more than double the strength suggested in the British and German regulations, but no detailed calculations are given.

E. H. K.

Standardization of Colours

Horticultural Colour Chart

Issued by the British Colour Council in collaboration with the Royal Horticultural Society. Pp. vii + 100 plates. (London: Royal Horticultural Society, 1938.) 10s. to Fellows, 21s. to non-Fellows.

COLOUR perception plays a very large part in everyday human experience. Yet most of us are singularly unable to describe colours with exactness, or order them systematically. We find ourselves lacking a yardstick and an exact terminology.

It is possible to analyse and define quite accurately the colour of any object under a given illumination, in terms of relative intensities and wave-lengths of light. But this is a cumbersome business, requiring special apparatus and technical skill. For ordinary purposes, it is easier to fall back on the method of comparison, and a number of attempts to provide an orderly basis for colour comparisons have from time to time been made, by printing standard colour charts. The most notable and widely used of these have been the "Colour Standards" of Ridgeway and of Ostwald, the "Répertoire de Couleurs" of Dauthenay and collaborators, and the later "Dictionary of Colour Standards" of the British Colour Council.

Recently another colour chart, prepared under the general direction of the art director of the Colour Council, Mr. Robert F. Wilson, has been published. The new work is in general layout very similar to the "Répertoire de Couleurs", consisting of loose sheets of handy size ($9\frac{1}{4}$ in. $\times$ $6\frac{1}{4}$ in.), in a stiff case. Each sheet, of smooth and white-surfaced paper, gives the name of a colour in English, and its synonyms in Dutch, French, German, Italian, Latin, and Spanish; references to any equivalents in the four older standard charts mentioned above, and a short historical note on the colour or its name; and the colour itself, in four rectangular blocks of increasing depth of tone, down the right-hand side of the sheet, in some instances accompanied by the names of one or more flowers of corresponding colour.

The volume now under notice—a second is projected—deals only with spectrum colours, and omits all the hues, such as browns and greys, which the artist would recognize as admixtures of all three primary pigments. The first sixty-four sheets range in sequence from yellows through oranges and reds to purples, and on through blues and greens back to yellow again. These are very well done, and justify the claim that recent advances in the art of colour printing have permitted

increased accuracy of reproduction. To most eye sheets 15 and 16, Fire Red and Poppy Red, and perhaps also 47 and 48, Oriental and Enamel Blues show colours approaching one another almost to redundancy. The gardener will note that few examples of flowers in the pure blues can be given.

The remaining thirty-six sheets in the volume are related to certain of the first sixty-four, being either lighter or darker tones of selected hues, and they are numbered in a manner which expresses this relationship. These supplementary sheets are less happily inspired. The user will resent the imposition of fresh names for different depths or 'tones' of the same colour, for example, Cairo Red for paler Orange. This is in direct contradiction of the premise in the introductory notes to the chart, that "There will thus be but one colour name recognised for each hue". The extra name is the more unfortunate because there is actually a very considerable overlap of the colours on the two sheets, so that a given colour may be equally well matched, as, say, Orange, intermediate between the blocks 12/3 and 12/2 in tone, or Carrot Red, intermediate between 612/2 and 612/1 in tone. All the supplementary sheets show this unnecessary duplication of tones on the parent sheet, often only the first or last block extending beyond the range already shown. The amount of overlap is not even constant, being less, for example, between sheets 14 and 614, Nasturtium Red and Chinese Coral, than between sheets 609 and 609, Tangerine Orange and Apricot. In fact these supplementary sheets might very well have been omitted. The chart would certainly have been simpler and more convenient in use if the increased range of tone had been obtained by adding a fifth block of colour to the sixty-four primary sheets.

Trying out the chart leads to some interesting discoveries. It is perhaps not very surprising that a certain amount of colour-blindness should occur amongst one's friends, hitherto unsuspected by the afflicted themselves; or that there should be great variation in an individual's capacities for memorizing colour. But few people will believe that lemon yellow is a deeper tone of straw yellow and at first sight the heading "Lemon Yellow" on sheet 4 appears a misnomer. Actually the sheet will be found to include an excellent match for lemon rind; the slightly greenish yellow hue which the name conjures up for most of us is a reflection of the unripe condition in which we get so much of our fruit.

There are few flowers in bloom and most of those given on the sheets as "horticultural examples" are at the time of writing unobtainable. Where it has been possible to check the colours of the flowers quoted, using the methods and precautions suggested in the notes supplied with the chart, confirmation of the careful work of the compilers has been obtained. The common Yellow Jasmine (or at any rate the particular plants at hand) provides the exception, for its corollas certainly match Canary Yellow, 2/1, excellently, and Aureolin, 3/1, where *Jasminum nudiflorum* is given, less well.

The sponsors naturally intend this publication to be primarily a stimulus to the more exact description and recording of flower colours. It is too early to estimate how far this aim will be realized. The price of ten shillings is not prohibitive of fairly extensive use, which is as well, for it is plainly unreasonable to expect nurserymen to spend a good deal of time and trouble matching their wares to the chart, and describing them by

reference to it, unless a large proportion of their customers can be expected to possess it. (Some years ago a Continental house actually issued its own chart with its catalogue.) Only the cynical are likely to repine if, before this further onslaught of standardization, romantic fancy is driven from its stronghold in the seed, bulb, and plant catalogues. Where the columns of the gardening press are concerned, the matter is more debatable, for the precise quotation of "Saturn Red (H.C.C. 13/1)" instead of "resplendent flaming orange" would inevitably mean a sacrifice of readability.

The chart will, however, be of utility in a much wider field than horticulture. Many chemists and biologists, especially ecologists, will find it of great value. To the dye, paint, and pigment trades and the textile industries it should be very welcome, although the latter, in particular, will still find the varying texture of surfaces a considerable handicap when colours are being matched.

SAMPSON CLAY.

Debatable Points of Animal Ecology

Problems of Animal Ecology

By Prof. F. S. Bodenheimer. Pp. vii+184. (London: Oxford University Press, 1938). 12s. 6d. net.

THE science of animal ecology is young, but is rapidly developing, and it is not surprising that its high rate of growth often leads to the formulation of theories, which, on mature consideration, appear to have their foundation not so much on facts, as in the wish to discover harmony and logic in all phenomena of life. It is refreshing, therefore, to see a book such as the present collection of six essays by Prof. Bodenheimer, who sets out to discuss without prejudice several of the outstanding problems of animal ecology.

The first two essays deal with the physiological (or theoretical) longevity and life-history, as compared with the ecological (or actual) processes of life in Nature. Important and new suggestions are made with regard to the methods of studying life-histories against climatic background, but apart from that these two chapters contain little that is of wide general interest.

The third essay, entitled "What really occurs in the *Drosophila* bottle?" deals with modern population studies based on breeding *Drosophila* in a limited space. A long series of original experiments is described, in which the population

counts were based on the numbers of eggs, larvae, pupae and adults. The results show most convincingly that previous conclusions as to the critical density of populations were at least partly fallacious because they were based on counts of adults alone, and that the final contraction of a population which has been ascribed to "self-regulation", is actually due to intoxication of younger stages in the breeding medium. This is a striking example of a very attractive theory destroyed by mere facts.

The chapter on biological equilibrium in Nature presents a well-balanced estimation of the relative value of climatic and biotic factors in the control of animal populations in Nature. The author (who used to be an enthusiastic adherent of the climatic school) is coming to the conclusion that both the climatic and the biological school are right to some extent and in some cases, and that the truth can be reached only by their combined efforts. He has some good words to say for the mathematical method as applied to these studies, but stresses the fact that most of the conclusions reached by it are based on extremely simplified assumptions and cannot be as yet applied to natural phenomena.

The fifth essay deals with the problem of animal community, the very name of which presupposes some definite organization. The author marshals some good evidence to show that there is no

justification for approaching the study of animal communities in the same way in which plant communities are studied. He defines an animal community as only "a combination of (plants and) animals, recurring in an approximately similar composition . . . wherever similar ecological conditions exist within the same zoogeographical territory". Each species "exists within the community on its own right", and animal community is only "a useful empirical and statistical conception". These conclusions are bound to call forth severe criticisms and stormy controversy, since community studies have lately become very popular and have led to an extraordinary multiplication of terms and conceptions which tend to present animal community as an organized unit, even as a super-organism. In this chapter the author incidentally comes into conflict with himself, since in discussing the factors regulating the distribution of a species he stresses the fact that the physiological characteristics of a species are not constant and may vary both in time and in space. In the light of this undoubtedly true statement, his own method of constructing life-cycle tables for any climate on the basis of a few observations (on temperature alone) in a single climate, as presented in the second chapter, appears to be an unjustifiable procedure.

The last essay is a bold attempt to face and to bridge the gap between the genetical and the ecological approach to the problems of adaptation and evolution. The author points out that ecology is a much younger science than genetics,

and its field of action is immensely wide and more varied, so that exact experimentation is practically impossible. "Who will reproach the geneticist for preferring his pure, clear-cut kind of thinking to this chaotic state", says the author, who, however, adds that the superior attitude of the geneticist towards ecology may also be partly ascribed to fear that sooner or later the ecological point of view will have to be admitted into his own field. "When this invasion becomes more and more urgent, he knows that the period of the Olympian mind is over and fears that the consequent revolution of genetics will rob him of the certainty of conceptions and results which are so satisfactory to him to-day." Since "the undisturbed peace of mind of the geneticist is not a final aim of biological research", the author urges geneticists to reconsider their outlook and methods in the light of modern ecological research, which, in its turn, cannot develop successfully without the co-operation of geneticists. This plea for co-operation is long overdue, and one hopes that it will, at least, lead to a discussion which is needed to clear the air.

Taken as a whole, the book deserves to be read by every biologist, and it is regrettable that its style is anything but an easy one, while the editors should have been much more drastic in the matter of the English, which is generally very peculiar and at times difficult to comprehend. The system of numbering separately the references to each chapter makes their use very inconvenient.

B. P. UVABOV.

The Flora of South Africa

The Vegetation of South Africa

By Prof. R. S. Adamson. (Monographs of British Empire Vegetation.) Pp. xvi + 235 + 9 plates. (London: British Empire Vegetation Committee, 1938.) 10s.

IN compiling this account of the vegetation of South Africa, Prof. Adamson has had the advantage of a very considerable amount of pioneer work, beginning with the celebrated account by Drège ("Zwei pflanzen geographische Documente": 1843), by Bolus ("Sketch of the Floral Regions of South Africa": 1905), and more recently several papers by Pole-Evans and others.

Three chapters are taken up with accounts of physiography, climate and weather, and geology and soils, and the actual account of the vegetation does not therefore begin until p. 86.

For the well-known 'Cape bush', 'fynbos',

'south-western vegetation' (Bolus) or 'macchia,' the term 'sclerophyll' is used. It is composed of shrubs with evergreen leaves of small size and hard in texture, which enjoy a winter rainfall of not less than 12 inches. This vegetation, among which the families Proteaceae, Bruniaceae, Restionaceae, and others peculiar to South Africa are very conspicuous, is further subdivided into five parts, and it contains very few plants of use to man. In the drier eastern portions of the area, *Aloe ferox* is very abundant, and the 'renosterbush', *Elytropappus rhinocerotis* Less., represents the most arid kind of sclerophyll.

The forest vegetation, which occupies only 0.3 per cent of the area of the Union, is subdivided into four: (1) temperate forest; (2) warm temperate forest; (3) subtropical forest; and (4) montane forest. Only two of these are of much economic importance. The highest trees of the

temperate forest are *Podocarpus* (up to 150 ft.), whilst another well-known tree of economic value is the 'stinkwood', *Ocotea bullata* (Lauraceae). Cleared forest land in this area is used for plantations of exotic pines, gums, and other trees, and some of these grow so rapidly that their timber is of poor quality.

The subtropical forest is, perhaps, the most picturesque. In this there are palms, *Phoenix reclinata* and *Hyphaene crinita*, besides the striking *Strelitzia augusta*, whilst the trees are festooned by lianes and a few epiphytes. Mangroves occur in the estuaries and lagoons of Natal, but they are not extensive. The soils of this forest are deep and very fertile, and the crops grown are maize, Kaffir corn, sugar, tea and cotton, whilst bananas, pawpaws, mangoes, pineapples and avocado pears are much in evidence.

Certain floral regions of other authors are classed together under the heading 'savanna

vegetation'. This includes temperate savanna, embracing the 'acacia grassland' of Natal, the 'bush veld' which occurs in the northern half of the Transvaal, and the 'low veld' of the north-eastern Transvaal.

Chapters devoted to 'grassland' (high veld) and semi-desert (karoo) follow, and the book ends with a short account of land utilization and natural products, and a most interesting chapter entitled "General Conclusions and Prospects".

Having travelled through all these South African regions, the reviewer desires to offer no criticism of this well-written book other than that the first three chapters might have been much condensed, with fewer meteorological details. The space gained could then have been used for more photographs, of which there are only seventeen, and more detailed descriptions of the regions and the numerous interesting plants inhabiting them, few of which are mentioned. J. H.

Diseases of Trees and Decay of Timber

Forest Pathology

By Prof. John Shaw Boyce. (American Forestry Series.) Pp. x+600. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 30s.

PROF. Boyce's work is a welcome addition to the scanty collection of text-books in English dealing with forest pathology. It is mainly concerned to give an account of the diseases of forest trees in North America which are due to plant parasites, and of the fungi which cause decay and stain of timber. Non-infectious diseases are dealt with in a short and summary manner. The book is written to serve a dual purpose. First, it is designed as a text-book and work of reference for foresters in North America, and secondly as a reference book for specialists. The first is, doubtless, its main purpose. This is reflected in the arrangement of diseases according to the organ of the host affected, instead of according to the classification of the parasites concerned, and in the suppression, so far as possible, of technical, mycological and especially taxonomic descriptions. The second purpose is reflected in the carefully selected lists of literature references appended to each chapter.

The quality of the book is seen in the well-informed and carefully balanced discussions, in the well-produced and adequate illustrations, and in the carefully related references to literature. The discussions always seem sufficient to the importance of the subject, especially when one allows for the limitations imposed by the work

being confined to a single volume of convenient size, and for the fact that they are written for a North American public. The European reader will find that many pathogens occur which are unknown in Europe, that diseases which are of considerable importance to him are but shortly mentioned, and that no mention is made of many purely European parasites. In spite of this, the book is of considerable value to British foresters; indeed, there is no other written in English which, for them, so adequately deals with forest pathology.

Any weakness in this work, as a text-book, is involved in its limited objective, which is mainly to give an account of the development and means of control of individual diseases, decays, and stains, in relation to the organisms which cause them. Such a treatment is most successful in dealing with phenomena in which these organisms are all-important, such as the decay of converted timber, or the diseases which arise owing to obligate parasites, such as the rusts. It is very much less satisfactory in dealing with diseases which begin their development owing to the action of some non-infectious factor. Such factors receive very much less attention than they deserve, for to the practising forester they are often of great importance. The failure to deal adequately with non-infectious factors has also resulted in there being no sufficient discussion of the etiology of disease within the forest community in general. The discussion on the deterioration of forest products, because of its almost purely biotic

origin and relatively simple etiology, is not affected by the method of treatment.

There is every evidence in this book of great care in preparation. This is seen in the accurate use of terms, in the clear and simple style of writing, and in the freedom from mistakes. The matter is presented in a manner relevant to the needs of foresters, who as a rule are laymen in pathology. If this not infrequently results in a collection of interesting information about a fungus which it

would be difficult to identify from the text, recourse can always be had to papers cited. In this way is solved the difficulty of catering both for the forestry student, who must needs learn some pathology for his examination, and for the serious student of the subject, who requires more detailed information. Prof. Boyce is to be congratulated on the successful completion of a difficult task, and English-speaking foresters on the receipt of a book of real value and service.

W. R. DAY.

Chemical Analysis

(1) Gas Analysis

By A. McCulloch. Pp. 166. (London: H. F. and G. Witherby, Ltd., 1938.) 7s. 6d. net.

(2) Micromethods of Quantitative Organic Elementary Analysis

By Prof. Joseph B. Niederl and Victor Niederl. Pp. xvi+271. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 15s. net.

(3) Tables of Reagents for Inorganic Analysis: First Report of the International Committee on New Analytical Reactions and Reagents of the Union internationale de Chimie. By C. J. van Nieuwenburg, W. Böttger, F. Feigl, A. S. Komarovsky, N. Strafford. Pp. xxiv+409. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1938.) 36 gold marks.

IN these days of extreme specialization, it can scarcely be expected that the basic subject of analytical methods will escape selective treatment. The trend is manifest in the preparation and publication of small text-books in which the methods applicable to the practice of a particular industry are selected: these probably save a good deal of time to workers in the special subjects, and to students taking limited laboratory courses in which the practice, rather than the art, of chemistry is demonstrated.

(1) A good example of such books is that on gas analysis, a subject which is much to the fore both in connexion with fuel technology, the science which is enabling one ton of coal to be burnt where three tons were necessary before its application, and in relation to syntheses from elementary gases in presence of catalysts. It covers the field satisfactorily without going into great detail; the more complex apparatus for analysing mixtures of hydrocarbons is omitted.

(2) Quite another field is the micro-analysis of organic substances which has rendered it possible

for the research worker, particularly in the biochemical field, to make astounding progress with quite small quantities of material. Pregl, in Vienna, made the start in this work; his methods have since been copied, adapted, and improved in many centres. The latest book comes from the New York University in Washington Square, and describes and figures the apparatus required, and how to use it. In large research laboratories it is becoming usual, and, indeed, necessary, to set aside a special room for this purpose staffed by competent assistants, who give their whole time to the work. It is good news to hear that there is about to be such a laboratory at the Imperial College, South Kensington.

(3) A third line of development worthy of emphasis is that of reagents. During the last decade the technique of qualitative analysis has been facilitated by the use of an exceptionally large number of new reagents, many of them organic compounds. The Union Internationale de Chimie has set up a Committee of five to report on new analytical reagents and reactions, on which Mr. N. Strafford, of Manchester, represents Great Britain; the report takes the form of a book largely in tabular form, in three languages, an achievement which is in itself substantial.

There are so many new reagents that teachers are faced with problems regarding their suitability which they lack the time to investigate. The report aims at giving help to this end, and contains full information, with references to all the reagents discovered in the period 1910-36. Some of them bear the indication "recomm."

Such a book was badly needed, and will no doubt find shelf room in every laboratory. It is printed and published in Germany.

It is pleasing to have this result of international co-operation, and it may be hoped that, in future, these congresses will more and more have the effect of getting the chemists of the nations to work together to similar ends.

The Silica Minerals

Quartz Family Minerals

A Handbook for the Mineral Collector. By H. C. Dake, Frank L. Fleener and Ben Hur Wilson. Pp. xvi+304. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 12s. 6d.

IN an age when thousands of books are published annually, covering almost every subject, it seems remarkable that so few have been written to introduce the general reader to the wonder and beauty of the mineral kingdom. In the United States some attempts have recently been made to fill this gap in the literature—an outstanding example being “Getting Acquainted with Minerals” by G. L. English. The present work is of the same persuasive kind, and though limited in its field to the silica minerals, serves also as an introduction to general mineralogy.

Like so many other of the common minerals, quartz possesses properties of the deepest scientific interest and furnishes problems, many of which still remain unsolved. Moreover, since some 60 per cent of the lithosphere consists of silica, a great part of which is in an uncombined state, ample material for first-hand study can be gathered by the collector in almost any part of the world, or can be purchased cheaply from a mineral dealer. “Quartz Family Minerals” opens with an explanation of the importance of quartz and a brief survey of its use in past ages. After two excellent chapters, in which the authors discuss the various conditions which led to the deposition of silica minerals in the rocks; a description is given of the quartz crystal habit and of the various types of quartz—crystalline, crypto-crystalline and amorphous.

There is a long chapter on agate; theories of

the manner of its growth are discussed and prescriptions given for producing banded, agate-like precipitates in suitable gelatin media on the Liesegang ring principle. Chapters on opal and on petrified forests complete the descriptive part of the book.

Naturally enough, in a work intended for American readers, the localities quoted for each variety of mineral are preponderantly American. Thus in the section on sand-filled calcites no mention is made of the curious sand-calcite rhombohedra found at Fontainebleau, so well known to the European mineralogist. The beautiful Mexican ‘water opal’ is not described, and quartz cat’s-eye is dismissed in a single short sentence. The last twenty pages of the book deal with “The Art of Cutting Gem Quartz”. In an appendix is given a selected bibliography of books and articles on the silica minerals and precious stones generally, in which the standard British work, G. F. Herbert Smith’s “Gemstones” and Liesegang’s classic, “Die Achate”, should have been included.

Numerous misprints, and one or two factual errors, will need correction in future editions. On p. 36 it is stated that “the purest quartz (rock crystal) has a specific gravity of 2.69” whereas the correct figure is 2.654; and on p. 176 fused quartz imitations of amethyst, etc. are said to have the “identical hardness and specific gravity” of the natural gem, which is by no means true.

Much interesting material, gathered from widely scattered sources, is collected together in the book, and it is well illustrated; it can be read with profit not only by the beginner but also by the more advanced mineralogist. B. W. A.

Applications of Ultrasonics

Ultrasonics and their Scientific and Technical Applications.

By Prof. Dr. Ludwig Bergmann. Translated by Dr. H. Stafford Hatfield. Pp. ix+264. (London: G. Bell and Sons, Ltd., 1938.) 16s. net.

THE scientific study of ultrasonics, or the properties of high-frequency inaudible mechanical vibrations, may be said to date from the year 1883, when Galton published his book “Enquiries into Human Faculty”. In this book he described the construction of the Galton whistle, an

instrument which, refined in some details, is used to this day by psychologists and physiologists for the production of sounds of high pitch. The subject remained of little more than academic interest until, during the Great War, Langevin devised the first practical apparatus for the transmission and reception under water of inaudible ‘sound’ signals. For this purpose, Langevin utilized (1) the discovery by the brothers J. and P. Curie of the piezo-electric properties of quartz, and (2) the methods of generating and detecting electric oscillations made possible by the invention of

the three-electrode thermionic valve. Langevin saw quite clearly that the use of disturbances of short wave-length enabled him to exploit the effects of unidirectional propagation, reflection, refraction, interference, diffraction, etc., until then more usually associated with optical phenomena. He might justly be called the 'Father' of modern ultrasonics.

Soon after the end of the War, Cady showed that the piezo-electric property of quartz could be used to maintain and control the electric oscillations in a suitably designed valve-amplifier circuit. A little later, Pierce and the late J. H. Vincent independently developed similar oscillators based upon the magnetostrictive properties of iron and nickel and their alloys. Almost all the latest developments of ultrasonics have been concerned with the applications of these two methods of producing high-frequency vibrations to various problems of science and industry. Mention may be made of submarine signalling, echo sounding, the sterilization of milk, the preparation of photographic emulsions, television scanning and precision time-keepers. A considerable impetus was given to such investigations by the publications in 1927 of R. W. Wood and Loomis on the physical and

biological effects of high-frequency sound waves of great intensity. These investigators showed how large amounts of energy could in this form be communicated to small portions of matter, with the result that surprising mechanical, thermal, chemical and biological effects were observed.

Until the publication of this book, no comparable comprehensive account existed in the English language of the achievements of ultrasonics and the present state of development of the subject.

Dr. Bergmann's book supplies the need of the moment in a most happy manner, and we have nothing but praise for it.

Particularly valuable is the discussion of the optical methods of measurement and investigation given in chapters ii and iv. The English edition of 1938 differs from the original German one of 1937 by the inclusion of an account of the application of ultrasonics to television, and a list of references to papers published in the interval.

The book is well printed and well illustrated, and shows little evidence that it is a translation and not an original version. We heartily commend it to all who are interested in any branch of this fascinating subject.

F. L. HOPWOOD.

Radioactivity, New and Old

A Manual of Radioactivity

By George Hevesy and F. A. Paneth. Second edition, completely revised and enlarged. Translated by Robert W. Lawson. Pp. xvi+306+5 plates. (London: Oxford University Press, 1938.) 17s. 6d. net.

THIS book was published originally in German in 1923, then in English in 1926 (reviewed in *NATURE*, 118, 475; 1926), again in German in 1931 (reviewed in *NATURE*, 129, 560; 1932), and now appears a second time in English. This new edition has come out at a most appropriate time. It is the only book of its size and scope that includes the great discoveries that have been made in the subject since 1932, discoveries which in fact and interest have exceeded the wildest dreams of the most sanguine workers of ten years ago. They have so enriched and enlarged the subject of radioactivity that the earlier treatises published before 1932, excellent as they were when they appeared, are, if still readable, greatly shorn of interest.

The discovery seven years ago that nuclei of light atoms could be changed by artificially accelerated protons shattered the old view that that kind of thing could be done only by the

spontaneously ejected α -particles from rare and costly elements. Then came heavy hydrogen and the neutron. These had scarcely been discovered before it was found they were excellent projectiles against nuclear targets, and the neutron, in particular, whether slow or fast, has proved so effective against almost every atomic nucleus bombarded that the profusion and variety of the results have become an embarrassment to the compiler.

All this was, in a sense, an extension of Rutherford's original work on artificial disintegration by bombardment, but in 1933 something quite novel forced itself on the attention of experimenters: the production from atoms, radioactive or not, of unstable nuclei which themselves were radioactive, emitting either the β -particle of natural radioactivity or a new particle, the positive electron, which a year earlier had been found in the cosmic radiation. One result of this advance was the extension of the list of elements at the heavy end; radioactive isotopes of the new elements 93, 94, 95, 96 have been prepared by bombardment of uranium and have given the chemist some idea of the chemical character of *eka-rhenium*, *eka-osmium*, *eka-iridium*, and so on.

In this new edition, concise accounts of this recent work have been embodied in the fuller descriptions of the older and fundamental experiments and theories. The book is not overloaded with the new material. It still retains its characteristics as a text-book for the ordinary student of physics and chemistry. The new chemistry (the production of one kind of element by bombardment from another)

and the new artificial radioactivity are admirably related to the old pre-1932 radioactivity which derived from the disintegration theory of 1902-3. Here in three hundred pages, as nowhere else in English, the student is given an account of a great subject in all its important physical, chemical, geological and biological aspects. It is a pleasure to welcome this new edition.

A. S. R.

Vectors

An Introduction to Vector Analysis

For Physicists and Engineers. By Dr. B. Hague. (Methuen's Monographs on Physical Subjects.) Pp. viii+118. (London: Methuen and Co., Ltd., 1939.) 3s. net.

"**V**ECTOR analysis is the natural means of expression for the three-dimensional problems of physics and engineering; because its conciseness and freedom from mathematical detail enable the relationships between the various physical quantities to be kept clearly in view". This is the first sentence in the preface of the book under review. The author continues: "... it has now become almost essential for any advanced worker in these sciences to have some knowledge of vector analysis. Much good work can be done with the aid of a very few elementary principles. It is the object of this monograph to give an introduction to these principles and to explain them from a physical standpoint, so that they may be easily available to the busy physicist or engineer approaching the subject for the first time. Such workers are usually so much occupied by their major task as to lack the time necessary to enable them to seek out such principles as they need to use from the more comprehensive treatises which aim at mathematical completeness. This monograph is not, therefore, intended for the readers with purely mathematical interests, whose more rigorous and systematic requirements are fully satisfied elsewhere. For these reasons the outlook adopted is almost entirely physical; geometrical matters and questions of an exclusively mathematical interest are limited to essentials. Formal proofs of invariance and conditions of continuity in vector processes are replaced by an appeal to physical intuition. Purely analytical topics of an advanced kind, such as Green's theorem, are justifiably omitted from such an introductory treatment as this monograph aims to present. . . ."

The author later directs the attention of the reader to "the inclusion of a chapter giving a

brief sketch of the elementary properties of tensors and dyadics in their relation to vectors. This is a subject which usually puzzles and often repels physics and engineering students because of the abstract mathematical way in which it is usually brought to their notice".

Finally the author informs his readers that "The monograph is based on a course of lectures given a few years ago to post-graduate electrical engineering students in the Polytechnic Institute of Brooklyn, New York".

I have quoted at this length from the preface because I feel strongly that the author has done a valuable service to students and teachers of applied mathematics in producing this small but comprehensive account of vector (and even the elements of tensor) analysis. The publishers also deserve praise for making available at so modest a price a book of 118 pages, including much mathematical printing and 39 diagrams (mostly excellent). In thus commending the book and those to whom we owe its production, I am not endorsing all its contents; there are many things in it that I think might better be put differently (and at no greater length), and a few that seem misleading; but all these points can be dealt with by teachers who may commend the book to their students, as I shall to mine; and readers who study the book by themselves can gain so much knowledge thereby, well set forth in small compass, as will far outweigh the few deficiencies of the treatment.

It is a remarkable sign of the ever-widening vogue of vector methods that this book has been written by an engineer. It is also remarkable that these methods have taken so long in winning adoption, still far from universal. The author points out that even Maxwell, who introduced the fundamental vector ideas into the theory of the electric and magnetic fields, did not make any use of vector analysis in manipulating his equations, relying entirely upon the usual lengthy Cartesian methods. The pioneers of vector methods in applied mathematics were Gibbs, Heaviside and

Lorentz. I recall that my own teacher, Horace Lamb, whose lectures and books were first-rate, never appreciated vector methods; he regarded vectors merely as a means of concise expression (in his view a rather dangerous conciseness), and had no conception of their value in mathematical manipulation.

Dr. Hague's book is already so full of excellent matter that examples on which the reader may

practice his 'prentice hand in vector manipulation are not included and could not be expected, nor is guidance given as to how such skill can be acquired and used, beyond references to further reading on vectors. His inclusion of a brief chapter on tensors and dyads will, it is to be hoped, interest many readers in this fascinating branch of mathematics.

S. CHAPMAN.

Courses in Engineering Science

(1) Mechanical Engineering Science

A Second Year Course. By Dr. Arthur Morley and Dr. Edward Hughes. Pp. xiv+260. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1938.) 4s. 6d.

(2) Engineering Science

By H. B. Brown and A. J. Bryant. Vol. 2: Heat and Heat Engines and Electrotechnics. Pp. x+450. (London: Macmillan and Co., Ltd., 1938.) 6s.

(3) Engineering Mechanics

By Prof. Seibert Fairman and Prof. Chester S. Cutshall. Pp. xi+267. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 13s. 6d. net.

IT is of interest to observe the variety of views which are current as to the way in which the science of engineering is to be taught, more especially as they are indicated in the text-books of the day. While engineering is, in one sense, merely a branch of applied physics, the training of the engineer must necessarily be conducted on lines fundamentally different from those on which the physicist is prepared for his life's work. Prof. Southwell has pointed out that the problems of the engineer are inexorable and are recognized by him as so. The physicist, barred from progress in one attempted path, is free to try another; the engineer must solve his problem as it is presented, and some solution he must have even though it may only be approximate. From this it clearly follows that the engineer must study his subjects from the practical point of view; and that he inclines not to draw fine distinctions between them but rather to regard them as parts of one whole. Such distinctions as are made are more for convenience than otherwise, and to him the main end is to be able to estimate the practical effect of all the influences which bear upon any work in hand.

Up to about twenty-five years ago, the general practice in technical institutes in Great Britain was to provide a course consisting of quite a number of subjects, each dealt with in a separate

class, with clear-cut distinctions between them. Since then, a tendency has been noticeable towards grouping these individual subjects in more general courses under some such comprehensive title as 'engineering science'. This, no doubt, makes a more attractive-looking subject to the less keen type of student, and it also recognizes in some measure the essentials in an engineering training.

(1) An example of this is the course suggested for National Certificate students by Dr. A. Morley and Dr. E. Hughes. In their text-book "Elementary Engineering Science", the work of the first year in statics, heat and electrical technology was set out. They have now followed this with a second-year course for students of mechanical and of electrical engineering in a more recent text-book, "Mechanical Engineering Science", in which are presented dynamics, energy, hydraulics, and the mechanics of gases, leading up to the principle of the heat engine and a descriptive and explanatory section on engines and boilers.

As in the earlier course, emphasis has been laid on energy as the principal method of approach to the problems which these sections present, and the subject is demonstrated largely by means of practical examples fully worked out. It is in this respect that the book attains its highest qualities, for these examples have been well chosen and are methodically elaborated, no essential step being omitted. The explanatory text might, however, have been arranged in much more simple and direct terms and so have had more appeal to the ordinary student. For example, a straightforward statement of the engineer's point of view as to inertia, mass and weight would have been better than the postulation of different aspects which are not fully discussed and indeed cannot be. Thus they leave the student in some measure of doubt and hesitancy.

(2) A somewhat different sequence has been adopted in "Engineering Science", by Brown and Bryant, the first volume of which presented a first-year course in applied mechanics and hydraulics.

The second volume now shows the work of the second year to be devoted to heat, heat engines and electrotechnics. The scope is thus kept within somewhat narrower bounds, but the treatment goes deeper and, being direct and practical, should make an appeal to both students and their teachers.

The main principles have been stated clearly and succinctly, and the approach to the subject is largely by experiment and deduction. The course outlined is a progressive one and provides a good preparation and basis for the more specialized studies which have to follow, and the student will get considerable help from the numerous illustrations of machinery and apparatus which have been supplied by their makers.

(3) In the preparation of "Engineering Mechanics" by Fairman and Cutshall, the authors have adopted quite a different method of overcoming the difficulty of keeping within the available facilities for study. Appreciating that in institutions

where time is limited by the requirements of other subjects in the curriculum a full basic course cannot be attempted, they have eliminated those portions which must, in any event, be dealt with in more specialized classes and may therefore be deferred until later. They hold that a task is more easily accomplished if all the tools are available, and therefore, at each stage, make careful preparation for it by setting out and explaining clearly the methods, conditions, and the fundamental laws of physics applicable.

The course is one of general mechanics as applied to engineering, and includes statics, dynamics, friction, energy, balancing, impulse, impact and gyroscopic action. It is intended for students who have had a training in mathematics up to the integral calculus, and for such as have this preparation it offers a clearly stated exposition of the subject with a discreet mixture of problems of the practical and the academic types.

Modes of Thought

Modes of Thought

By Prof. Alfred North Whitehead. Pp. x + 241. (Cambridge: At the University Press, 1938.) 7s. 6d. net.

PROF. A. N. WHITEHEAD'S latest book consists of eight lectures and a short address as epilogue. Two of the lectures have been published before under the title "Nature and Life". Any reader who is unfamiliar with the author's philosophy would be well advised to begin with the first of these (Lecture VII). Prof. Whitehead points out there that according to the traditional doctrine of science, which has been taken over by common sense, Nature consists of permanent things, bits of matter, moving about in a space which is otherwise empty. The connexions between such bits of matter are purely spatial, and therefore motion is the only mode of change. Modern physical theory contradicts everything this doctrine asserts, nevertheless it remains as a general presupposition.

The result is a complete muddle in thought, yet any theory which does not presuppose the traditional view seems paradoxical. The traditional view, it is argued, is not merely inconvenient, but definitely self-contradictory. The only final real fact admitted by it is "this bit of matter occupying this region of space at this durationless instant", without reference to any other instant or any other piece of matter or to any other part of space. But what are we to make of velocity, acceleration or momentum at an instant? These notions are

necessary for physics, and yet are without meaning on the traditional view. For the modern view, process, activity and change must be taken as primary matter of fact. At an instant there is nothing. Each instant is only a way of grouping matters of fact by taking a cross-section through them. All interrelations of matters of fact must involve transition. Each concrete fact is the consequence of a process of 'concrecence' from other facts. In its turn it gives way to contribute to the concrecence of others. A thing becomes real by being involved in the "creative advance of nature". The notion of creative advance is the starting-point of Prof. Whitehead's theory.

The rest of the book is concerned with the development of certain aspects of this fundamental notion. The treatment is useful and illuminating for anyone who already knows something of his views. To anyone not so prepared a good deal of it may be puzzling. The author's mode of expression, though often most happy and usually clear, is sometimes elusive. Unfortunately the opening pages are of this character, and might frighten off an unwary reader.

It is interesting and cheering to find Prof. Whitehead, who cannot be accused of ignorance of mathematical logic, combating the fashionable doctrine that arithmetical propositions are all tautological. The doctrine has been propagated with the help of such a terrifying array of technicalities that scarcely anyone has dared to protest against it.

A. D. RITCHIE.

SHORT NOTICES

Anthropology and Archaeology

The Southern Bantu

By L. Marquard and T. G. Standing. Pp. vii+262. (London, New York and Toronto: Oxford University Press, 1939.) 7s. 6d. net.

THE aim of the authors, it is stated, is to remove some of the hindrances to understanding which subsist between the white race and the black. Few who have set out with the same unimpeachable purpose have come nearer success than they do in the few pages of introduction, in which they show how differences in manners and etiquette as between the two races, matters of long tradition, lead to mutual misinterpretation, misunderstanding, or disapprobation. For example, the Bantu is stigmatized as 'furtive' because his etiquette eschews the direct glance, which the European, rightly or wrongly, interprets as a mark of honesty; and this is only one of a number of points, ostensibly trivial, but important in this connexion and cumulative in effect, which give rise to lack of ease in intercourse, or even friction.

From this excellent and sympathetic beginning, the authors conduct the reader through a rapid but adequate survey of the history, social organization, material culture and beliefs of the Bantu of the Union of South Africa, Southern Rhodesia, the Protectorates, and the Mandated Territory of South-West Africa. Full emphasis is laid on the fact, often overlooked in discussion and controversy, that these peoples vary widely in characteristics and culture, notwithstanding a general resemblance. Following on this survey, which will give the reader who is not a specialist in the anthropology of southern Africa an adequate idea of the material with which the native problem, so-called, is concerned, the authors pass on to the conditions of the life of the native as he lives it in the reserves, on European farms, or in European towns, and then set out the circumstances of administration of native affairs, economics, industry and occupation, land tenure, religion, education and the like.

Treatment of the material throughout is objective, and the authors, beyond stating opinions which are generally accepted, refrain from drawing conclusions from the facts. This is left to the reader.

The Origins of Early Semitic Ritual

By Prof. S. H. Hooke. (The Schweich Lectures of the British Academy, 1935.) Pp. xi+74+3 plates. (London: Oxford University Press, 1938.) 6s. net.

THE more intensively the material brought to light in the archaeological excavation of the Syrian site of Ras Shamra, the more clearly is its importance realized in relation to the study of the culture of western Asia in the second millennium B.C. It is the source upon which Prof. Hooke relies

mainly for his most illuminating material in his study of the origins of Semitic religion, which formed the subject-matter of his Schweich Lectures before the British Academy in 1935. His purpose was to relate the ritual practices of the Hebrews, as contained in the Old Testament, to the rituals of Mesopotamia and Canaan. This is now possible, but only through the information which has been amassed in the excavations of archaeologists in the Near East of recent years. As the author points out, such elements of Hebrew culture as the Passover can now be related to the ritual practices, which existed in their ancient Semitic environment.

The first lecture is devoted to the sources and types of Mesopotamian ritual, material familiar to the archaeologists, but as Prof. Hooke suggests, not equally well known to students of the Bible; the second deals in like manner with the ritual of Canaan. It is in connexion with the latter that the material from Ras Shamra is most valuable, for we now have for the first time a contemporary account of Canaanite practice at a crucial moment, hitherto known only from much later and more biased sources. The third lecture brings the Hebrew ritual into relation with the two systems previously discussed, the process suggesting the possible importance for Hebrew culture of Hittite and Hurian influence.

Witchcraft in the Star Chamber

By O. L'Estrange Ewen. Pp. 68. (London: The Author, 103 Gower Street, W.C.1, 1938.) 3s. 6d.

MR. EWEN, whose two earlier books on witch trials drew mainly on the records of the assizes, has now extended his researches to cases before the Star Chamber in the early years of the seventeenth century, not long before its abolition in the reign of Charles I. This court was a convenient and inexpensive method, for the less wealthy members of the community, of seeking redress in a civil action. Its records of trials afford an interesting and in certain respects an enlightening view of the reactions of persons accused of witchcraft. For the cases which came before the court were not witch trials—these went to the assizes—but actions for slander or libel brought by the alleged witch, usually after acquittal in another court, claiming damages from the accuser.

The statements of claims give some interesting information as to the character of the alleged bewitching; but while in some instances there is evidence of a genuine belief in the powers of the witch, not infrequently it is clear that behind the accusation lay the real motive—a family feud, a squabble between the wives of tradesmen, jealousy, or a dispute over property. An accusation of witchcraft would secure removal of an enemy or rival by incarceration for a time at least, and even if unsuccessful left a stigma, which carried with it social

ostracism and even danger of assault by the mob. One of the most interesting cases comes from Berkshire—demoniac possession of a girl of fourteen, a clear case of hysteria, which was investigated personally by King James I, who was a great demonologist; while in another from Oxford the motive of accusation was evidently blackmail.

Biology

German-English Botanical Terminology (Englisch-Deutsche Botanische Terminologie)

An Introduction to German and English Terms used in Botany, including Plant Physiology, Ecology, Genetics and Plant Pathology. By Dr. Helen Ashby, Prof. Eric Ashby, Dr. Harald Richter and Dr. Johannes Bärner. Pp. xi+195. (London: Thomas Murby and Co., 1938.) 10s. net.

ON its publication by Messrs. Murby and Co., "German-English Geological Terminology" received such unanimous approval that the publishers have decided to issue "Terminologies" in other sciences along similar lines. The decision is a happy one, for the series is being written on novel lines.

This book deals with botanical terminology, and the editor of the series clearly made a wise choice in his British and German authors. The book will form excellent material for the student of botany who is learning technical German, for, instead of being a mere vocabulary of German-English terms, it is actually a survey of botany given in English on alternate pages with the German equivalent on the opposite pages.

The subject-matter is divided into: two chapters on plant morphology, two on classification and phylogeny, one on cytology and genetics, one on plant physiology, one on ecology and one on plant pathology. In appendixes are given lists of common European plants, common names of plant diseases, abbreviations frequently used in German botanical literature, and abbreviations used in English botanical literature.

The whole method of approach is commendable, since the book will help the student to enlarge his vocabulary and become familiar with botanical terms in German and English almost subconsciously while reading and revising his botany. Above all, the reader will have impressed upon him the very important fact that the same idea is often expressed differently in German and in English.

We would strongly recommend every student of botany reading for a university degree in the subject to obtain a copy of this very useful work.

Ascaris: the Biologist's Story of Life

By Dr. Richard Goldschmidt. Pp. viii + 312. (London: English Universities Press, Ltd., 1938.) 10s. 6d. net.

DR. R. GOLDSCHMIDT has written this book in order to provide an introduction to biology for readers with no previous knowledge of science. Taking as his unconventional starting-point the parasitic worm *Ascaris*, he uses it as a text for a

very readable account of modern conceptions of physiology, experimental morphology, and genetics, with excursions into bionomics and ecology. In all these matters it need scarcely be said that the distinguished author is a trustworthy guide, and from his point of view the survey is doubtless a well-balanced one.

From another angle, however, the perspective would be very different. Dr. Goldschmidt writes as a convinced mutationist. Mutations arise with "no relation to usefulness or non-usefulness"; natural selection is merely the elimination of the grossly unfit; inheritance of impressed modifications does not happen; organisms having acquired new characters can "afford to look for new modes of living" but otherwise adaptation is an unsolved and perhaps insoluble mystery. It is true that he does not, like some modern biologists, expressly disclaim all curiosity as to evolution. The account of the vertebrate ear leads him on a brief excursion into comparative morphology and even phylogeny and 'recapitulation', although palaeontology is barely glanced at. Nevertheless, with the reservation that there is a great deal more to be said on all these points, the book is one to be recommended to the university student as well as to the layman or the "not-too-tired" business man mentioned in the preface.

Actual mistakes are few and trivial; but surely "the Kerguelas" is scarcely a happy designation for the islands discovered by and named after Yves Joseph de Kerguelen Trémarec. W. T. C.

Chemistry

The Chemical Studies of P. J. Macquer

By Dr. L. J. M. Coleby. (History of Science Library.) Pp. 132. (London: George Allen and Unwin, Ltd., 1938.) 6s. net.

ONE of the outstanding French chemists of the eighteenth century was Pierre Joseph Macquer (1718-1784). He was the author of a dictionary of chemistry which went into a second edition and was translated into English as well as other languages, and in addition to valuable investigations in pure chemistry he was director of the dyeing industries and superintendent of the State factory at Sèvres for the manufacture of porcelain. Mr. Coleby has given a clear and interesting account of the work of Macquer which is based on the original sources, and his book is a useful contribution to the history of chemistry.

The Elements of Physical Chemistry

By F. W. Goddard and Dr. E. J. F. James. Pp. viii+251. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1938.) 5s.

THIS text-book is planned to meet the requirements of students preparing for Higher Certificate, First Medical, and University Entrance Scholarship examinations. The text is clearly written and on the whole very suitable in standard for the aim of the book. The section on atomic

structure requires correction, since it assumes that the atomic nucleus contains electrons, and it is doubtful whether the circular diagrams of atoms are the most suitable for explanations of valency. It is questionable whether adsorption should be introduced into the section on solutions. The sections on solutions and electrolysis are very good, and give an adequate account of the subjects; that on catalysis is rather old-fashioned, and the reactions given on p. 213 for the lead chamber reactions would be more accurate if water were introduced into the first.

A good feature of the book is the emphasis laid on numerical calculations, and the excellent series of problems given at the ends of the chapters will be very helpful on this side. The book is one which should prove useful both to junior students and to teachers.

Geography and Travel

Physiography of Eastern United States

By Prof. Nevin M. Fenneman. Pp. xiii+714+7 plates. (London and New York: McGraw-Hill Book Co., Inc., 1938.) 36s.

THE equivalent in Great Britain of the term physiography is geomorphology, and that is the content of this book. It is planned and written on the same lines as the author's volume on the Western United States which was published seven years ago. The area now covered stretches westward across the Mississippi basin to the edge of the High Plains. It is a massive book, full of detail, arranged under the provinces which in America are the generally accepted physical divisions. As a whole these are the divisions of the country accepted by the United States Geological Survey.

The material available to the author was abundant, though of varying value in different provinces. He has tried, and with a large measure of success, to produce something more than a mere compilation of details. There is certainly much purely descriptive matter, but the broad issues of geomorphological evolution are never lost to view. One might, however, wish for a chapter or two of general summary for those who have not time for the fuller treatment. The book is fully documented on every page and has a number of maps.

Northernmost Labrador Mapped from the Air

By Alexander Forbes, with Contributions by O. M. Miller, N. E. Odell and Ernst C. Abbe. (American Geographical Society Special Publication No. 22.) Pp. xx+255. Navigational Notes on the Labrador Coast. By Alexander Forbes. Pp. 26+6 plates. (New York: American Geographical Society, 1938.) 4 dollars.

THE greater part of this book contains accounts of aerial surveys made in Northern Labrador in the summers of 1931, 1932 and 1935. Previous maps of that part of Labrador were vague and generalized on the whole, although some of the inlets had been charted. Details of the organization, equipment and methods are given with much general information about the country. The methods are fully described by

Mr. O. M. Miller. The net result was a map of some 4,000 square miles extending from Nachvak fjord to Cape Chidley, most of which is produced on a scale of 1:100,000. The sheets accompany the monograph in a separate cover. In addition to this side of the work the volume contains a number of other useful articles, including one by Mr. N. E. Odell on the geology and physiography, and another by Mr. E. C. Abbe on phytogeographical observations, and a separate pamphlet of Navigational Notes on the Labrador Coast by Mr. A. Forbes. The flora of the higher mountains contains many of the same species as the nunataks of Greenland. These Dr. Abbe regards as the hardiest members of the flora, but he does not believe that they survived through the last glaciation on nunataks, which Mr. Odell in any case does not think existed. He favours the hypothesis of relatively rapid migration northward in a past glacial optimum. Subsequent refrigeration may have resulted in a shrinking of the distributional areas of these species.

The volume contains a large number of fine photographs illustrating every aspect of the work.

The South

Its Economic-Geographic Development. By A. E. Parkins. Pp. ix+528. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 25s. net.

THE title of this book refers to the sixteen States in the south-east of America from Delaware and Maryland westward to Oklahoma and Texas. This area covers a great deal more than the plains of the south-east and the cotton belt since it embraces much of the Appalachian uplands, but is nevertheless a fairly well-defined region on economic and cultural grounds. Mr. Parkins attempts to give a survey of this area leading from physical factors and historical records to the present geographical and economic conditions. In short, he is concerned with an interpretation of life as it exists to-day, in a region that is primarily agricultural but in which agriculture is changing in aspect and intensity and where mining and manufactures are beginning to play an important part. The book, which is well documented and has abundant maps and illustrations, is a valuable contribution to the geography of the United States, and is, moreover, a good example of geographical reasoning.

R. N. R. B.

Engineering

Carburettors and Fuel Systems

The Theory, Application, Construction, Fitting, Testing, Tuning and Maintenance of Carburettors and other Fuel Combustion Devices. By Arthur W. Judge. (Motor Manuals: a Series for all Motor Owners and Users, Vol. 2.) Third and revised edition. Pp. 362. (London: Chapman and Hall, Ltd., 1938.) 6s. net.

THIS, the second volume in a series of four motor manuals which have proved very popular, has now reached the stage of being issued in a third

edition. The series has been designed to present in simple and, so far as possible, non-technical terms the essentials of each branch of the subject, so that it might be of practical service to all who are interested in the motor-car. With this aim in view, its principal features have been descriptions and explanations of the construction and operation of the several parts of the car. Theory has only been introduced to a limited extent, and in the present volume a short introduction puts the reader in possession of the main points as to the theory of carburetion, the chemical and thermal properties of fuels, and the process of combustion. Starting from the simplest types of carburettor, the author builds up a picture of the development of this delicate piece of apparatus as further and further improvements were indicated by the need of greater economy and smoother running of the engine. He retains descriptions of older models because they embody important and interesting principles.

Of up-to-date types a large number are illustrated and described, and among the more recent developments dealt with are the various types of British and foreign carburettors having original systems of mixture compensation, automatic air chokes, acceleration pumps, power jets and other special features. The subject is treated very broadly, as, in addition to those for motor-cars and motor-cycles, carburettors for aircraft are also included, so that with the chapters treating of such ancillary matters as air cleaners, fuel feed systems, design of inlet manifolds, vaporization and testing, tuning and trouble tracing, the information given is very complete of its kind. In its extended form it should continue to prove of great help to motorists, repairers and students and to enjoy a full measure of popularity.

Theory of Alternating-Current Machinery

By Alexander S. Langsdorf. (Electrical Engineering Texts.) Pp. xviii+788. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 36s.

THIS large volume is devoted solely to the theory of the steady state of electromagnetic A.C. machinery (thus excluding electronic devices such as mercury arc rectifiers). Questions of design are touched only so far as they form the background from which the theoretical problems arise. The wide field thus available enables the author to adopt a comprehensive and at the same time broad and easily readable treatment. A specially commendable feature of the book is that the usual analysis by means of vector diagram and complex algebra is always preceded by a very full discussion of the physical relations. In this connexion the chapter on asynchronous machines, which can well be read independently of the rest of the book, should be of special interest to students.

Other noteworthy features of the book are: in the introductory part a special chapter on the theory of polyphase current systems which includes an introduction to the method of symmetrical components, in the treatment of the transformer a discussion of the transformer with three windings, and

in the chapter on synchronous machines a simplified presentation of the Doherty-Nickle theory for the calculation of armature reaction in machines with salient poles. The book can be thoroughly recommended.

A. B.

Autographic Indicators for Internal Combustion Engines

By J. Okill. Pp. 88. (London: Edward Arnold and Co., 1938.) 5s. net.

THIS is a subject which has been somewhat neglected and, as a result, connected information regarding the use of indicators on internal combustion engines is not readily obtainable. The author, who designed that most useful instrument, the Okill maximum pressure indicator, has given the matter much study and, in this monograph, presents a range of information and suggestions which should be most acceptable to those who have not had an extensive experience in the manipulation of these instruments. His survey is limited to the combined piston, spring and pencil-lever types, and traces their development from the original instrument devised by Watt about 1790 to the very carefully proportioned and accurate types now made to suit the severe requirements imposed on them by high-speed internal combustion engines. The possibility of inaccuracy and distortion of diagrams arising from piston friction, overheating and mishandling are pointed out and the methods of testing and calibrating the pencil movements are described. Then after dealing with inertia effects, spring vibrations and the correct forms of connectors, operating gears and other details, a number of present-day instruments are described and explained. The book should therefore be a most useful guide to the many engineers who depend on the indicator for periodical information as to how their engines are operating.

Automatic Telephony

By Charles W. Wilman. Second edition, thoroughly revised and reset. Pp. viii+208. (London: The Technical Press, Ltd., 1938.) 10s. 6d. net.

AUTOMATIC or machine switched telephony is a very specialized subject; but the fundamental principles can be easily grasped. Few relevant text-books indicate these principles without confusing the student with circuit complexities; the author does provide a readable introduction both for students who intend to go further in their studies of the subject and for those who have to include an outline in their general study of electrical communication. The extensive study of the subject is not to be recommended to anyone who has not a suitable flair for the peculiar but necessary diagrammatic nomenclature.

One is surprised that the author does not give a technique for studying complicated switching problems; some form of pictorial shorthand is always used by engineers when studying machine switching circuits or devising new ones. There is likewise no complete circuit, such as a complete call through the minimum of a line-switch and selectors, or a director,

so that the student can have the mental exercise of seeing how the elemental functions, each clearly described with circuits, operate in concord and with economy of apparatus. One would have liked more details of some of the other automatic switching systems in use. We are committed to a Strowger-director system in Great Britain, but other systems, such as the rotary, have special advantages, and are, in fact, largely manufactured here for export. The proportion of telephones in Great Britain which are operated by machine switching is high and is increasing, and no student of electrical engineering can be without some knowledge of the basic ideas. There is little scope for young engineers in automatic telephony, but the inherent principles are widely applicable in many other directions, such as remote-metering and control, traffic-lights, and signalling schemes of all descriptions. L. E. C. H.

Mathematics

Solid Mensuration

With Proofs. By Prof. Willis F. Kern and Prof. James R. Bland. Second edition. Pp. vii+172. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 10s. net.

THIS is practically a new book although a second edition, for not only is it more than twice the size of the original edition, but substantial alterations have also been made in the text by the authors. After an introductory chapter giving suggestions for practical computation and a clear summary of plane mensuration, lines, planes and dihedral angles are dealt with. Then follows a good course on solids of uniform section, pyramids and cones, frusta, prismatoids and the sphere. Later come the theorems of Pappus without proofs and a consideration of polyhedra. Finally, the general prismatoid is discussed and a proof of the prismoidal formula given.

The book is thoroughly well illustrated by clearly drawn figures—a very essential feature for any book on mensuration—and there is an abundance of interesting exercises with a practical bias, including a good set of review problems.

Les géométries

Par Prof. Lucien Godeaux. (Collection Armand Colin: Section de mathématique, No. 206.) Pp. 215. (Paris: Armand Colin, 1937.) 15 francs.

PROF. GODEAUX'S addition to this excellent series of popular monographs, will be found of interest to the general reader and to the specialist. The former will be made familiar with the fundamental concepts of the various types of geometry; and both will learn much about their historical and methodological background. The six chapters of this work deal respectively with elementary geometry, analytical geometry, projective geometry, the principles of geometry, the theory of groups and topology. The mathematical notation used is quite simple, and the book makes easy reading owing to the explanations covering all the difficult intuitions of the geometricalians. T. G.

Medical Studies

Research in Medicine and other Addresses

By Sir Thomas Lewis. Pp. viii+75. (London: H. K. Lewis and Co., Ltd., n.d.) 5s. net.

THIS book contains a collection of addresses delivered by Sir Thomas Lewis on various occasions, including the Harveian Oration on "Clinical Science" to the Royal College of Physicians, London, 1933, and the Huxley Lecture on "Clinical Science within the University", at the University of Birmingham, 1935, and all first published in the *British Medical Journal*.

During the last twenty years, Sir Thomas Lewis has made outstanding contributions to medicine dealing with disorders of the heart and circulation.

In the preface to this volume, Sir Thomas says that in his earlier days, when working upon physiological problems, he came to the belief that the problems daily encountered in hospital wards, despite their complexity, are capable of solution by a similar form of investigation, that is, by the experimental method directly applied to man, and he tells us that he has never wavered in this belief and that all his later experience has confirmed it. Actually, this method in Lewis's hands has yielded rich results. A second motif running through these addresses is the hope that a science of medicine might develop through the freeing of investigators from the necessity of earning a livelihood by practice. At the end of his Huxley Lecture he says: "It is my conclusion that it is largely within the power of our universities to establish the branch of work that studies disease in living people as a science, by removing the obligation to engage in and teach the practical art, and by treating Clinical Science on precisely the same basis as the allied sciences, physiology and pathology, are treated, thus bringing all the work into real harmony".

Sufficient has been said to indicate the content of these addresses, and many will probably agree that Sir Thomas has established his thesis.

The Health of the Nation and Deficiency Diseases

By John Maberly. Pp. xi+118. (London: Baillière, Tindall and Cox, 1938.) 5s.

THE author maintains that the physique of the younger generation has steadily declined during the last twenty years in spite of improvement in hygiene, labour conditions, and provision for unemployment and sickness as well as for clinics for child welfare. He attributes the ill-health which is prevalent among a large section of the people, especially in the form of neurasthenia, to partially deficient diets resulting from the present methods of milling wheat and the making of white bread. According to him, the vitamins B and E, as well as iron, iodine and copper, which are contained in adequate amounts in wheat but are either wholly or very largely confined to the germ and cortical layers of the grain, are excluded in the ordinary white bread. He therefore recommends an absolute

abolition of the practice of removing the germ and cortical layers of the wheat which at present are given to cattle or poultry, and urges that millers should be compelled to supply flour containing all the nutritious elements of the grain.

The last three chapters, which have no obvious connexion with the rest of the work, are devoted to pernicious anæmia, non-pernicious anæmia and glycosuria and diabetes mellitus respectively.

The Medical Press and Circular, 1839-1939

A Hundred Years in the Life of a Medical Journal. By Dr. Robert J. Rowlette. Pp. x+127+10 plates. (London: Medical Press and Circular, 1939.) 10s. 6d.

THE *Medical Press and Circular* was founded in Dublin by Dr. Arthur Jacob in January 1839 under the title of the *Dublin Medical Press*. The medical profession was entirely unorganized at the time of its foundation, and Jacob was one of the first to recognize the need for organization. To mark its centenary (see *NATURE*, Feb. 11, p. 237) Dr. Robert Rowlette, for many years Irish editor, has written this interesting history of the *Journal* and its development, and has woven into his account the medical history of the times.

The *Medical Press* was published in Dublin up to 1866; but in that year it absorbed a London periodical, the *Medical Circular*, founded in 1852 by Dr. James Yearsley, a well-known aural surgeon, and edited by Dr. George Ross during the fourteen years of its existence.

Arthur Jacob was a prominent surgeon in Dublin, and he was the discoverer of the layer of rods and cones in the retina of the eye. He was succeeded as editor by his son, Dr. Archibald Jacob, and the *Journal* then took a close interest in the betterment of the profession employed under the Poor Law system. In the 'nineties, in common with other journals, it pressed for reforms in the Army Medical Services, and in recent years has pursued an editorial policy of providing concise and authoritative articles upon the latest methods of diagnosis and treatment.

Dr. Rowlette's "History" is attractively produced, being printed on cream antique laid paper, and bound in crash canvas with green labels lettered in gold, and is illustrated with ten excellent plates.

Diets for Diabetes

Arranged in Menu Form. By Dr. G. E. Beaumont. Pp. vi+49. (London: J. and A. Churchill, Ltd., 1938.) 2s. net.

IN this short booklet, diets for those suffering from diabetes are presented in menu form, so that the patient need not calculate equivalent food values from tables. Having been informed by his doctor of the amount of carbohydrate, etc., and number of calories appropriate to his condition, the patient may thus select meals suitable for him, and which appeal to his appetite and his taste. First of all, tables are given of the carbohydrate, protein and fat content and calorie value of fruits, vegetables, meats, etc., after which a number of daily menus is set out, each with its dietary constitution and calorific value. The

diets suggested commence with a scanty one of only 178 calories and become progressively more and more generous. The information given should be very useful to the sufferer from diabetes, and will alleviate some of his trials.

Viscosity of the Blood

The Cause and Cure of High Blood Pressure. By Major Vincent Nesfield. Pp. 96. (London: R. Cobden-Sanderson, Ltd., 1938.) 5s. net.

IN this work, which is based on eight years' research, the author maintains that high blood-pressure is due to increased viscosity or thickness of the blood, for the measurement of which he has devised a special instrument or viscometer.

The chief cause of viscosity of the blood is stated to be over-eating and lack of exercise, which account for its rarity in farm labourers, among whom the author had a practice for more than fifteen years, and its frequency among the well-to-do. Treatment of the condition, therefore, should consist in a reduction of diet and in bleeding, which though carried out to excess in the past has been too much neglected at the present day.

Miscellany

Essential Facts about the League of Nations

Ninth edition (revised). Pp. 349+9 plates. (Geneva: League of Nations; London: George Allen and Unwin, Ltd., 1938.) 1s.

THIS admirable but lucid recapitulation of the essential facts about the League of Nations provides an indictment of recent statesmanship which is the more impressive because the book is wholly free from polemics. The bare statement of the achievements of the League, the outline of its contribution to human welfare in many technical fields as well as in the political, make it the more amazing that nationalist policies anywhere should have hampered that continued development and contribution. The immense amount of readable information provided here in pocket form and easy of reference in itself emphasizes the necessity of a return to the League system and the evolution from within its framework of a more perfect structure where required. Only as the principles upon which the League is based are recognized can there be for any nation either the security or the amelioration of economic conditions which in these last few years have been sought increasingly but in vain by very different methods.

Catalogue of Lewis's Medical and Scientific Lending Library

New edition, revised to the end of 1937. Part 1: Authors and Titles. Pp. viii+550. (London: H. K. Lewis and Co., Ltd., 1938.) 16s. net; to Subscribers, 8s.

THIS new edition of Part 1 of the Catalogue of Lewis's Medical and Scientific Lending Library has been revised to the end of 1937. It contains the list of authors and titles, estimated to be some twenty thousand in number, of the works in the

Library. All works of any importance, English, American and foreign (when translated), are to be found in the Library, as well as a number of journals, reports and annual reports and year-books. All those who have used this Library know how useful it is, and the subscription rates are very moderate. Part 2, which gives the classified index of subjects, is in active preparation, and is expected to be ready early this year.

English for Students in Applied Sciences

By Prof. S. A. Harbarger, W. R. Dumble, W. H. Hildreth and Prof. Bert Emsley. Pp. xiii+260. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 12s.

THIS book outlines a course for American science students in the writing of English. It is thoughtfully written and well produced. Though not entirely suitable in structure or detail for students in Great Britain, it should be found stimulating by their teachers. The average science student's technical knowledge of writing falls far short of his technical knowledge of science, and the difficulty of getting results on paper in a lucid way is often a factor which limits his usefulness as a research man. Many productive workers seem unconscious of the need to examine the bases of composition, or consider the vital relation between author and reader.

A course in English directed to making clear the principles underlying the writing of English, and giving an opportunity for practice in drawing up reports and similar documents, should be of much value in the science courses of English universities. Everyone who has to deal with the preparation of manuscripts for the press or with their subsequent abstraction would be grateful if the universities gave the science student a more deliberate training in this matter. In view of the vast annual output of scientific papers, and the endless labour involved in keeping abreast of them, everything possible should be done to make such papers as clear and understandable as the subject allows.

B. S.

The Official Year-Book of the Scientific and Learned Societies of Great Britain and Ireland
With a Record of Publications issued during Session 1937-1938. Compiled from Official Sources. Fifty-fifth Annual Issue. Pp. vii+169. (London: Charles Griffin and Co., Ltd., 1938.) 10s. net.

MESSRS. CHARLES GRIFFIN are to be congratulated on the promptness with which they have issued the 1938 edition of this useful annual. The extent of the volume is about the same as that for 1937, and checking here and there shows that as regards recent changes of address and similar facts it is up to date. The data given include the full names of every society and institution mentioned, its address, officers, conditions of membership and particulars of meetings and publications. Government institutions such as the British Museum, Kew Gardens, Meteorological Office, and so on, are also included. It is worth emphasizing that the volume is "Compiled from Official Sources".

The Roof-Tree

By James Kenward. Pp. xxv+124+26 plates. (London, New York and Toronto: Oxford University Press, 1938.) 8s. 6d. net.

THIS book traces in a popular and entertaining style the structural development of the dwelling-house. The author has followed its growth from the shelter of a tree, through pre-, proto-historic and historic forms to the multicellular erection of modern type, as seen in the rural dwellings of Kent. Although his illustrations are drawn from a single English county, in which his interest centres, the principles exemplified are of general application. He shows how human needs have been met by extension of the primitive structure along lines determined by constructional possibilities and the character of the material available from local resources. As his title indicates, Mr. Kenward deals only with the northern form of European house evolved from a prototype in which the formative element was a wooden structure. His book is written with an infective enthusiasm for craftsmanship and the craftsman.

Chemical Engineering Economics

By Chaplin Tyler. (Chemical Engineering Series.) Second edition. Pp. ix+241. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 18s.

THE economic problems of chemical engineering are those of industry in general, varied only in so far as production is based essentially on change in chemical form. The graduate entering industry is very soon confronted with them, and finds them to be of a different character and wider in their ramifications than those he has studied for his degree. It will come as a boon to many to have these economic questions concisely and clearly set out in book form. The author is qualified by his experience for this task, which he has accomplished in a praiseworthy manner: there can be few chemists who will not profit by reading it, even though it applies to American conditions.

The subject is considered under such headings as organization, project analysis, plant location and design, operation control and cost, cost accounting and sales development, whilst the research aspect is not overlooked. The tendency towards continuous or semi-continuous operation is emphasized, which involves the construction of large unit plants to reduce the cost of direct labour and supervision. As a result the capital investment in a chemical establishment tends to be much higher than in industry generally, and manual skill is becoming less important in every branch.

Colour Photography in Practice

By Dr. D. A. Spencer. Pp. xvi+275. (London: Sir Isaac Pitman and Sons, Ltd., 1938.) 21s. net.

GOOD colour transparencies can now be made on material readily available in most photographic shops. Colour films are frequently shown in the cinemas, and good colour photographs on

paper are obtainable; but except for the first of these the technique is difficult and requires very great resources of knowledge and equipment in order to produce good results with certainty. The commercial use of colour photography for advertising purposes alone has made it worth while to master the difficulties of reproducible technique and to discover the detail of the operation of the principles of colour photography. Success has not been achieved very long, and there are few workers in colour photography who will not be glad to read this book, which reveals so much of the science behind their craft.

Dr. Spencer treats the subject in relation to the existing successful processes of still photography. He omits colour cinematography altogether on account of its complication and the great space which would be needed for its treatment.

The book is divided into four main parts: Part 1 describes general considerations, including the outline of the principles of subtractive and additive colour photography. It contains also a chapter on lighting and another on the use of colour photographs; Part 2 describes in detail the subtractive methods; Part 3 describes, also in detail, additive methods. Finally, Part 4 outlines the accuracy of reproduction attainable, reproduction of colour photographs by modern illustration processes, and aesthetic considerations.

The widely extended commercial application of photography, and to some extent also the resurgence of its popularity as a hobby, have caused the technical classes in various schools to be well attended. The number of entrants for the City and Guilds examinations in photography also is higher than formerly. The need for better text-books is thus very great. The volume under review will probably be regarded for many years as a standard text-book, combining exceptional clarity of exposition with a readable style in a way which is admirable.

Psychology

Psychology in Everyday Life

By Dr. Walter C. Varnum. Pp. xii + 444 + 16 plates. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 15s.

THIS book is designed for non-professional students of psychology. It will also meet the needs of the inquiring layman.

Written in a perfectly clear and simple style, it presents some of the simpler applications of psychological research in the fields of industry, education and mental health. The author is cautious and restrained, and avoids the sensations and loose generalizations one meets in popular books of this type.

One of the chief merits of the book is that it brings home the utility of much so-called academic experimentation in practical problems. The most satisfactory sections are those on the "Psychology of Learning". Following each chapter is a list of about fifty assertions on topics discussed, which the reader

has to accept or reject as a test of his having mastered the contents of the chapter.

The selection of subjects dealt with in a short work of this kind is, on the whole, a judicious one. Although it is full of factual material and a minimum of discussion this book can scarcely be called a text-book of psychology; but is probably an excellent introduction to the subject for the non-technical student.

J. I. COHEN.

Psychology of Music

By Prof. Carl E. Seashore. (McGraw-Hill Publications in Psychology.) Pp. xix + 408. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 24s.

FROM the preface to this book we learn that it is a logical sequel to the author's "Psychology of Musical Talent". His present purpose is "to stimulate and guide the student of music in scientific observation and reasoning about his art. . . . Since the book is written for beginners, no technical description of apparatus or method is given. . . . Certainly, good service is done by every book which teaches the student of music that his perceptions of musical sounds are not mere reproductions of their physical causes; but, faced with graphs of pulsating frequencies and intensities in a melodic line of music, as performed, the serious student will ask questions that are left unanswered by the author's decision to omit these technical descriptions. The physicist will want to know the nature of the response of the recording instruments, and how they were calibrated. The musician will want to know whether the melodic line was unaccompanied; and, if not, how it was related to its musical context. His question is fundamental; for the foundation of the art of music, as we know it, lies in polyphony.

Seventy-five years ago, Helmholtz directed attention to our ignorance of the psychological section of the theory of hearing. The studies reviewed in this book show how much we have still to learn before the whole story can be told. Meanwhile, not all musicians will accept the whole of the author's postulates as axioms. The book contains a lengthy bibliography, including the titles of papers to which the author refers.

LL. S. L.

Intuition

By K. W. Wild. Pp. vii + 240. (Cambridge: At the University Press, 1938.) 10s. 6d. net.

MISS WILD is to be congratulated on a very readable and careful account of intuition. The whole subject is fraught with difficulties and pitfalls, and it is startling to be presented with thirty-one definitions of intuition.

We cannot help but feel that intuition is in some cases the result of pure chance—when it is regarded as "an abnormal method of knowing based neither on the senses nor on deduction and inexplicable as to its working". There is, as the author wisely points out, much room for research, and possibly the final result of the research may be that there is no such thing as intuition, as some writers would like us to believe about instincts.

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Announcements

PROF. F. G. DONNAN, emeritus professor of chemistry in the University of London, has been elected an honorary member of the Société Philomathique de Paris. This Society was founded in 1788.

THE following have been elected honorary members of the Royal Meteorological Society: Jules Jaumotte, director of the Royal Meteorological Institute of Belgium, Uccle, near Brussels; Prof. Carl-Gustaf Rossby, professor-in-charge of the Meteorological Department, Massachusetts Institute of Technology; Philippe Wehrli, director of the National Meteorological Office of France.

THE Hillebrand Prize for 1938 of the Chemical Society of Washington has been awarded to Raleigh Gilchrist and Edward Wichers, of the U.S. National Bureau of Standards, for their paper entitled "A New System of Analytical Chemistry for the Platinum Metals," presented before the Ninth International Congress of Pure and Applied Chemistry at Madrid.

PROF. EGON RITTER VON SCHWEIDLER, hitherto general secretary, has been made vice-president of the Vienna Academy of Sciences, and Prof. Ernst Spath has succeeded him as general secretary.

A CHAIR of aerology has recently been instituted in the University of Rome and to it will be attached a laboratory for studies and researches in aerology. The first occupant of the chair is Prof. Filippo Eredia, whose address is Istituto di Aerologia, Via Emilio de' Cavalieri, 7 Rome, 108.

DR. BERNARD H. KNIGHT, lecturer in roadmaking in the College of Estate Management, London, has been recently appointed senior research assistant in highway engineering in the University of the Witwatersrand, Johannesburg.

COMPENSATION has recently been made for the use of the University of Bristol botanic garden for building purposes by the provision of another site on the Royal Fort estate. The new garden will be known as the Hiatt Baker Botanic Garden.

THE centenary meeting of the Royal Microscopical Society will be held on October 25-26. Further information will be available later from the Secretary, Royal Microscopical Society.

THE next meeting of the International Society of Cosmobiology will be held during April 9-11 at Mentone. Further information can be obtained from the general secretary, Dr. Maurice Faure, 24 rue Verdi, Nice.

THE Netherlands Congress of Natural Sciences and Medicine will be held at Nymwegen on April 11-13 under the presidency of Prof. G. Holst. Further information can be obtained from the general secretary, Dr. D. Collingh, Regenteslaan, 2, Bussum.

THE eighteenth International Congress of Agriculture will be held in Dresden during June 6-12, when the following subjects, among others, will be discussed: agronomy, crop production, disease, etc.; vines, fruits and special crops; agricultural industries; agricultural research. Further information can be obtained from the general secretary, Dr. F. Sohn, Hafenplatz 4, Berlin, S.W.11.

A PRIZE of £20 and a diploma are awarded annually by the Royal Asiatic Society for an essay, the object being to encourage interest in the history and civilisations of the East among non-Asiatics. It is confined to members of certain universities. Further information concerning subjects for 1939 can be obtained from the Secretary, Royal Asiatic Society, 74 Grosvenor Street, London, W.1.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 438.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The 'Failure' of Quantum Theory at Short Ranges and High Energies

IN Dr. Bhabha's letter in *NATURE* of February 18, reference is made to a breakdown of quantum theory at high energies and short intervals. This seems to be widely interpreted as setting a limit to the validity of our present physical conceptions. Some indeed would associate it with a fundamental discontinuity of structure of space and time. I have no occasion to criticize Dr. Bhabha's letter which, so far as it goes, is opposed to the more extreme interpretations. But I venture to suggest that an unnecessary mystery is being made of what is really an elementary point of relativity theory. In short, we know why the present theory has got into difficulties, and we know what must be taken into account if it is to get out of them.

Relativity theory begins with a denial of absolute motion. Every observed velocity dx/dt is a relative velocity of two physical objects. Likewise the ' x ' of which velocity is the time-derivative is a relative displacement of two physical objects. Both objects are connected with the space-time frame in the way pointed out by Heisenberg; namely, they are not locatable as points (or, in four dimensions, world-lines) but have an uncertainty of position and momentum.

Usually dx/dt and x are assigned to one of the objects (here called the object particle), the other being regarded as a reference body. In precise formulae, the reference body must evidently be a particle. The reference particle is then the physical 'origin' from which the observable co-ordinate x of the object particle is measured. Current quantum theory has repeated the pre-relativity mistake of paying insufficient attention to the definition of the physical reference system to which its exact formulae are intended to apply. It enunciates formulae involving x and $\partial/\partial x$, but omits to specify the standard deviation (uncertainty) of position and momentum of the origin from which x is measured. Clearly, the formulae cannot be true for an arbitrary standard deviation; if true at all, they must hold for a particular standard deviation of position ϵ which ought to have been specified. Since there is no explicit reference, the actual value of ϵ must be implicit in the empirical constants (such as $\hbar/mc$) of the quantum formulae.

When two object particles with co-ordinates x_1 and x_2 are considered, the displacement ξ_1 of one relative to the other is observable independently of any origin of co-ordinates, being the original observable called ' x ' in our second paragraph. This must not be confused with the co-ordinate difference $\xi = x_2 - x_1$, which introduces twice over the uncertainty of the physical origin from which x_1 and x_2 are measured. We have (in the notation of the theory of errors)

$$\xi = \xi_1 \pm \epsilon\sqrt{2}.$$

The failure of current theory is due especially to its omission to distinguish the two observables ξ and ξ_1 .

The physical origin has uncertainty both of position and momentum; for if either were zero the other would be infinite, and the physical origin would not approximate to a geometrical origin with a definite world-line. An energy m_0c^2 corresponding to the mean square of the uncertain momentum is therefore associated with the origin. Except in two-body problems (in which one object particle is used as physical origin for the other) the practice is to treat all the object particles symmetrically; the physical origin must then be an additional *virtual* particle, that is, a particle inserted in the system as part of the apparatus of measurement, but not counted among the object particles, and only taken into account as representing the disturbance of the system which the carrying out of a measurement implies. The energy m_0c^2 belongs to the physical origin contemplated as a virtual particle, and gives it a proper mass m_0 . In order that quantum equations may be definite, the uncertainty constants ϵ and m_0 of the physical origin must have standard values.

Naturally physicists who have neglected the uncertainty ϵ of the origin will find that their equations break down at distances of order ϵ . Nothing has gone wrong with space; it is the theorists who have failed to apply their own principles in relating the observable physical system to space. To state their failure summarily: there are two recognized principles of observability, namely, the quantum principle that an observable *object* has an uncertainty relation to the geometrical space-time frame, and the relativity principle that an observable *quantity* relates to two observable objects. Current theory recognizes these principles separately but not in combination; and in dealing with co-ordinates and momenta it pays attention only to the uncertainty at the object-particle end of the relation.

The remedy is obvious. I do not say that the application of the remedy is an easy matter; but, if it is clearly the thing most worth doing, that will not deter anyone. An astronomer, unable to solve his own 'problem of three bodies', can only admire the success with which physicists tackle the more numerous closely interacting particles of the nucleus. But I think the advance would not be less rapid or less substantial if they gave up using the wrong formulae. My own work¹ (chiefly concerned with the momentum uncertainty m_0) has been confined to extra-nuclear problems; no insuperable difficulty has appeared, though progress has not been easy.

I turn now to the actual values of ϵ and m_0 . A geometrical frame of space-time is not a physical reference system, since its exactitude is incompatible with observability. (To assign infinite mass to the frame, so as to make both its position and velocity exact, would introduce infinite curvature, and defeat its use in a different way.) We turn it into a physical

frame by associating with it uncertainty constants, namely, a particular length ϵ and a particular mass m_0 . (In mathematical treatment we should assign to the frame a wave function describing a probability distribution corresponding to these constants.) These 'put the scale into' physical systems, and all other natural lengths and masses will stand in a definite numerical ratio to them. Since we observe only relative scale, the arbitrariness of the initial choice of ϵ and m_0 is eliminated. From extra-nuclear investigations I have found that m_0 is 10/136 of the mass of a hydrogen atom; and ϵ , which is very simply related to certain magnitudes calculated in cosmological theory¹, has the value $1 \cdot 10 \times 10^{-13}$ cm. (For technical reasons, the constant more usually given is $k_0 = 2\epsilon = 2 \cdot 20 \times 10^{-13}$ cm.)

That the virtual particle of mass m_0 , originally studied in extra-nuclear theory, is the particle now used in nuclear theory under the name of 'mesotron', or 'meson', admits, I think, of no doubt. But whether the usual assumption is correct, that nuclear mesotrons are the same as the actual mesotrons observed in a Wilson chamber, I have no means of judging. Since m_0 and ϵ are conjugate, it is optional which we treat as the more fundamental; but I would point out that to proceed *via* the mesotron mass is a roundabout way of getting at the range of nuclear forces, since the range is an immediate manifestation of the uncertainty of position of the origin. The nuclear force between two protons comes from an energy-singularity occurring when two protons coincide—a sink which (in uniform distribution) just compensates the Coulomb energy occurring when they do not coincide. The condition of coincidence $\xi = 0$ gives $\xi_0 = \pm \epsilon/\sqrt{2}$, which (for the calculated value of ϵ) agrees exactly with the range of force found by Breit, Condon and Present in their discussion of the scattering of protons.

A. S. EDDINGTON.

Observatory,
Cambridge.
Feb. 27.

¹ Eddington, "Relativity Theory of Protons and Electrons", Chapter xi, xii.

² Eddington, *Proc. Roy. Soc., A*, 168, 155 (1937).

Variation of Field Penetration with Temperature in a Superconductor

We have recently completed an investigation of the magnetic threshold fields for thin superconducting films of mercury. The extended magnetic transition curves described in a previous communication¹ have been removed by using in place of a strip of film a circular disk with embedded current and potential leads. In this way, effects due to the diminishing thickness of the film at the edges of a strip are eliminated.

Fig. 1 gives an example of the results obtained. The left-hand scale of ordinates gives the values in gauss of the critical field at half-height at different

temperatures for a film $1 \cdot 2 \times 10^{-4}$ cm. in thickness. The right-hand scale gives the corresponding values of H_f/H_c , where H_f is critical field for the film and H_c is critical field for bulk mercury. To give an idea of the consistency of the results, values for successive films are plotted with different symbols. Values are included for films deposited at various temperatures

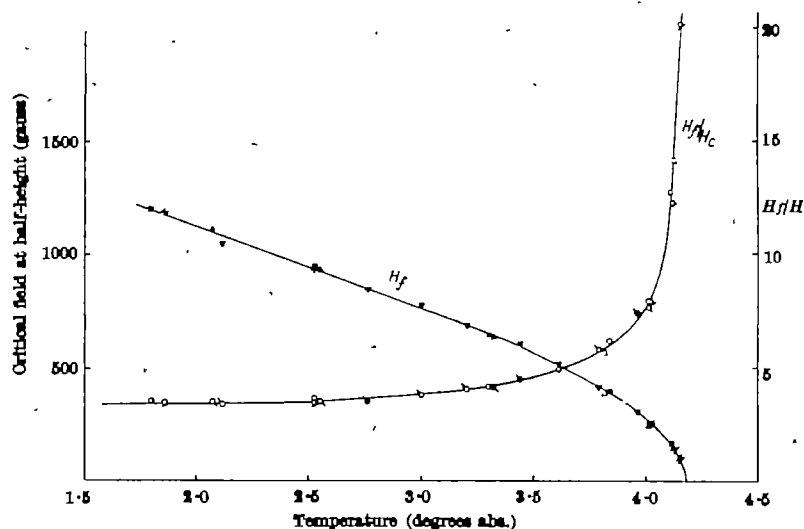


Fig. 1.

and afterwards annealed to different degrees. The agreement shows that we are here dealing with a true size-effect independent of structure.

It can be seen that the field-ratio H_f/H_c rises very steeply in the neighbourhood of the transition temperature and that it seems likely to approach infinity at that point. Unfortunately, there is no complete theory of the threshold fields for superconductors of small dimensions, but it is generally accepted that the critical field will increase rapidly when the conductor becomes comparable in thickness with the depth of the field penetration. We conclude from our experimental results that the field penetration is not constant, but that it increases rapidly near the transition point and may even become infinite there.

In default of an explicit formula, we may assume

$$\frac{H_f}{H_c} = f\left(\frac{d}{\lambda(T)}\right),$$

where d is the thickness of the film and $\lambda(T)$ is a parameter (of the dimensions of a length) which defines the field distribution inside the superconductor.

If we now take two films of thicknesses d_0 and d and find two temperatures T_0 and T at which the values of H_f/H_c are the same, we have:

$$\frac{d_0}{\lambda(T_0)} = \frac{d}{\lambda(T)}, \text{ or } \frac{\lambda(T)}{\lambda(T_0)} = \frac{d}{d_0}.$$

In this way, from a series of experimental curves for film thicknesses varying by a factor of 50, we have built up a rough curve giving the relative values of $\lambda(T)$ at different temperatures. Fig. 2 shows a curve so obtained. Ordinates are ratios of field penetration at any temperature to field penetration at 2.5° K. With one or two doubtful exceptions the points fit on a smooth curve.

If we accept a theory of the London¹ type, this result can be most simply explained by assuming that the number of electrons responsible for superconductivity is small or zero at the transition point and increases rapidly as the temperature is lowered. A similar suggestion was advanced by Gorter and Casimir² some years ago to account for the specific heat anomaly at the transition point.

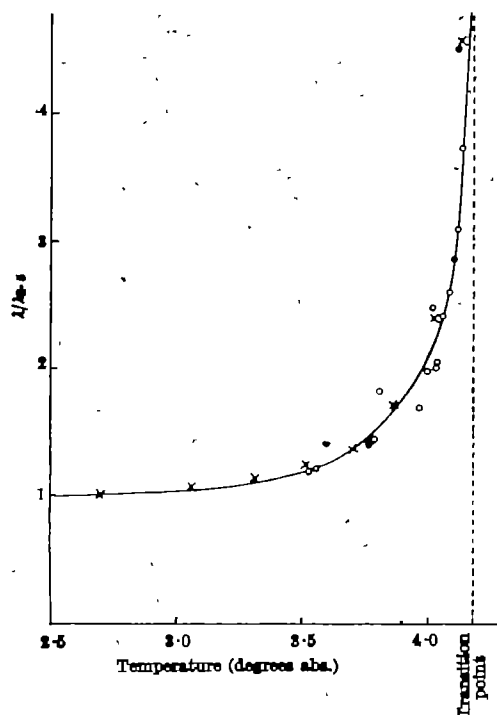


Fig. 2.

○, APPLEYARD, BRISTOW AND LONDON.

×, SHOENBERG'S RESULTS. (See letter below.)

The absolute magnitude of the field penetration can be estimated by making certain reasonable thermodynamic assumptions. With an exponential type of field-distribution, we obtain the relationship

$$\frac{H_f}{H_c} = 1 + \frac{\lambda}{a}$$

for very thick films.

Our results are in agreement with this expression and give a value $\lambda = 1.2 \pm 0.1 \times 10^{-6}$ cm. at 2.5° K., which is of the same order as the rough estimate made by Pontius⁴ using thin wires of lead.

E. T. S. APPLEYARD.
J. R. BRISTOW.
H. LONDON.

Royal Society Mond Laboratory,
Cambridge,
and
Wills Physical Laboratory,
Bristol.
Feb. 6.

¹ Appleyard and Meeson, *NATURE*, 140, 474 (1938).

² London, F. and H., *Proc. Roy. Soc., A*, 142, 71 (1935).

³ Gorter and Casimir, *Phys. Z.*, 35, 965 (1934).

⁴ Pontius, *Phil. Mag.*, 24, 787 (1937).

Superconducting Colloidal Mercury

THE magnetic properties of some colloidal mercury preparations have been investigated by a ballistic method, and provide direct evidence for the existence of a small penetration depth of a magnetic field into a superconductor, and for a temperature dependence of this penetration of the same kind as observed by Appleyard, Bristow and London¹. From the initial slope of the magnetization curve, the magnetic

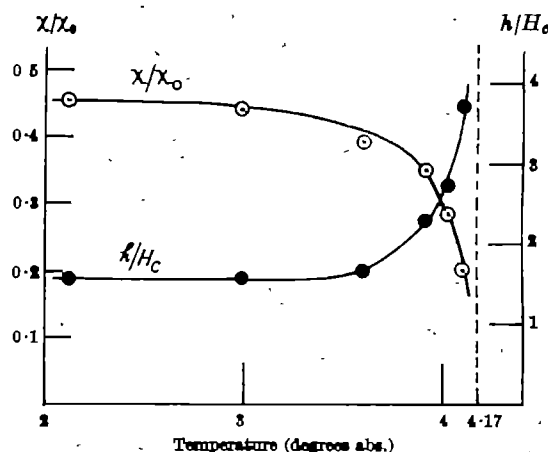


Fig. 1.

moment per unit field per unit volume of mercury (χ) can be deduced for the small spherical particles of the colloid, and this was found to be appreciably smaller numerically than the value $\chi_s = -\frac{1}{3}\pi$ for a large sphere (in which the penetration of the magnetic field is relatively negligible), and to decrease with increasing temperature towards the transition temperature (4.17° K.). This is illustrated in Fig. 1,

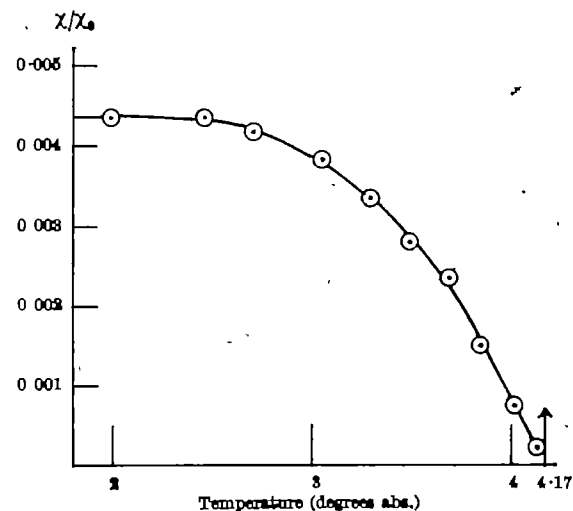


Fig. 2.

which shows the temperature variation of χ/χ_0 for a colloid of mercury in gelatine (average particle diameter of order 10^{-6} cm.). From the magnetization curves, the critical field h was also obtained, as the field at which the magnetization disappeared, and as in the case of thin wires² and thin films³, h was larger than the bulk critical field H_c ; the temperature dependence of h/H_c is shown in Fig. 1.

The fact that χ/χ_0 is less than 1 can be immediately interpreted as due to a penetration of the magnetic field into the particles, to a depth comparable to the particle size, while the fact that χ/χ_0 decreases with increasing temperature must mean that this penetration increases. It will be seen that h/H_0 increases just in the region where χ/χ_0 is decreasing, thus confirming the inference of Appleyard, Bristow and London¹ that this increase is associated with an increasing penetration depth. Similar results were obtained with an emulsion of mercury in chalk, but the effects were less pronounced owing to the larger average particle size.

Measurements were also made with a colloid of mercury in albumen in which the particle size was about ten times smaller than for the gelatine colloid, and the values of χ/χ_0 were now extremely small (Fig. 2), showing that the penetration of the field was almost complete. The critical fields, however, were so large that they could not be reached with the largest field used (900 gauss) even at the highest temperature.

If the law of falling-off of magnetic field into the surface of a superconductor is known, the value of χ/χ_0 can be calculated as a function of r/λ , where r is radius of the sphere, and λ the penetration depth. The London theory⁴ assumes the law to be according to the differential equation $\nabla^2 H = H/\lambda^2$, and with this assumption it has been shown⁵ that

$$\chi/\chi_0 = 1 - 3\left(\frac{\lambda}{r}\right) \coth \frac{r}{\lambda} + 3\frac{\lambda^2}{r^2} \quad (1)$$

which for $r \ll \lambda$ reduces to

$$\chi/\chi_0 = \frac{1}{15} r^2/\lambda^2. \quad (2)$$

Assuming this formula, we have calculated λ/λ_0 as a function of temperature for the albumen colloid, and as can be seen from Fig. 2 of Appleyard, Bristow and London's note, the results agree quite well with those from the thin mercury films, suggesting that equation (2) is of the correct form. At present only the order of magnitude of the average value of r^2 is known, so the absolute value of λ_0 cannot be given exactly; it agrees, however, in order of magnitude with the thin film estimate. It will be noticed that close to the transition point, T_0 , χ/χ_0 decreases linearly with $T_0 - T$, which means that the penetration depth becomes infinite at $(T_0 - T)^{-1/2}$.

In the case of the larger particles, as in the gelatine colloid and the chalk emulsion, the London assumption cannot be tested exactly, since the lack of uniformity of particle size complicates the application of equation (1); this complication does not arise in the case of particles so small that equation (2) can be used. It is hoped to overcome this difficulty by working with a more uniform preparation of known particle size.

In conclusion, it is a pleasure to thank Mr. R. T. M. Haines, of British Colloids, Ltd., for preparing the colloids used in these experiments.

D. SHOHNBURG.

Royal Society Mond Laboratory,
Cambridge.
Feb. 6.

¹ Appleyard, Bristow and London, see letter above.

² Pontius, *Phil. Mag.*, **24**, 787 (1937).

³ Shalnikov, *NATURE*, **142**, 74 (1938); Appleyard and Maesner, *NATURE*, **142**, 474 (1938).

⁴ London, F. and H., *Proc. Roy. Soc., A*, **140**, 71 (1933).

⁵ London, F., *Physica*, **2**, 450 (1936). von Laue, *Ann. Phys.*, **58**, 253 (1938).

Atomic Nuclei in Primary Cosmic Radiation

It is generally assumed that the mesotrons in cosmic radiation are produced by primary electrons in the upper atmosphere, but there seems as yet not to be any direct evidence for such a process. On the contrary, experiments by Jánosy¹ indicate that electrons cannot produce mesotrons with a probability sufficient to account for the intensity of the mesotronic component.

According to a recent theory of the origin of the cosmic rays², these are likely to constitute a more or less fair sample of the charged particles in the neighbourhood of the stars (especially the double stars). This means that the primary cosmic radiation is likely to contain electrons but also a considerable fraction of atomic nuclei with very high energies.

The number of protons or other nuclei observed at sea-level is, however, very small. This might be accounted for by the assumption that incident high-energy nuclei are strongly absorbed when colliding with nuclei in the atmosphere. Such an absorption could be due to a nuclear correspondence to the *Bremsstrahlung*³, which would imply that it is accompanied by the emission of mesotrons. This would explain the origin of the mesotrons in cosmic radiation at the same time. Processes of this kind must be accompanied by nuclear explosions of the kind observed especially at high altitudes. As the frequency of the explosions increases extremely rapidly with the altitude, it is improbable that they are caused by the mesotronic or electronic components.

In order to fit observations, the nuclear absorption cross-sections in air must be at least $\sim 2 \times 10^{-25}$ cm.² which at the energies concerned corresponds to 1.4×10^{-28} cm.² in hydrogen. For the latter, Euler and Heisenberg⁴ give as a preliminary theoretical value $\sim 10^{-28}$ cm.².

HANNES ALFVÉN.

Forakningsinstitutet för Fysik,
Stockholm 50.
Feb. 6.

¹ Jánosy, L., *Proc. Camb. Phil. Soc.*, **34**, 614 (1938).

² Alfven, H., *Z. Phys.*, **107**, 579 (1937); Compare *Phys. Rev.*, **54**, 97 (1938).

³ Euler, H., and Heisenberg, W., *Zyg. d. ex. Naturw.*, **17**, 30 (1938).

Bursting of Glass Tubes by Thixotropic Pastes

In a test for the liquid absorption of light powders, water is gradually added to the powder in a hard-glass thick-walled test-tube fitted with a rubber bung. This is shaken between additions by giving several successive brisk taps each with the closed and the stoppered ends downwards on to a rubber pad until a paste is produced which flows out under certain standard conditions. The tubes, of 155 mm. length and 22 mm. bore, are about half full at the completion of the test.

Occasionally, while tapping the tube stopper downwards, the end of the tube bursts outwards and the main bulk of the paste is violently thrown a considerable distance as a single blob. The pastes are strongly thixotropic (false-bodied) and the bursting occurs at the stage when the paste appears quite fluid during shaking but sets rapidly and will not flow out. On these occasions the operator is not sensible of having used excessive force; indeed,

there is a feeling of surprise that such an effect should be produced by a relatively light action. It is significant also that during tapping a sharp click, resembling the impact of a column of mercury on the end of an evacuated tube, is sometimes heard. This is especially noticed when the paste is shaken down to one end and the tube then inverted and tapped with this end uppermost. This sound cannot be produced with water only in the tube, neither is it possible using reasonable force to burst such a tube containing water.

A singular feature is that in the cases we have noticed the type of fracture is always the same and, as will be observed from the accompanying photograph of four tubes collected in 1938, has a symmetrical character. The first three are Monax and the fourth, on the left, is of combustion quality hard glass. The similarity of fracture reflects the directional properties of the forces acting on the different occasions, and since the tubes are well annealed it is presumed that the axis of symmetry of the fractures is related to the plane in which the tube was moving when it burst. (A recent experience suggests that the two planes are at right angles.)



As a tentative explanation of the bursting, it is suggested that the main body of the paste sets into a piston-like cylinder which slides easily in the tube because it is violently sheared at the surfaces where it becomes fluid—a characteristic of thixotropic pastes. This piston slides downwards on impact and then, absorbing the energy of the blow, rapidly returns as a whole to the upper end. Since the pastes have very high yield values, the piston has considerable strength and is presumably rigid enough to prevent air 'blowing' through it. Thus effectively all the air is confined to the lower end, leaving a vacuum in the upper space, so that the piston on returning to this end impacts violently without the cushioning effect of the air film. Such an impact would be absorbed by the rubber bung, but the rigidity of the glass is such that bursting occurs when the closed end is uppermost.

It would be interesting to design an impact apparatus to test our suggestion as to the importance of the type of paste and to measure the forces involved, but at the moment we have no time to pursue the matter further.

G. W. COWDREY.
MARVYN L. SMITH.

John and E. Sturge, Ltd.,
Birmingham, 15.
Feb. 8.

Flavin Component of the Pyruvic Acid Oxidation System

EVIDENCE for the earlier suggested¹ participation of a flavin compound in pyruvic acid oxidation by *Bacterium Delbrückii* has been obtained by a procedure similar to that used by Warburg and Christian² to remove the prosthetic group (flavin-adenin dinucleotide) from amino-acid oxidase. Phosphate extracts derived from the lactic acid bacteria were repeatedly precipitated with 50 per cent ammonium sulphate at pH 3 at 1–2° C. By this treatment a protein fraction was obtained, which on addition of thiamin (vitamin B₁) pyrophosphate only³, did not catalyse pyruvic acid oxidation, but did so on addition of thiamin pyrophosphate together with flavin-adenin dinucleotide, kindly supplied to me by Prof. O. Warburg.

In the following experiment, 1 ml. of protein solution, corresponding with 0.1 gm. of dried bacteria, was shaken with air for 30 minutes at 37° in the presence of 0.1 mol. pyruvate:

Thiamin pyrophosphate	..	—	15γ	15γ
Flavin-adenin dinucleotide	..	20γ	—	20γ
Oxygen used (ml.)	..	15	5	248

Riboflavin and the 'old' yellow enzyme were inactive.

In the light of our hypothesis that thiamin when acting as coenzyme is reduced reversibly⁴, it is not surprising to find the insertion of a flavin compound between the assumed α -dihydrothiazole and oxygen. We know from the work of Warburg, of Karrer and of v. Euler that compounds of this type (for example, the dihydropyridines) are not autoxidizable, but do easily reduce flavin, which in turn is autoxidizable. Also, it seems significant that in the animal cell the same flavin-adenin dinucleotide has been found^{5,6} to be the prosthetic group of diaphorase⁷ (coenzyme factor⁸), the carrier between pyridine coferments and cytochrome.

This work was supported by the Ella Sachs Plotz Foundation.

FRITZ LIPMANN.

Biological Institute,
Carlsberg Foundation,
Copenhagen.
Feb. 9.

¹ Lipmann, *Enzymologia*, 4, 65 (1937).

² Warburg and Christian, *Biochem. Z.*, 298, 150 (1938).

³ Lipmann and Perlmann, *J. Amer. Chem. Soc.*, 60, 2574 (1938).

⁴ Straub, *NATURE*, 143, 77 (1939).

⁵ Straub, Corran and Green, *NATURE*, 143, 119 (1939).

⁶ Adler, Euler and Heikström, *Sw. Vet. Akad. Arb. Kemi*, 13, 1 (1937).

⁷ Dewan and Green, *Biochem. J.*, 32, 630 (1938).

Present Condition of a Twelve-Year Old Pure Strain of Carcinoma Cells *in vitro*

ON February 23, 1927, five small fragments of a mouse adenocarcinoma (Frankfurt strain of Ehrlich) were cultivated as hanging drop cultures¹. With slight modifications, the culture medium used has remained practically the same throughout this period of twelve years. The medium used for cover-glass cultures consisted of one volume of a plasma mixture (equal parts of chick and rat plasma) and one volume of embryonic tissue juice of chick. For cultures in Carrel flasks, the solid medium was composed of equal parts of dilute chick and rat plasma coagulated by a drop of embryonic tissue juice; the supernatant liquid phase, 0.5 c.c., consists of 20 per cent embryonic tissue juice (chick), 20 per cent rat serum and 60 per cent 'Tyrode' solution.

Research Items

Painted Skulls from Northern Australia

D. F. THOMSON, who was recently engaged in observing conditions among the aborigines of Northern Australia on behalf of the Federal Government, figures and describes in *Man* of January two painted skulls, which were obtained by him in north-east Arnhem Land. The practice, which is found among groups occupying the territory between Cape Stewart on the Arafura Sea and Blue Mud Bay on the Gulf of Carpentaria, is closely bound up with funerary customs and totemic beliefs. The material is transient as the pigment used is mixed with water, and the skulls, after being carried about by a relative, usually a woman, for a period of two or three years, are pulverized with pounding stones. Hence no record is left which might provide a key to further investigation. Great numbers of the painted designs are employed on ceremonial occasions, each group having an appropriate type for painting the bodies at initiation, after death, and later on the skulls, also on grey-bearded men and upon a man some-time after the conclusion of the final ceremony at which he attains the status of full initiation to the totem group. Each group, sometimes bound together by so slender a thread that it can be understood only by study of mythology, owns distinctive patterns. The right to use these is vested in members of the group only and guarded with the most intense jealousy, as it is bound up with the spiritual and social existence of the group. It is believed that the 'marks' were present on the bodies of the ancestors, when they sank beneath the waters at the sacred places marked to-day by water holes, at which the totemic objects are kept, and to which they are returned at the close of the totemic ceremonies. These are also the places from which emerge the shades of the babies when they enter their mother at conception. The significance of the designs is clearly that they are used in rites of aggregation. Hence the painting of the skull is in the nature of a benediction and a consecration.

Statistics of Literary Style

THE science of statistics, originally restricted to problems of the State, has long been extended from demography and economics to biology and psychology, but it is rather surprising to find it applied to problems of literary style and disputed authorship. When the application is made by such an authority as G. Udny Yule and published in *Biometrika* (30, 363; 1938), it cannot be dismissed as a mere curiosity. What Mr. Yule has done is to make an analysis of the sentence-length of certain authors. Thus, for example, Bacon's "Essays" contain three sentences containing 1-5 words, sixteen containing 6-10 words, forty-nine containing 11-15 words, . . . and so on. This forms a frequency distribution, which can be analysed by any of the usual statistical methods. Mr. Yule has selected the mean, median, upper and lower quartiles, interquartile range, and ninth decile. These numbers come out very differently for Bacon, Coleridge, Lamb, and Macaulay. Moreover, if the tests are applied to two fairly long extracts from the same author, on similar subject-matter, they give reasonably consistent results. This seems to show

that sentence-length can be taken as a characteristic of the author's style. As an example of the application of these methods, it is shown that the style of "De Imitatione Christi" is consistent with that of Thomas à Kempis, but not with that of Gerson, to whom the work was sometimes attributed. Similar objections are raised against attributing the authorship of "Observations upon the Bills of Mortality" to Sir William Petty.

Habitat of the Lapwing

THE Edward Grey Institute of Field Ornithology, Oxford, has issued in booklet form a hundred pages of reprints from *British Birds* covering the 1937 lapwing habitat inquiry conducted by E. M. Nicholson with the co-operation of fifty-five observers in twenty-six English and one Welsh counties. It did not appear that different geological formations or soils influence very substantially the distribution of this species (*Vanellus vanellus*), but it was not found breeding freely much above 1,200 ft., and steep slopes are generally avoided. The most frequent habitat types are newly ploughed land, fallow and stubble, and fair permanent pasture above alluvial level. Tidal beach or shore, margins of salt or brackish standing water, bare peat and rabbit warrens are little used, and dry shingle, bracken moorland, bare stony mountain, urban public parks and playing fields, scrub with trees and bushes and woodland clearings were avoided. Farming, burning and flooding cause substantial changes in their haunts. Material collected for nesting shows no apparent preference between a wide range of different habitats; flocks may occur at all seasons but are largest in the second half of the year, feeding or roosting in all weather conditions at all times of the day, resting birds often pecking closely in some hollow or sheltered slope. Heavy passing traffic and farm workers' movements have little effect upon the bird, nor do wild mammals, birds and livestock have much noticeable effect, but some parasitism by gulls was noted. The lapwing is essentially a bird of the soil, it is noted, and therefore closely linked with agriculture. It is stated there is still scope for further study, including intensive survey work on limited areas, study of flocks over large areas, fifty-field samples at different periods, study of daily time-tables for the species, and study of its diet in relation to other factors. There is appended an important ecological survey by M. D. Lister of the lapwing population on a 225-acre Epsom (Surrey) arable farm, showing annual fluctuations and relations to crops.

Division of Labour among Asiatic Ants

THE workers of the Asiatic carpenter ant, *Campenotus japonicus* var. *atrimus*, differ greatly in size, but form a continuous series from smallest to largest, although there are some slight morphological differences among them observable, for example, in the proportions of the head. In a series of field observations, Juishuan Lee has endeavoured to classify the activities of the workers in relation to the size grade of the individuals (*Peking Nat. Hist. Bull.*, 13, 137; 1938). The results show that specialization is much less marked than in some species, for every worker

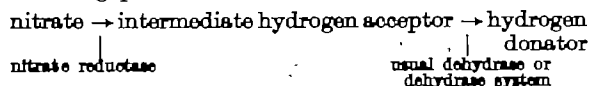
class was found to share in all kinds of work within the colony. The only difference was that certain activities were performed predominantly by one particular class. Thus large workers took most part in work requiring strength and courage, such as fighting, foraging, guarding and exploring, and also in food regurgitation, which is probably related to foraging. The small workers are most active in carrying, foraging, building, tending the young and carrying the jumping plant-louse. The intermediates are active in all sorts of labours, but always to a moderate extent, neither most active nor most indifferent. Division of labour, therefore, has here no definite specialized castes, but is exhibited as a matter of degree whether expressed in size or in activities.

Response of Leaves to Gravity and Light

LEAVES of terrestrial plants usually tend to orientate themselves so that the upper surface of the lamina is perpendicular to and facing unilateral light. Their reaction to gravity tends to bring the lamina horizontal. The combined stimuli of light, gravity and any others result in a position effecting a compromise. W. Neilson Jones has recently carried out some interesting comparative work on this subject, using the leaves of the terrestrial *Tropaeolum majus* and the floating leaves of *Limnanthemum peltatum* (*Ann. Bot.*, New Series, 2, No. 8, 819; 1938). He found that the leaves of both plants tend to orientate their laminae in relation to gravity by curvatures of the petioles in such a way as to bring the laminae into a horizontal plane. On the other hand, leaves of *Tropaeolum majus* are also sensitive to unilateral illumination, whereas those of *Limnanthemum peltatum* are not. This reaction to light, he claims, may be expected on biological grounds as a general difference between aerial and floating leaves.

Bacterial Reduction of Nitrates

The mechanism of nitrate reduction in *Bacterium coli* (*Escherichia communior*) has been investigated by Syunji Yamagata ("Über die Nitratreduktase von *Bacterium Coli*", *Acta Phytochimica*, 12, No. 2, 283; Oct. 1938). Several research workers have maintained that the reduction of nitrates is accomplished by the usual dehydroase system of the bacteria. The present experiments with cell-free enzyme preparations show, however, that the reduction is accomplished by two separate enzymes, according to the following plan:



The two enzymes are shown to be separate mainly upon their varying reactions with potassium cyanide.

Accuracy of Direction Finders

On March 1, R. L. Smith-Rose, of the National Physical Laboratory, presented a symposium of papers on direction finders to the Wireless Section of the Institution of Electrical Engineers. The first paper on the subject describes an improved medium-wave Adcock direction finder, and was published in 1937 (*J. Inst. Elec. Eng.*, Nov. 1937). Since that date, four papers have been published in the *Journal* and a further one by W. Ross was read at the meeting, all of which discuss direction finders used in wireless.

In the operation of radio-direction-finding, the user is generally faced with the problem of effecting the best possible calibration of his instrument which circumstances permit. Ideally, an overall calibration would be made by setting up a transmitter at known points in the sector and at the distances for which the direction finder is required to be used. Mr. Ross explains how this is not always possible and the expedient of using calibrations made at one particular distance for transmissions from all distances frequently leads to errors. Part at least of the error revealed by calibration, as for example, the error arising from changes in the medium in which or over which propagation takes place is frequently found to vary considerably with distance. That part of the error which arises from the instrument itself is a constant and if known could always be allowed for accurately. If an ideal overall calibration is not possible, it is best, as a rule, to allow for the instrumental calibration only. The errors due to various causes are discussed mathematically and it is shown how the results obtained can be applied practically. In particular, the case of a four-aerial Adcock direction finder is considered at length. The effects of ground attenuation have been neglected, but on very poor sites the radiation component of the electric field from a short vertical radiation will attenuate with distance more rapidly than inversely as the distance, which has generally been assumed throughout the analysis. The papers presented at this meeting should be a great help in increasing the practical accuracy of direction-finding in navigation.

Galactic Rotation

G. L. CAMM has recently issued a paper entitled "A Study of Galactic Rotation, based on the Velocities of the Planetary Nebulae" (*Mon. Not. Roy. Astro. Soc.*, 99, 2; 1938) in which he analyses the radial velocities of the planetary nebulae to discover the relation between the angular speed of rotation of the galaxy and the galactic radius. A knowledge of the distances of the nebulae is essential and the method adopted was to use angular diameters and apparent magnitudes, treating them as equally reliable indicators of distances. The method is admitted to be too crude to make any allowance for interstellar absorption or for the effects of selection; but the author shows that the former is of little consequence. From Table 1 it appears that, though the planetary nebulae are close to the galactic plane, they are affected by interstellar absorption to a very small extent. From the analysis of the radial velocities there are deduced values for the constants of solar motion, the distance and direction of the galactic centre and also a constant K-term. The proper motions of twenty-one planetary nebulae determined by van Maanen were used to find the linear speed of rotation at the distance of the sun; but the result is unsatisfactory owing to the fact that the proper motions are too few. On the assumption of a linear speed of 275 km./sec. at the sun's distance, the variation of the gravitational attraction of the galaxy is shown to be similar to that arising from a thin circular disk, its density decreasing uniformly outwards, and a massive nucleus existing at the centre of the disk. It is interesting to notice that the best agreement between this model and the observed radial velocities of the planetary nebulae is obtained if the mass 0.76×10^{11} is assigned to the nucleus and 1.01×10^{11} to the disk, the mass of the sun being the unit.

British Industries Fair

AS year succeeds year, the visitor to the British Industries Fair, on the lookout for exhibits of scientific interest, finds the range and variety ever greater. Looking back over a period of years, he cannot fail to be struck with the emergence from time to time of entirely new industries, the fruits of scientific research and discovery. Not only so, but also the scope of long-established industries is being continually widened, as new products or new applications of old products are discovered. As one goes through the specifically scientific exhibits or exhibits possessing some scientific interest, one can picture the character and the extent of the prolonged scientific research that must have preceded the eventual production of the materials or articles exhibited.

The chemical industry in particular each year brings before the visitors to the British Industries Fair new products and long-established products manufactured to a still higher degree of purity, to meet modern needs. It may also be remarked that the art of displaying the exhibits seems to improve each year, although the writer noticed in a few cases a tendency, perhaps, to elaborate the framework at the expense of the exhibit framed. On the whole, however, this year marked a distinct advance in what may be called the informative and educative value of the exhibits. For example, this year's main stand of Imperial Chemical Industries, Ltd., at Olympia, consisted of a well-set-out diagrammatic exhibit dealing with the production of ammonia and its varied uses. Displays dealing with water sterilization, the preparation of rubber latex, refrigeration and metal production exhibited the uses of ammonia in its anhydrous form. The uses of ammonia liquor were indicated by references to the manufacture of cuprammonium silk, to toilet ammonia preparations and to laundry and textile processes. Among other sections of this comprehensive exhibit were those dealing with the uses of ammonia converted to cyanide—fumigation by hydrocyanic acid, gold extraction and case hardening—and of ammonia as urea in the manufacture of plastics and in the pharmaceutical trade.

On the stand of Boots Pure Drug Company, Ltd., was a large diagrammatic chart, showing stages in the manufacture of fine chemicals from coal tar. Among organic reagents for metals, Hopkin and Williams, Ltd., showed resacetophenone (dihydroxy-acetophenone), a reagent for iron, and dimercaptodithiodiazole, a reagent for bismuth, which has now been recommended for the determination of lead tetraethyl in petrols. They also showed for the first time a group of fluorescent indicators, which are recommended for the determination of acidity or alkalinity of strongly coloured solutions which inhibit the use of visual indicators.

Turning to the grouped exhibits of the scientific instrument manufacturers, these, as in the last few years, formed one of the outstanding features of Olympia. It is impossible within the limits of this article to do more than direct attention to a few of the novel products shown this year. Ross, Ltd., exhibited a very remarkable wide-angled survey lens, recently produced. It has an angle of 96° and consists of a five-lens system, in which the separation between

the component lenses is $1/1000$ in. The lenses are not cemented but held in position by special clips, in order to avoid strain that might be set up by the use of a cemented lens at high altitudes where very low temperatures prevail. Moreover, the system is mounted in stainless steel having a coefficient of expansion equal to that of the glass, so as to avoid any possibility of strain or deformation due to differential temperature changes. As to the performance of this lens, a photograph was exhibited taken from a height of 20,000 ft. covering 40 square miles of London with one exposure, all the streets and main landmarks being easily recognized by the naked eye. This lens is a remarkable achievement, of which the British optical industry may well be proud. It is made of $3\frac{1}{4}$ in. focus upwards and is priced from £250 upwards. Ross, Ltd., also showed a new, extremely lightweight prism binocular with extra-wide field. The effective diameter of the object glass is 30 mm. with a real field of view of 9° and an apparent angle of 63° , and the instrument is provided with central focusing by screw adjustment.

Charles Baker showed a new micrometer measuring microscope, with a travel of 300 mm. (12 in.), reading to 0.01 mm. direct and by estimation to 0.0025 mm. The microscope is mounted on two accurately ground, stainless steel bars on the kinematic principle. The stage is also mounted on the kinematic principle and has coarse and fine adjustment in the vertical direction.

Cooke, Troughton and Simms, Ltd., showed a new geodetic level designed for the Ordnance Survey in conjunction with Major Hotine of that Survey. The body of the telescope is made of metal having the same coefficient of expansion as that of the glass incorporated. The focal length is 13 in. and the aperture of the object glass 2 in. The main spirit level—a split bubble—is read in the field of view of the telescope by the coincident method.

E. R. Watts and Son, Ltd., exhibited a new theodolite, having the following novel features: short but powerful telescope, glass instead of metal circles, the use of an optical micrometer for reading the subdivisions, an optical plummet incorporated in the body of the instrument, and the complete enclosure of the circles and optical system.

Among the exhibits of R. and J. Beck, Ltd., was a combined binocular and monocular microscope, having an inclined eyepiece. It contained means for varying the inter-ocular distance and for the change-over to the monocular without dismantling the lenses. They also showed a new model of the Hart-ridge reversion spectroscope, designed specially for the physicist. It has a symmetrical slit and is graduated to read direct into Angström units.

Among the exhibits of W. Watson and Sons, Ltd., was an apparatus known as the 'library reader'. By means of a camera a photographic record of, say, a 500-page book can be taken on only 30 ft. of standard cine film. The film can then be projected on to a screen to be read conveniently. One purpose of this apparatus is to render accessible to serious students unique manuscripts and precious early editions of books possessed by libraries, where it would be inconvenient to allow the actual books to be used.

Adam Hilger, Ltd., showed a photometric colour comparator. Its main use is for the maintenance of colour uniformity or the matching of specimen colours in various industries. It makes use of polarizing laminae, the planes of polarization of which are mutually perpendicular. It is not suggested that this instrument can take the place of a colorimeter of such precision as the trichromatic colorimeter, or of an accurate spectrophotometer, but for the diagnosis of colour faults and for colour standardization within the factory it is claimed to be of great practical value. Messrs. Hilger also showed a projection spectrum comparator. This instrument projects the images of two spectrograms—the spectrum to be interpreted and the standard spectrum—in juxtaposition upon an easily viewed screen, and so avoids monocular observation through an eyepiece. This firm also showed a spectrograph having a flat focal field, so that no adjustment of focus is required for any part of the spectrum. An incidental advantage of the flat photographic plate that may consequently be used is that the thickness

of the glass does not matter and the spectrograph is no longer restricted to the use of thin plates.

The most prominent feature of the scientific instruments exhibit, and the one, perhaps, which aroused most interest in the visitors, was the anti-aircraft predictor. This instrument computes mechanically for anti-aircraft purposes the position of an approaching target, such as a hostile bomber. It will be realized that the speeds of modern aircraft are such that it may be necessary to direct the gun as much as two miles ahead of the path of the bomber, if the projectile is to hit the 'target'. The target must be visible to the observer and, therefore, at night must be 'caught and held' by the searchlight. The telescope of the predictor is then laid on to the target and follows it, and as it does so the instrument shows automatically the position and other data required and feeds the gun crew automatically and simultaneously with all the necessary information for firing, including even directions for the adjustment of the shell fuse. To the lay visitor it must have seemed almost like black magic.

Microtechnique in Organic Chemistry

A SURVEY of the most important advances in organic chemistry during the last ten or fifteen years shows that these deal very largely with the chemistry of naturally occurring products. Perhaps the most striking developments are the determination of the structure of the principal vitamins, the very existence of which was debatable fifteen years ago, and the elucidation of the nature of the sex hormones and of the plant growth substances (auxins). No less important, if less spectacular, work has been done on new alkaloids, plant pigments, insecticides and triterpenes.

A point which cannot fail to strike the observer is that the quantities of material available for these investigations are of necessity extremely small. Thus the total amount of auxin used by Kögl in the elucidation of its structure was of the order of one gram, yet the molecule of this compound contains eighteen carbon atoms; and the majority of the other hormones and vitamins are equally or more complex.

These investigations were only made possible by the development in the course of the last two decades of a number of new experimental methods, which have revolutionized the technique of organic chemistry; thus it is now possible to carry out analyses on quantities of about 1/50 of those formerly required, whilst the degree of accuracy and reliability attainable is definitely greater.

In view of what has been said, the symposium on microtechnique held by the Chemical Society on March 2 was particularly timely and a number of new advances were discussed by specialists.

Prof. I. M. Heilbron opened the discussion and gave a general survey of the methods available to the investigator. Of these, quantitative analysis is perhaps the most important; it is to-day possible to carry out exact estimations of carbon and hydrogen, nitrogen, sulphur, halogens and the metals using 2–3 mgm. of material. Molecular weights can be rapidly determined on even smaller amounts of material by Rast's cryoscopic method, and functional groups, such as acetyl, methoxyl and *N*-methyl, can all be determined

on quantities of not more than 5 mgm. Active hydrogen can be estimated by the micro-Zerevitinov method, while the modern methods of titration are extremely accurate and can be successfully applied to such compounds as the resin acids and the saponins of the C_{30} groups. Finally, the degree of unsaturation can be quantitatively estimated and an apparatus for this purpose, designed for quantities of 1 mgm. or less, was described by Dr. H. Jackson. An improvement of Pregl's microcombustion apparatus, in which rubber connexions have been entirely eliminated without making the apparatus fragile, was demonstrated by Mr. W. F. Boston.

Absorption spectra provide a purely physical method of observation which can be of the greatest service to the chemist, as Prof. Heilbron showed on several striking examples, and necessitates only minute amounts of material. The method is particularly valuable for ascertaining the number and arrangement of unsaturated centres in the molecule; it is indispensable when dealing with the vitamins of the A and D groups, carotenoids, etc. Thus, the constitution of myxoxanthin, $C_{40}H_{54}O$ was established by Heilbron and Lythgoe with considerable certainty on the basis of its absorption spectrum although less than a gram of the pure substance was available. The existence of a new vitamin peculiar to the liver oils of freshwater fish was discovered by the spectrographic method and later confirmed by chemical means. At times it is also possible to decide between two alternative types of ring structure, as in the recent instance of α -tocopherol; the extinction coefficient of this compound was found by John to be consistent with a chroman and not a coumaran skeleton.

The determination of molecular weights of solids can be carried out on less than 1 mgm. of material, provided one or two good crystals are available, by an X-ray method which was described by Mr. D. Riley working with Miss D. Crowfoot. The method depends on the accurate determination of certain constants, namely ρ , the density of the solid, V , the volume of the unit cell in the crystal, and n , the

number of molecules in such a unit, when the relationship $\rho = nM/V$ enables us to calculate M (the mass of the individual molecule or the molecular weight $\times$ the mass of an atom of hydrogen); n is, of course, a whole number which is dependent on the arrangement of the molecules in the unit cell and can be readily ascertained by a preliminary calculation. The order of accuracy attainable is such that even the number of hydrogen atoms, always an uncertain figure when dealing with large molecules, can be determined; Mr. Riley showed how the new method has been applied to such compounds as the esters of α -tocopherol.

The application of monomolecular films in solving constitutional problems was discussed by Dr. J. Schulman in the absence of Dr. E. Stenhagen. He referred to the new method of Langmuir and Blodgett, which consists in spreading a monomolecular film on water and, by alternately dipping and withdrawing a metal plate, depositing successive 'monolayers' on the metal surface, thus enabling their thickness to be measured by an optical method. From the surface potential and apparent dipole moment measurements it is possible to draw conclusions about the nature and position of the polar groups in the molecule. The area occupied on water gives a measure of the cross-section of the molecule and it is often possible to make deductions as to the shape of the molecule, such as the extent to which a long chain is branched, which would only be possible as the result of elaborate degradation experiments. This was particularly well exemplified by the recent beautiful work on phloic acid, a toxin derived from the tuberculosis bacillus; the results provide a starting-point for synthetic work in conjunction with biological tests.

Chromatographic adsorption, which was discussed by Dr. A. H. Cook, was discovered by Tswett so long ago as 1906, but its usefulness was not appreciated until it was recently reintroduced by Kuhn, Winterstein and many other workers for the separation of carotenoids. It is essentially a preparative method and its vast scope is only just being realized. In principle it depends on the fact that many substances of comparable solubility in a given solvent differ greatly in their capacity for being adsorbed on a variety of inert materials such as alumina. When a solution containing such substances is allowed to run through a column of the adsorbent, the most readily adsorbed substance is retained nearest the top and the least readily adsorbed is found at the bottom or goes right through. With coloured compounds, such as carotenoids, it is easy to observe the process of adsorption, since rings or zones of colour are produced; the adsorbed substances can then be eluted by changing the solvent or by cutting the column up into sections and extracting each separately. The adsorption of colourless compounds can sometimes be followed by means of ultra-violet light or the zones can be made visible by adding a coloured 'indicator'—a dye of the same degree of adsorbability as the required substance. This ingenious variant of the method was used by Brockmann in the isolation of vitamin D₂ from fish liver oils. The chromatographic method is also extremely useful for the purification of countless organic compounds and has the advantage that practically no material is lost; it can be used on an almost microscopic scale, as in Schöpf's isolation of the colouring matter of butterflies' wings, or adapted to large-scale work.

G. A. R. Kox.

Steel Castings

A SESSION of the adjourned Autumn Meeting of the Iron and Steel Institute was devoted to a consideration of the extremely important third report of the Steel Castings Research Committee.

After a short introduction, Section 2 deals with the fluidity of iron-carbon and alloy steels, by Prof. J. H. Andrew, G. T. C. Bottomley, W. R. Maddocks and R. T. Percival; together with other contributions on the Ruff test by T. R. Walker and R. J. Sarjant and T. H. Middleham. The fluidity tests carried out with the standard spiral mould described in the second report of the Committee have been extended and it is evident that in this type of test temperature is the all-important factor, composition itself playing a minor part. An outstanding feature of this paper is the serious attempt made to correlate fluidity with the liquidus and solidus curves. In the Ruff test, where the test piece is a straight rod, there are certain points of difference. As an example, the markedly greater fluidity of Swedish charcoal iron as compared with that of Armco iron of similar composition, indicates strongly that the difference in oxidation of the melt is a by no means unimportant factor. The influence of oxygen is also shown in the erratic results which are obtained when deoxidants, such for instance as aluminium, are added to the steel. Trials of the test have also been carried out on an industrial scale in a large steel foundry, the results indicating that this method of measuring

fluidity gives reproducible results which are sufficiently accurate for practical purposes.

Section 3 deals with a report by Martin Alexander on copper-containing steel castings. The effect of 1 per cent of copper has been investigated in cast steels of widely different composition. The results indicate that this metal is a valuable alloying element in such materials. It improves the mechanical properties of the annealed steel and renders the castings susceptible to a hardening treatment which can be carried out at a temperature below the critical range without distortion or the setting up of internal stress. The full effect of the temper-hardening treatment, however, cannot be employed with advantage on account of the accompanying embrittlement. To avoid the undue fall in impact strength it is necessary to provide a sufficiently tough matrix by keeping the carbon content low and to re-heat the casting to a temperature higher than that giving maximum hardness in order to cause some coalescence of the precipitated constituent.

Section 4 is concerned with the strength and ductility of cast steel during cooling in sand moulds from the liquid state. The author, H. F. Hall, has devised a most ingenious, and apparently successful means of determining the susceptibility of the material to give contraction cracks. The test piece is so designed that at some position within it the temperature during cooling is maintained above that of the remainder of

the bar, while a tension is induced at an early stage by the special design of the end conditions.

Section 5, which represents the first report of the Moulding Materials Sub-Committee and extends to something like 120 pages, is a remarkable achievement for the time this Committee has been at work, and certainly represents the most important contribution yet made to the scientific and technological study of moulding sands for steel castings.

The report ends with a bibliography of some ninety pages dealing with the manufacture, properties and testing of steel castings, prepared by the Library and Information Department of the Institute. To all who have been in any way concerned with the work for, and the preparation of this report, wholehearted congratulations may be offered.

Economic Policy in the Twentieth Century

A BROADSHEET, "Twentieth Century Economic Policy", recently issued by P.E.P. (Political and Economic Planning), directs attention to the need for guiding patterns to replace the one-sided patterns of *laissez-faire* and nationalism. The broadsheet largely summarizes the attempt to provide the essentials of such a pattern which are set forth in a memorandum prepared by Prof. N. F. Hall, director of the National Institute of Economic and Social Research. Measures adopted to maintain the volume of employment have checked improvements in the standard of living and new policies are required to raise the several national standards of living without in the process setting up intolerable strains. Recent scientific advances, moreover, justify the assumption that there is a minimum physiological standard of living which can be roughly measured and which is a necessary condition of progress in other directions. The satisfaction of minimum physiological needs can be set as an immediate goal for economic policies without sacrificing other values provided the methods adopted do not infringe individual freedom.

Economic adjustment demands increasing efficiency in the older lines of production to liberate resources and particularly labour for new enterprises. The standards now available for nutrition supply a definite basis for assessing advances and setbacks as regards food. Less exactly approximate minimum standards can be ascertained for clothing, house space, and equipment necessary for physiological well-being under different conditions of climate, etc. The first step towards stable national and international progress is therefore to draw up common standards of a broad and simple character and survey the deficiencies of different countries and regions. Not only is it becoming possible to determine such minimum standards but also to forecast the actual demand for the various products in given conditions of price, income and knowledge. The key to expansion of demand lies in the relation between money incomes of consumers and the unit prices of basic necessities, which determine how much purchasing power will be available to raise consumption of all classes of goods above the level necessary for mere survival.

The cardinal aim of economic policy should thus be to reduce costs and prices of necessities, setting free margins of purchasing power which will in turn lead to reductions in the price of semi-luxuries.

Science News a Century Ago

The Statistical Society and Vital Statistics

In the annual report of the Council of the Statistical Society, read at the anniversary meeting on March 15, 1889, it was stated that the Committee on Vital Statistics was still engaged in collecting data from which may be deduced the laws of human mortality. With regard to a collection of the experience of the numerous insurance societies, the circulation of the Committee's forms among the several offices had had the effect of inducing a committee of actuaries to renew the prosecution of a previously contemplated plan for collecting the desired information. Such a committee obviously possesses peculiar facilities for the task, the report said, and as the Council had received the strongest assurance that the actuaries had the same object in view as the Society, to which they had promised to communicate the results of their labours, the proposed inquiry had been abandoned. But the Council had received some valuable returns from various medical establishments in reference to the subject, and the forms of registry suggested by the Council had been adopted in important public institutions.

Stephen Peter Rigaud, F.R.S.

On March 16, 1839, the Oxford astronomer Stephen Peter Rigaud died at the house of his friend Benjamin Lewis Vulliamy, the clockmaker, in Pall Mall, London. Descended from a family of French Protestant refugees, he was born in Richmond, Surrey, on August 12, 1774, his father being Stephen Rigaud (d. 1814), who for many years assisted the Rev. Stephen Demainbray at the King's Observatory at Kew. In 1791, at the age of seventeen years, Rigaud entered Exeter College, Oxford, and he spent practically all the rest of his life at the University. Graduating in 1797, he became a fellow of the College, a tutor and examiner. In 1810 he succeeded Abraham Robertson in the Savilian chair of geometry and was again Robertson's successor in 1827 in the Savilian chair of astronomy, and this he held until his death. Described as "a laborious student, widely read, no mean conversationalist and a copious correspondent", he is remembered for his work as a mathematical antiquary and bibliographer.

The Polypi of the Mediterranean

"The observations of M. Milne-Edwards on the Polypi of the Mediterranean," said the *Athenaeum* of March 16, 1889, "have induced him to conclude, that the horny cartilaginous or calcareous coverings which envelope them, far from being mere external crusts, without any organic connexion with the animals, which produce them, are integral parts of these beings, and consist of an organised tissue, the substance of which is more or less charged with horny or calcareous matter deposited in it; and the nutrition of which is effected by intussusception. Among all these animals there exists a tendency in their tegumentary and reproductive parts to become hard, and the degree of solidification which these parts attain is the only character by which zoologists can class them, as naked polypi, flexible polypi, etc."

Prof. Henri Milne-Edwards (1800-1885), who was the son of an Englishman, filled the chairs of entomology, zoology and physiology at the Jardin des Plantes, Paris.

Societies and Academies

Paris

Academy of Sciences (C.R., 208, 397-472, Feb. 6, 1939).

- P. LEJAY: Study of the ionosphere at Shanghai: observation of frequency changes of waves reflected by the ionized layer.
- J. MARCINKIEWICZ: The problem of moments.
- G. MALHOTRA: Mendelian laws and homogamy. A mathematical discussion.
- F. S. I. BALAGUER: A class of transformations of some summability formulae.
- V. A. KOSTITZIN: Compatibility of stable singular points of some algebraic differential equations.
- H. CARTAN: Inequalities between the maxima of successive derivatives of a function.
- R. D'ADHÉMAR: Mayevski's two equations: remark on the exclusive use of the second.
- M. SÉDILLE: Axial compressors and the influence of flow.
- L. ESCOFFIER: Discharge at the downstream end of a weir barrage.
- R. REULOS: Maxwell's equations and the *séries de tourbillons*.
- M. SCHÉRRER: The Pirani gauge: improvements in its use.
- A. ROGOZINSKI: New method of stabilization of an electrometer lamp.
- R. WARNECKE and MILLE. M. LORTIE: Secondary emission of beryllium.
- J. YVON: The ray of the electron.
- A. MICHEL and MILLE. M. GALLISSOT: Relation between the magnetic susceptibility and interatomic distances of hydrogenated palladium. Susceptibility and other properties are unaffected by degassing at low temperatures either PdH_4 or PdH (prepared by hydrogenation at -40°). Difference of susceptibility with hydrogen content seems to be due to change of interatomic distance.
- R. DE MALLEMANN and F. GUILLAUME: Magnetic rotatory power of electrolytic ions.
- J. COURNOT and MILLE. L. HALM: Corrosion of assemblies [of metal parts]. Results with an ultra-light alloy containing 1.8 per cent manganese.
- P. SUE: Formation of sodium meta-niobate from niobium tetra-oxide and oxygenated salts of sodium.
- MILLE. M.-C. BAILLY: Reversibility of the glycerophosphoric transposition.
- F. CAUFOLLE: Thermal decomposition of nickel and cobalt formates.
- L. ROYER: Existence of pleochroic haloes in gneisses of the Algerian massif and the geological consequences which follow from it.
- E. A. DE LA RUE: Geological results of an expedition to the coast of French Somaliland.
- A. BONTÉ: Origin and genesis of Oxfordian iron ore of Neuviy (Ardennes).
- A. VIBERT: New formulae for calculation of yield of [subterranean] sheets of water.
- H. HUBERT: African origin of a disastrous tropical cyclone in the region of New York [Sept. 21, 1938].
- S. MAXLOUM: The annual components of the rain in Syria and in the Lebanon. There are two regimes, coastal and interior; a map is given.
- R. GARRIGUES: Action of colchicine and of chloral on the roots of *Vicia Faba*. The former influences

metabolism without changing cellular structures; the latter upsets the structure of the nucleus. Both inhibit cell multiplication.

P. C. DE BAILLON: Parthenogenesis of the Tettigoniidae (Orthoptera).

W. RIESE: The choroid plexus of newly born bears (*Ursus arctos*).

J. WOLFF: New observations on some biological phenomena of oxidation and of reduction. A substance obtained by benzene extraction of dried green plant material is used as a sensitizer of absorbent paper moistened with a solution of orcein. The orcein is oxidized in sunlight and the oxide reduced again by interposition of an opaque body.

A. BESSEDKA: Antitetanus serotherapy by the cutaneous route. Antitetanus serum applied to the scarified skin of a guinea pig is completely effective. If the skin is not scarified, it seems to be partially effective.

Brussels

Royal Academy (*Bull. Classe Sci.*, 24, No. 12, 1938).

- B. GAMBIR: A configuration of three conics.
- M. LINSMAN: Certain topological involutions (2).
- R. BAILLY: Use of the infra-red in the study of minerals. Description of apparatus for the determination of the refractive indices and other optical properties of minerals with the aid of infra-red radiation. Results for stibnite and molybdenite.
- J. E. VERSCHAFFELT: Application of the principles of thermomechanics to fluids in steady motion.
- P. VAN RYSSSELBERGHE: Note on the energetics of photo-chemical, chemiluminescent and electrochemical reactions.
- R. VANDENDRIE: Multiple aspects of sexuality in mushrooms.

Prague

Czech Academy of Sciences and Arts, November 25.

- Z. BAŽANT: Theory of a cylindrical wall with a variable radial pressure.
- J. KOMÁREK: A supplement to the problem of gut myiasis.
- J. MILBAUER: Catalysts for the reaction of acetylene with sulphuric acid.
- J. MILBAUER: An anomaly in the system acetylene, sulphuric acid, selenium and selenium dioxide. At 100°C . selenium dioxide acts as a positive catalyst in being reduced by acetylene to selenium and oxidized by sulphuric acid to the dioxide.
- J. MILBAUER: Two cases of the equilibrium of selenium and its dioxide in catalysis of the reduction of sulphuric acid.
- V. HOVORKA: The estimation of molybdenum by vanilidene - benzidine.
- V. HOVORKA: Estimation of tungsten by vanilidene - benzidine.
- V. HOVORKA and V. ŠÝKORA: Isonitroso-N-phenol-3-methyl-5 pyrazolone used as an analytical reagent.
- ZD. KÖCHER: An experimental study of the anthelmintic effect of duodecylalcohol.
- M. PRADÁČOVÁ: Favositidae from the Devonian of Catechovice.
- A. ŠTÁKOVÁ: Mushrooms from Kopřivnice.
- J. WOLFF: Finger-nail sheets in the light of relief pictures.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Tuesday, March 14

CHADWICK PUBLIC LECTURE (at the Royal Sanitary Institute), at 5.30.—J. B. Howell: "The Preservation of Child Life".*

BRITISH ASSOCIATION OF CHEMISTS (LONDON SECTION) (in the Conway Hall, Red Lion Square, W.C.1), at 8.—Prof. J. B. S. Haldane, F.R.S.: "Hereditary, Chemistry and Politics".*

Wednesday, March 15

ROYAL INSTITUTION, at 5.15.—Prof. F. G. Donnan, F.R.S.: Ludwig Mond Memorial Lecture.

Friday, March 17

ROYAL INSTITUTION, at 9.—Dr. W. H. Hatfield, F.R.S.: "New Researches in Steel Metallurgy".

Appointments Vacant

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

LECTURER IN MATHEMATICS in the Rugby College of Technology and Arts.—P. I. Kitchin, 61 Clifton Road, Rugby (March 16).

TEACHER OF ENGINEERING, MATHEMATICS, SCIENCE AND DRAWING in the Oxford Schools of Technology, Art and Commerce.—The Chief Education Officer, City Education Office, 77 George Street, Oxford (March 17).

LECTURER IN MATHEMATICS AND ELEMENTARY PHYSICS in the Polytechnic, Regent Street, W.1.—The Director of Education (March 20).

UNIVERSITY PROFESSOR OF THE PATHOLOGY OF MENTAL DISEASE in the University of London.—The Academic Registrar, University of London, Senate House, W.C.1 (March 23).

ASSISTANT in the University of London Observatory.—The Director, University Observatory, Mill Hill Park, N.W.7 (March 24).

SENIOR ASSISTANT in the Department of Mining, School of Metalliferous Mining (Cornwall), Camborne.—The Secretary (March 29).

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Publications of the International Tin Research and Development Council. No. 88: The Influence of Fluxes on the Spreading Power of Tin Solders on Copper. By Dr. A. Latini. Pp. 14. (Greenford: International Tin Research and Development Council.) Free. [132]

Falmouth Observatory. Report of the Observatory Committee to the Royal Cornwall Polytechnic Society and the Falmouth Town Council, by H. Dent Gardner, with Meteorological Notes and Tables for the Year 1938, with Mean Values for 65 Years (1871-1935), by W. Tregoning Hooper. Pp. 16. (Falmouth: Falmouth Observatory.) [142]

Publications of the International Tin Research and Development Council. No. 89: Tin and its Alloys in Dental Practice. By F. O. Thompson and N. Wild. Pp. 18. (Greenford: International Tin Research and Development Council.) Free. [142]

Metropolitan Water Board. Thirty-second Annual Report on the Results of the Chemical and Bacteriological Examination of the London Waters for the Twelve Months ended 31st December 1937. By Lt.-Col. C. H. H. Harold. Pp. 104+6 plates. (London: P. S. King and Son, Ltd.) 10s. 6d. [162]

Imperial College of Science and Technology: City and Guilds College. Research financed from Clothworkers Company's Grant, 1937-38. Pp. 17+12 plates. (London: Imperial College of Science) [162]

Other Countries

Annuaire de l'Académie Royale de Belgique, 1939. Cent-cinquantième année. Pp. 160+390+10 plates. (Bruxelles: Palais des Académies.) [82]

The Engineering Foundation: a Department of United Engineering Trustees, Inc. Annual Report, October 1, 1937, to September 30, 1938. Pp. 48. (New York: Engineering Foundation.) [132]

India Meteorological Department. Meteorological Organisation for Airman. O.M.O.A. Pamphlet, 1939. Pp. v+66. (Delhi: Manager of Publications.) 1.2 rupees; 1s. 9d. [132]

Journal of the Indian Institute of Science. Vol. 21 A, Part 37: Dissociation Constants of Oxalic, Male- and Pyru-Hydroxy Benzoic Acids, Gallic Acid, Catechol, Resorcinol, Hydroquinone, Pyrogallol and Phloroglucinol. By C. T. Ababandani and S. K. K. Jaitkar. Pp. 417-443. 1.12 rupees. Vol. 21 A, Part 38: Interfacial Equilibria in Vapour Phase: Equilibrium between Methyl Alcohol, Acetic Acid, Methyl Acetate and Water. By S. K. Kulkarni Jaitkar and N. G. Gajendragad. Pp. 443-448. 10 annas. Vol. 21 A, Part 39: Activity of Different Catalysts for Vapour Phase: Esterification. By S. K. Kulkarni Jaitkar and R. K. Vaidkar. Pp. 449-454. 10 annas. Vol. 21 A, Part 40: Supersonic Velocity in Gases and Vapours. Part 2: Supersonic Satellites in Vapours. By S. K. Kulkarni Jaitkar. Pp. 455-460. 1 rupee. Vol. 21 A, Part 41: Equilibrium in Electrodeless Discharge. Part 6: Influence of Rate of Flow on the Formation of Ozone in the Stemen's Ozonizer. By R. Krishnan and S. K. K. Jaitkar. Pp. 467-476. 12 annas. Vol. 21 A, Part 42: Supersonic Velocity in Gases and Vapours. Part 3: Volume Resonance in a Supersonic Interferometer. By S. K. Kulkarni Jaitkar. Pp. 477-488. 14 annas. Vol. 21 A, Part 43: Activation and Clarifying Properties of Fuller's Earth. Part 5: Dehydration of Fuller's Earth. By B. S. Kulkarni and S. K. K. Jaitkar. Pp. 489-504. 1.2 rupees. (Bangalore: Indian Institute of Science.) [132]

Contributions from the Biological Laboratory of the Science Society of China. Zoological Series, Vol. 12, No. 7: On some Points concerning the Functions of the Mammalian Cerebral Cortex. By Chi Ping. Pp. 107-130. Zoological Series, Vol. 12, No. 8: Study of some Forest Insects of Nanking and its Vicinity, Part 1. By C. P. Miao. Pp. 151-162. Zoological Series, Vol. 12, No. 9: Birds of Nanking and its Vicinity, Part 1: Passeriformes. By L. T. Chong. Pp. 183-374. (Shanghai: Science Society of China.) [132]

Veröffentlichungen des Geobotanischen Institutes Rubel in Zürich. Heft 14: Ergebnisse der Internationalen Pflanzengeographischen Expedition durch Marokko und Westalgerien, 1936. Redigiert von B. Rubel und W. Ludi. Pp. 258+17 plates. (Bern: Hans Huber.) 12.50 francs. [132]

Egyptian University. Bulletin of the Faculty of Science, No. 14: The Osteology of the Lizard *Scincus scincus* (Linn.). By M. R. El-Touhi. Pp. 88. (Cairo: Egyptian University.) [142]

U.S. Department of the Interior: Office of Education. Bulletin, 1937, No. 23: Professional Library Education, Introducing the Library. By Nora H. Benet. Pp. v+78. (Washington, D.C.: Government Printing Office.) 15 cents. [142]

Agricultural Experiment Station of the Rhode Island State College. Bulletin 268: A Study of Land Utilization in Newport and Bristol Counties, Rhode Island. By Paul H. Gilbert. Pp. 40. Bulletin 269: Farm Taxes and Farm Real Estate Transfers in Rhode Island. By J. L. Tennant. Pp. 24. Bulletin 270: Pasture Improvement Practices in Rhode Island. By T. H. Odland and B. S. Shaw. Pp. 24. (Kingston, R.I.: Rhode Island State College.) [142]

Spisy vydávané Přírodovědeckou Fakultou Masarykovy University. Čís. 250: Beiträge zur Kristallographie einiger Mineralien von Pflanz (Kristallographische správy o některých rudních minerálech Příbramských). Von Josef Bokanina. Pp. 16. Čís. 260: Beitrag zur Morphologie des Calcit von Island (Přispěvek k morfológii Islandského kalcitu). Von Dr. Vojtěch Rosický. Pp. 16. Čís. 261: Sur une équation fonctionnelle de la théorie des probabilités (Troisième partie). Par B. Horánský. Pp. 16. Čís. 262: Galvanické články se složenými elektrodami (Galvanic Cells with Composite Electrodes). Napsal V. Čupr a O. Kouřim. Pp. 18. Čís. 263: Přispěvek k poznání květeny Českého lesa, 3 (Ad floram, Československou additamentum, 3). Napsal Vlad. Kríst. Pp. 12. Čís. 264: Geologická mapa kraje mezi Loučkovem, Břevnem a Křivkem a nové názory na stratigrafii křídý poohřechu (Geologische Karte der Gegend zwischen Loučkov, Weidenbach und Brädek und neue Ansichten über die Stratigraphie der Kreide der Bagergebirge); Puzosia (sub. Anstomionema) Anstom (Bharpe) v křídě na "Oškově" u Bezkovic (Puzosia (sub. Anstomionema) Anstom in der Kreide auf der Anhöhe "Oškov" bei Bezkovice). Napsal Břetislav Zahálka. Pp. 74. Čís. 265: Studies on Multiplicative Systems, Part 2. By O. Borůvka. Pp. 24. Čís. 266: Lokální články na kovyh elektrických (Local Cells on Metallic Electrodes). Napsal V. Čupr. Pp. 14. Čís. 267: Diaphyse filiforme a finé abnormní sjevy pozorované ve křídě Maleschovy silnice Rohl (Diaphyse filiforme und andere abnorme Bruchrichtungen, beobachtet an den Kluten Maleschovy silnice Rohl). Napsal F. Unselitz. Pp. 10. (Brno: A. Pšm.) [142]

A Preliminary Survey of Soil Types of Sugar Estates of Trinklad: with Special Reference to the Allocation of Sugar-Cane Varieties. By P. M. Turner and C. F. Charter. Pp. 73. (Trinklad: Sugar-Cane Investigation Committee.) [162]

New York Academy of Sciences. Scientific Survey of Porto Rico and the Virgin Islands. Vol. 8, Part 3: Botany of Porto Rico and the Virgin Islands—Diatomaceae. By Robert Hagelestein. Pp. 311-450. (New York: New York Academy of Sciences.) [162]

Catalogues, etc.

Stillbastro B.D.H., a New Synthetic Oestrogenic Substance. Pp. 10. Placental Globulins (Human) B.D.H., for the Modification, Prevention and Treatment of Measles. Pp. 2. (London: British Drug Houses, Ltd.)

Die Askania-Werke. Nr. 15, Januar-Februar 1939. Pp. 24. (Berlin-Friedensau: Askania-Werke A.G.)

Landwirtschaft: Pflanzenbau, Ackerbau, Tierzucht, Obst- und Gartenbau, Bodenkunde, Agrarpolitik. (Antiquariatkatalog Nr. 729.) Pp. 208. (Leipzig: Gustav Fock, G.m.b.H.)

Livogen: Liquid Extract of Yeast (supplying the Vitamin B complex) with Liquid Extract of Liver and additional Vitamin B, and Nicotinic Acid. Pp. 14. (London: The British Drug Houses, Ltd.)

74 in. Reflecting Telescope of the Radcliffe Observatory, Princeton. (Reprinted from the Engineer, Sept. 16, 23, 30, 1933.) Pp. 23. (Newcastle-upon-Tyne: Sir Howard Grubb, Parsons and Co.)

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Organization and Development of Museums

IT is keeping within the truth to say that in Great Britain and Ireland a new museum is born every three weeks, roughly twenty in a year, or two hundred since Sir Henry Miers's report to the Carnegie United Kingdom Trustees was published in 1928. That is an index to the enthusiasm of groups of people aware that there are hidden things the public ought to see ; but, alas, it is no index to the foresight of the enthusiasts, for the history of museums indicates that many of the new foundations, without endowments or any guarantee of permanent backing, will sooner or later drop out of the running and disappear. The death-rate of museums all but keeps up with the birth-rate ; but the spectacle of the lingering death of the idea embodied in a collection which has outlived its interest does infinite harm to the museum movement.

Museums die because the people do not want them, at any rate in the form which their presentation too often takes ; and if only the secret of a live interest could be discovered, and the discovery were rigidly and universally applied, a new page would be opened in the museum story. A great contribution towards this end is made in S. F. Markham's recent report to the Carnegie United Kingdom Trustees*, a book which ought to be pondered over by everyone interested in the present condition and potential future of the museums and art galleries of Great Britain.

The origin of the report is of historic interest. Ten years ago, Sir Henry Miers wrote the first thorough-going account of the museums of Great Britain, also for the Carnegie United Kingdom

Trustees, and having exhibited the pitiful shortcomings of the museum service, which in his opinion required complete reformation, he made suggestions for improvement along three lines—by individual effort on the part of museum authorities, by co-operation, and by the helping hand (or purse) of external bodies. Anyone who takes the slightest interest in these public institutions must be aware of the stimulus Sir Henry Miers's investigation gave to the museum movement and the progress in certain directions made during the decade which has elapsed.

Mr. Markham acted as secretary to Sir Henry Miers ; he has since carried out a survey of museums in most of the British Dominions and Colonies and in India, on behalf of the Carnegie Corporation of New York ; so that no one could have been better equipped for the new British survey which the trustees desired to make, in order to assess the progress of the past ten years and to foreshadow the needs of the future.

Many years ago (1889), Sir William Henry Flower, in his presidential address at Newcastle-on-Tyne to the British Association for the Advancement of Science, defined the purposes of a museum as the advance or increase of knowledge in some given subject, and the diffusion of knowledge among the interested public—in short, the two aims of research and instruction. Half a century has seen great developments in museum standards, but the aims remain essentially the same. The first great purpose is to collect and conserve objects of historic, scientific or artistic importance for our own and future generations ; there follows the furthering of specialized knowledge by research in these collections, the more recent and very

* A Report on the Museums and Art Galleries of the British Isles (other than the National Museums), by S. F. Markham. Pp. 311 + 179 + 24 plates. (Dumfriesline : Carnegie United Kingdom Trust, 1938).

insistent aim of the education of the people by attractive exhibits, and the ultimate ideal of stimulating love of beauty or endeavour in some branch of human achievement.

Every museum cannot compass all these objects, but every museum must set out with its objective clearly conceived and must bend its activities to the accomplishment of its particular goal. But the goal is never attained. The essence of museum success—even of museum existence—is perpetual striving and continuous progress. The only type of museum which can afford to remain static is that devoted to perpetuating the memory of a great personage—Shakespeare, Livingstone, Wolfe, to mention recent examples—where personal relics are bound to be limited in number, and where the attraction is predominantly emotional rather than educational. These, however, form a relatively small proportion of Great Britain's museums: of our eight hundred museums, "about 165 are devoted to a historical or personal theme, 100 to natural history alone, about 80 to art, 20 to medicine, and 20 to industry. The remainder, therefore, totalling some 400 museums, are general in their character, though many, probably 150, have a distinct emphasis upon illustrating their immediate environment" (p. 52).

Sir William Flower wisely said, in the address referred to, "A museum is like a living organism—it requires continual and tender care. It must grow, or it will perish." We would prefer to say 'develop' rather than 'grow', for there is an impression that the addition of new rooms always means progress, whereas extensions may actually hinder the development constantly required in any collection. But the plain fact is that museums die (and we know of collections excellent in their day, and their day opened nearly a century ago, disappear in recent years) because they have become moribund—activity, the breath of life, has departed from them long ago.

The first essential for a developing museum (and all others are moribund) is a competent curator, who has the knowledge, the skill and the brains to plan and execute; and a competent curator deserves his reward—he may at least expect a living wage. Yet, apart from a hundred and forty out of more than eight hundred museums in Great Britain, "in nearly every other case the curator is paid a scandalously low salary". There are pitiful examples mentioned by Mr. Markham of salaries of £50 recently raised to £75 or to £100 a year. The County Borough of West Ham (population

294,000) offered £155 per annum for "a full time assistant with biological training, knowledge of photography, and a Science degree (not essential)"; the County Borough of Reading (population 100,000) advertised for "a male assistant with practical Museum and Art Gallery experience, not under 22 and preferably registered for the Diploma, salary offered £115". And the London County Council pays its dust-collecting gangers £158 and its dustmen £150 a year! Is it surprising that dust accumulates and men and ideas decay in some of the provincial museums?

The ten years which have passed since Sir Henry Miers made his recommendations have emphasized the backwardness of the weaker museums (nearly four hundred and fifty in number), since the better institutions have taken advantage of new opportunities and have pushed ahead. There is closer co-operation between them, expressed in flourishing regional federations, and in the growing power of the Museums Association; they have been aided and advised to a greater extent by the national museums; and they have made more use of the development of exhibition technique, to the great benefit and the educational value of their halls and galleries.

The increasing museum contribution to education in progressive institutions has indeed been one of the impressive features of this century. Not only have greater efforts been made to replace dull collections by displays in which art and science blend for the attraction and instruction of the public, but a deliberate attack upon indifference has also begun. Temporary exhibits of objects of particular interest, special exhibitions illustrating achievements of, or developments in, art and science, the increasing use of modern methods of publicity, in which the newspapers have proved loyal helpers, the encouragement of regular school visits, and the circulation of loan collections among schools—all these devices have become part of the recognized services of museums to the public; and the public has responded by showing a new and increasing interest in museums.

But something still is lacking. Efforts tend to be spasmodic and confined to comparatively few centres; improvements are costly, and municipalities and private bodies are already hard put to it to find the funds required, even if they were sure of the most desirable lines of advance; and there are museums that are static, because no interest is taken in them. If the country's museums over all are to be made worthy of the

great purposes which it is in their power to serve, some beneficent *deus ex machina* must appear to weld the scattered units into a national movement. Whether that kindly guiding power shall be vested in a Government department, or shall emerge from the museums themselves by way of the Museums Association, it is essential that it should have two basic functions: first, that of giving advice where advice is sought, and of making recommendations where museums are moribund, and secondly, that of subsidizing improvements and encouraging developments by the use of

moneys allocated by Government for museum purposes.

So, as Mr. Markham says: "In the mind's eye one can see organised throughout the length and breadth of the country temples of vision, where young enthusiasts will find a ready welcome and a helping hand with a colossal book of knowledge; schools will have auxiliaries on the cultural side not less than those which playing-fields now give them on the physical side, and adults will find in these centres a combination of relaxation, interest, and ever-widening horizons."

The Scientific Work of Charles Fabry

Œuvres Choiesies

Par Charles Fabry. Publiées à l'occasion de son jubilé scientifique. Pp. vi+695. Jubilé scientifique de M. Charles Fabry célébré à la Sorbonne le 3 décembre 1937. Pp. 96. (Paris: Gauthier-Villars, 1938.)

WHEN, in 1937, Charles Fabry retired from his professorship in the University of Paris, he was persuaded to arrange and edit his principal scientific papers. The "*Œuvres Choiesies*" is the result.

It is an impressive record, not so much from the actual amount of reading matter, though that is considerable, but because the author by selection and compression has been able to present an adequate record of the main results of half a century's research in about two hundred and fifty thousand words.

Before we attempt to summarize the contents of the book, let it be said at once that Fabry's love of research was accompanied by a devotion to teaching. He has said himself: "Toute mon existence a été consacrée à la Science et à l'enseignement, et ces deux grandes passions m'ont procuré les plus vives joies." There are, perhaps, not many teachers who could refer to their vocation with such enthusiasm; but all would agree that it is a great consumer of time and energy. In assessing the magnitude of Fabry's work one must read between the lines of his paper a story of tireless activity as an inspiring and greatly loved teacher.

To return to Fabry's "*Œuvres Choiesies*". He was only about twenty years old when he took a post at the Faculté des Sciences at Marseilles under Macé de Lépinay. It was not long before the two published in collaboration a paper on the "Théorie

générale de la visibilité des franges d'interférence" (1891). Thus early the keynote was struck which was to echo through so much of Fabry's work—more than half the book is concerned with the phenomenon of the interference of light and its application to the solution of physical problems.

About five years later, Fabry commenced to study the interference fringes of silvered plates in collaboration with A. Perot, and in 1897 they published the first important description of the Fabry-Perot type of interference fringes and their use in the measurement of length.

This was the type which Fabry always used thereafter, its advantage lying in the much greater fineness of the fringes as compared with those used, for example, by Michelson.

In a series of papers, Fabry and Perot described the properties of these fringes; how to determine the number of the order of a fringe corresponding to a large path difference, how to use them for the measurement of lengths up to several decimetres, and for the comparison of wave-lengths of different rays (1898 and 1899). They then applied the method to determine the size of a 4 cm. cube of quartz in wave-lengths of cadmium red light, and with Macé de Lépinay determined by its aid the mass of a decimetre of water. Other papers on interference metrology finally led, in 1907, to the epoch-making "Nouvelle détermination du mètre en longueurs d'ondes lumineuses" and the "Détermination de la longueur d'onde de la raie rouge du Cadmium".

This determination led to Benoît, Fabry and Perot making, in 1907, at the Conference of the International Union for Co-operation in Solar Research at Meudon, the following recommendation: "La longueur d'onde de la raie rouge de la lumière

du Cadmium produite par un tube à électrodes est 6438,4696 Angström, dans l'air sec 15° du thermomètre à hydrogène à la pression de 760 mm. de mercure, la valeur de g . étant 980,67 (45°). Ce nombre sert de définition à l'unité de longueur d'onde."

This recommendation was adopted by the Conference. Twenty years later (1927) the determination was officially recognized by the Comité (and later by the Conférence générale) du Bureau International des Poids et Mesures as still the best. In June 1936, Fabry was able to show at a session of the same Committee that, applying certain new corrections discovered at the Reichsanstalt, the measurements were in excellent accord with the latest made at Teddington and at Berlin.

Fabry and Perot then turned their attention to the use of their étalon for determining wave-lengths. Previously the wave-lengths of rays had been found by comparing their positions in a spectrum with those of other rays the wave-lengths of which had been determined by Rowland from the measured dimensions of a grating. Fabry and Perot set themselves to determine a number of wave-lengths by comparison with one selected ray, with all the accuracy attainable with their new method.

The technique for carrying out this work was published during the years 1898-1900, a further application being added, that, namely, of determining in a like manner the wave-lengths of the Fraunhofer lines of the solar spectrum. In 1902 they published thirty-three wave-lengths of the solar spectrum determined in this way, together with the wave-lengths of a number of metals, including iron; altogether more than sixty wave-lengths being given to the seventh decimal place.

In a subsequent paper (1905), they described their more expeditious way of determining intermediate wave-lengths by forming an image of the diffraction pattern yielded by one of their étalons on the slit of a spectrograph.

To apply the method to measurements of extremely small variations of wave-lengths was but a short step, and Fabry and Buisson in 1910 studied in this way such problems as the widths of the line of the solar spectrum, the Doppler-Fizeau effect on rays from the circumference and middle of the solar disk, the kinetic theory of gases, and the internal movements of the Orion Nebula. Differences of line of sight velocities present in the nebula were determined to a much greater accuracy than had before been possible.

To study the Doppler-Fizeau effect in the laboratory, Fabry devised a very ingenious piece of apparatus, using a revolving disk of white paper

as the means of producing a moving source of light.

There is no space to deal here with minor applications of interferometry, such as the determination of the voltage of a Latimer-Clark standard cell in absolute electro-static units.

The next section of Fabry's work became of great practical interest in the highly technical problem of heterochromatic colorimetry. This presented difficulties which increased with every new source of illumination.

Fabry put forward the suggestion in 1903 that the problem should be simplified by the use of liquid colour filters which, placed between the standard lamp and the photometer, gave a colour match with the lamp to be measured. The transmission of the filters could be carefully determined once for all to the necessary accuracy, and then all subsequent measurements could be made under conditions involving no colour difference. When he put forward this suggestion at the Academy of Sciences in November 1903, it met with great opposition—indeed, the member who presented the note for Fabry wrote to him that he did so only "après beaucoup d'hésitation". Nevertheless, in a few years the method was accepted throughout the world, as were also the views on the universal unit of illumination, put forward by Fabry in his report on the subject to the International Commission on Illumination in 1921.

Lack of space forbids more than a mention of Fabry's work in astrophysics in connexion with photometry of the sun, stars and night sky, and the diffusion of light by gases; but something more must be said concerning his study of the ultra-violet end of the solar spectrum. In a preliminary investigation he came to the conclusion that the limit to the ultra-violet spectrum of the sun results from three causes: molecular diffusion, scatter by dust or other fine particles, and absorption by ozone; and he then proceeded to work out a technique whereby the amount of ozone could be measured.

Such measurements are now regularly made in the manner developed by Fabry. The theory had long before been put forward by Hartley that the limits of the solar spectrum were due to ozone, but no measurements had been made previously to Fabry's in support of this hypothesis.

In 1937, Prof. Charles Fabry was seventy years of age, and on the occasion of his jubilee celebration he told his audience that he was accustomed to using logarithmic tables at the age of eleven years, and could almost say that he learnt to read from the "Annuaire du Bureau des Longitudes". His undiminished ardour and vitality permit us to hope that he only closes this volume to commence a fresh one.

F. TWYMAN.

Explorations in Climatology

(1) Handbuch der Klimatologie

Herausgegeben von W. Köppen und B. Geiger. Band 4, Teil T: Klimakunde der Südsee-Inseln, von Prof. Dr. G. Schott; und Band 4, Teil U: Klimakunde der Antarktis, von Prof. Dr. W. Meinardus. Pp. T114 + v + U133. (Berlin: Gebrüder Borntraeger, 1938.) 40 gold marks.

(2) Die Meteorologie des Sonnblicks

Teil 1: Beiträge zur Hochgebirgsmeteorologie nach Ergebnissen 50 jähriger Beobachtungen des Sonnblickobservatoriums, 3106 m. Von Ferdinand Steinhauser. (Herausgegeben vom Sonnblick-Verein.) Pp. 180 + 1 map. (Wien: Julius Springer, 1938.) 8 gold marks.

(1) **THIS** part of the great "Handbuch der Klimatologie" contains two sections, the South Sea Islands and the Antarctic. In spite of their apparent total dissimilarity, these two regions are alike in being represented by few and scattered climatological data, which are none the less impressive because they show the interaction of meteorological forces on a scale seen in few other parts of the earth.

The equatorial Pacific is the meeting-place of two great converging wind systems—the north-east and the south-east trades—which have swept over thousands of miles of tropical ocean and are hot and humid. By the canons of meteorology, convergence means forced ascent, and the meeting-place of the winds would therefore be expected, and was long supposed, to be a region of frequent and intense rainfall. Observations have shown, however, that the actual meeting-place of the winds is on the whole an arid region with a violently fluctuating rainfall which may sink almost to zero for months at a stretch. The expected heavy rains fall on either side of this dry strip, but especially to the southward, where the transition is very rapid. It is an interesting problem in the effects of air masses, to which the author recurs several times, though he does not bring out clearly the remarkable relation between wind direction and rainfall.

In the well-known trade winds themselves the rainfall on the small mountainous islands is almost entirely orographic. The steady winds and the rugged topography bring this out with almost startling emphasis, as, for example, in Oahu, Hawaii, where the annual rainfall varies from more than 236 inches on the peaks to less than 20 inches on the leeward shores. Incidentally, the rainfall charts for the

Hawaiian islands are rather confusing because some are given in centimetres and one in millimetres.

The ice-covered Antarctic continent and the surrounding seas provide a great natural laboratory of a different type, where emphasis is laid on the effects of temperature. The author takes as the boundary of the sub-antarctic region not the shifting and uncertain limit of ice but the much more regular 'convergence line' where the cold antarctic waters meet the warmer seas of the main Southern Ocean. He thinks that it is the contrast of temperature across this boundary which provides most of the energy for the continuous storms of that region. The rest of the energy comes from outbreaks of cold air from the ice-covered continent, but these are confined to three separate regions. Elsewhere the outflowing winds are deflected by topography into great eddies the courses of which are reflected in the streams of drift ice. There is an interesting analysis of the conditions along the boundary between the antarctic and maritime winds, the more or less continuous antarctic polar front, but all this part of the earth is still rich in unsolved meteorological problems, both at the surface and in the upper air.

Both sections are well provided with diagrams, and all available statistical information is set out in the numerous tables which are a regular feature of the "Handbuch". In the Antarctic section perhaps a little too much is made of the scanty data by harmonic analysis, and one would have preferred more quotations of descriptive passages. There are very full bibliographies in both sections.

(2) The completion at the end of 1936 of an unbroken series of meteorological observations covering a period of fifty years, at a height of 10,190 ft. on the summit of the Sonnblick, marks a magnificent achievement, great not only for the scientific value of the results but also in terms of sustained effort against the difficulties of Nature, which can readily be appreciated from the coloured panorama slipped inside the front cover. This volume presents a summary of the climatological results with a wealth of detail.

The elements discussed include temperature, humidity, cloud and sunshine, precipitation, wind and pressure. The mean temperature for the year is only 20.5° F., falling to 8° F. in February, while only two months, July and August, have a mean just above the freezing point. Greater interest is attached to the secular variation. As is now well

known, the first fifteen or twenty years of the present century were mainly a period of mild winters and less definitely of cool summers in Europe. The same tendency is shown by the Sonnbliek observations, proving that this change is not confined to the lowest layers of the atmosphere.

In humidity the mountain-tops present some unusual phenomena of the 'looking-glass' sort. Relative humidity is greatest in summer, and in summer it is greatest in the evening and least in the morning. This is because the whole layer of air below contracts during the night and expands during the day, while irregular movements cause some very rapid changes from one hour to the next. Cloudiness shows similar features, being greatest in summer, especially with easterly winds! Even the duration of sunshine is greater in March than in June but varies little throughout the year,

while the percentage of possible sunshine is greatest in February and January. Sonnbliek well supports the famous winter climate of the high Alps; Vienna presents a very different picture.

Mountain stations were formerly important as the only source of information about the winds at high levels and they are still valuable to control and supplement the pilot balloon observations. Sonnbliek has a cup anemometer, and the results have already been the subject of some important memoirs. The present publication gives the results of the tabulations in great detail.

The discussions are supplemented by an impressive appendix containing full series of the monthly values of all elements, which will prove very valuable for reference. The whole work will appeal not only to meteorologists but also to all who know and love the Alps in their many moods.

C. E. P. B.

Egyptian Prehistory

Cemeteries of Armant I

By Sir Robert Mond and Oliver H. Myers. With Chapters by F. J. C. Baly, Dr. A. J. E. Cave, Suliman Huzayyin, Dr. J. W. Jackson, and Rev. De Lacy O'Leary, and other Contributions. The Text. Pp. xiii + 300. The Plates. Pp. xi + 78. (London: The Egypt Exploration Society, and Oxford University Press, 1937.) 25s.

IT is a far cry from digging treasures centuries ago to modern excavations, and between the first memoirs of excavations in Egypt and this book there is almost as great a difference. Its results are of interest not only to archaeologists but also to students of natural science.

"Cemeteries of Armant I" is a report on the excavation of, for the most part, prehistoric cemeteries at Hermonthis (Armant) in Upper Egypt. There is also an account of a prehistoric settlement. In its production many experts have collaborated, with the result that it is not a mere survey of work done in the field but an attempt to apply new principles to the study of Egyptian archaeology.

On one hand, the writers employ technological and chemical tests to a great—almost too great—extent in order to get the best out of "material of no outstanding value". They describe how beads were manufactured, and the different qualities of the brickwork which was used in

tomb construction. They have analysed, by different methods, certain unique pieces of stuccoed linen found in a prehistoric tomb, perhaps a kind of primitive cartonnage similar to that which was used in later times for the covering of mummies. There are also metallurgical analyses and chapters on the anatomical study of human remains carried out *in situ*. Far-reaching theories concerning climatic changes in Africa are founded on the discovery of a new kind of pottery and traces of tree-remains in the desert sand. A valuable addition to archaeological technique is the introduction of a colour-chart, based on the "Ostwald Colour Album", in order to facilitate the accurate description of the colours of beads and pottery.

Another characteristic feature of the book is the authors' emphasis on the need to improve the systems of classification hitherto current in Egyptian archaeology, or to substitute new systems for the old. They suggest, for example, a new typology for pottery. Instead of arranging the pots in the first instance according to their pattern and shape—the system used by classical archaeologists which Petrie introduced into the study of prehistoric pottery—they are to be classified primarily by 'ware', and only within that grouping by the orthodox method. The authors also criticize the two systems of classifying beads which are at present in use, but have not attempted to devise another because of the comparatively small

number of beads found in their own excavations. A long chapter is devoted to flint implements, of special importance since there is as yet no comprehensive account of the Egyptian flint industry. Only flints from Armant are treated here, but they are classified and illustrated in a way which it is hoped will provide a basis for all future work on flints. At the end of each chapter is a useful index of the objects discussed in it.

The whole book is distinguished by a thoroughness and a scholarship which does not shrink from

confessing that the only iron ring found during the excavations—of which there is a photograph on one of the plates—was lost on the way to the laboratory! Nor are the authors afraid to state conclusions that are entirely negative.

This report of a single excavation is little short of a text-book alike for excavators and students of Egyptian prehistory, and should be studied by all who undertake research in the subject; even if, as is stated in the first chapter, "the parts are greater than the whole".

K. B.

The Ways of the Red Deer

A Herd of Red Deer

A Study in Animal Behaviour. By Dr. F. Fraser Darling. Pp. x+215+8 plates. (London: Oxford University Press, 1937.) 15s. net.

OF the large land mammals which originally inhabited the British Isles, civilization has left as sole survivors the deer, and of these the red deer, saved from extinction because of their value throughout the ages for the chase, have been studied perhaps more than any other British mammal. Yet there was more to be done. The growing appreciation of the oneness of an animal with its environment, animate and inanimate, demanded that a closer reckoning should be made between vital reactions and the condition or combination of conditions with which they were associated.

Dr. Darling has accomplished this "study of animal behaviour" with painstaking thoroughness and devotion. For two years he lived with the deer in the wilds of Wester Ross, following their movements and studying their activities at all seasons and under all sorts of conditions; as a result he has contributed and added precision to our knowledge of their natural history, and by emphasizing the relationship between weather and movement and the influences of communal life has opened up a new field of interest and speculation.

A main thesis developed in the book is the importance of the hind as a leader in the deer community: "the stag never attains to leadership, and the first stag in rut which may be running round a group of fifty hinds has no power of leadership"; but "the outstanding feature of the hind group is its cohesion which, doubtless, is derived from the stability of the family". Many telling examples are given of the supremacy of the leader hind in her own coterie, as controller

in advance and retreat, as watch and ward; even in the harem of the rutting stag the hind still retains her leadership in spite of the "egocentric and casual dominance of the stag". To this social system in a gregarious community the author applies the term "matriarchal".

The analysis of the differences between the behaviour of stag and hind groups, of their selection and use of distinct territories, and of the influences of atmospheric moisture and wind upon herd movements are valuable contributions to the ecology and reactions of the red deer. Although physiological speculation has perhaps outrun the evidence, the factual description of the phases of reproduction and of their bearing upon the sociality of the species is thorough and suggestive.

The book appears to have been written somewhat hurriedly, and inaccuracies have crept into the text: poplar trees are not "relics of a golden age of pine forest" (p. 12) judging by pollen statistics, and the pine forest of the peat did not follow upon the last glacial period (p. 15); to state boldly that Rowan's experimental crows flew *northwards* (p. 155), when the majority did not, is somewhat distorting the evidence; the map of the distribution of red deer in Scotland (p. 28) omits the interesting colony in North Uist; and it seems inconsistent to state that "man has been at pains to breed out the social instincts" of sheep (p. 95), and on the following page to say that the primitive or wild type has no flocking instinct. Sometimes, too, assertion goes further than is warranted.

Dr. Darling's book is attractively written, and he has made out a good case for "taking sociality into account in observing and interpreting behaviour"; his work will remain an example of how such observation may and should be carried out in the haunts of a wild creature.

(1) Spontane und Strahleninduzierte Mutabilität. Von H. Stubbe. (Probleme der theoretischen und angewandten Genetik und deren Grenzgebiete.) Pp. 190. (Leipzig: Georg Thieme, 1937.) 6.80 gold marks.

(a) Erbschädigungen

Von Dr. Gerhard Schubert und Dr. Artur Pickhan. (Probleme der theoretischen und angewandten Genetik und deren Grenzgebiete. Herausgegeben von H. Böhm, G. Gottschewski, W. Hüttig, G. Just, A. Pickhan, W. F. Reinig, O. H. Schindewolf, H. Stubbe, N. W. Timoféeff-Ressovsky, F. von Wettstein, K. G. Zimmer. Redigiert von W. F. Reinig.) Pp. 164. (Leipzig: Georg Thieme, 1938.) 6.80 gold marks.

THESE two volumes belong to a series dealing with the problems of theoretical and applied genetics.

(1) The first, by Dr. Stubbe, is a detailed account of spontaneous and induced mutations in animals and plants, but with the main emphasis on X-ray mutations. The results in this field are carefully analysed, and the methods used in such work are described, especially as regards dosage and length of exposure. The book will be useful for reference by all workers in this subject.

(2) The second volume, edited by medical workers, covers part of the same ground as the first. Beginning with introductory chapters on the groundwork of genetics and the nature of mutations, the third chapter discusses the genetics of wild populations in relation to isolation and selection. Chapters iv and v are concerned with the production of mutations by various types of radiation and by other physical and chemical means. The concluding chapters discuss the genetic bases of germinal injuries and defects, with particular reference to conditions in man. The mutation frequency in man and the relative importance of different types of radiation therapy are considered.

Pascal

The Life of Genius. By Morris Bishop. Pp. xii+398+6 plates. (London: G. Bell and Sons, Ltd., 1937.) 12s. 6d. net.

WE have very few books in English about this great French thinker, who has always had an extraordinary following on the Continent. Prof. Bishop's study is therefore most welcome. The various aspects of Pascal's personality are studied in turn: a thinker, a mystic, a philosopher, a physicist, a mathematician, a theologian, a man of the world, Pascal had many interests and must be credited with many achievements. These, however, are not considered quite so eminent by the author as to justify the usual estimate of Pascal's genius as one of the first rank. In science, in particular, Pascal did not do so much as some other of his contemporaries: by stressing the importance of intuition, with due regard to the claims of experience in physics, and of formalism in mathematics, it would appear that Pascal was ultimately concerned more with religion than with positive knowledge.

The attraction of man towards the infinite is, indeed, the mainspring of Pascal's thought: his theories and thoughts are really illustrations of this

leading conception of man's destiny. Prof. Bishop is therefore right in suggesting that Pascal's work is more significant for the history of religious thought than otherwise. In this respect, he rightly sides with the Jesuits against the Jansenism of Port-Royal. In spite of the light thrown by the author with excellent scholarship on Pascal's personality, the impression remains that Pascal emerges rather smaller from this scrutiny. But this, of course, is not the wish of the author of this excellent work.

T. G.

Lac Cultivation in India

Being a second and revised edition of "A Practical Manual of Lac Cultivation". By P. M. Glover. Pp. vii+147+25 plates. (Namkum: Indian Lac Research Institute, 1937.) 2 rupees.

IT is tolerably well known that lac is a resinous substance secreted by a scale insect (family Coccidae) known as *Laccifer lacca* (Kerr.). The production of lac is virtually a monopoly of India and Burma. The greater amount of lac is produced in Bihar: outside India, lac is grown in small quantities in Ceylon, Java, Borneo, Malay States, Siam, China and Indo-China.

A great deal of biological and practical work respecting lac and the lac insect has been carried out at the Indian Lac Research Institute at Namkum, Ranchi, Bihar. The results of this work are embodied in this book, now under notice, written by Mr. P. M. Glover, entomologist to the Institute. Its first edition appeared in 1931 but, since that time, conditions affecting the lac industry have changed very considerably including, more especially, the plantation growth of lac. The whole subject is very comprehensively treated by Mr. Glover, particularly from the cultural and commercial points of view, while essential knowledge regarding the biology of the insect and of its parasites and predators is not overlooked. The book is well printed and fully illustrated, while its low price should ensure its continued success.

A. D. I.

The California Woodpecker and I

A Study in Comparative Zoology. By William Emerson Ritter. Pp. xiv+340. (Berkeley, Calif.: University of California Press; London: Cambridge University Press, 1938.) 16s. net.

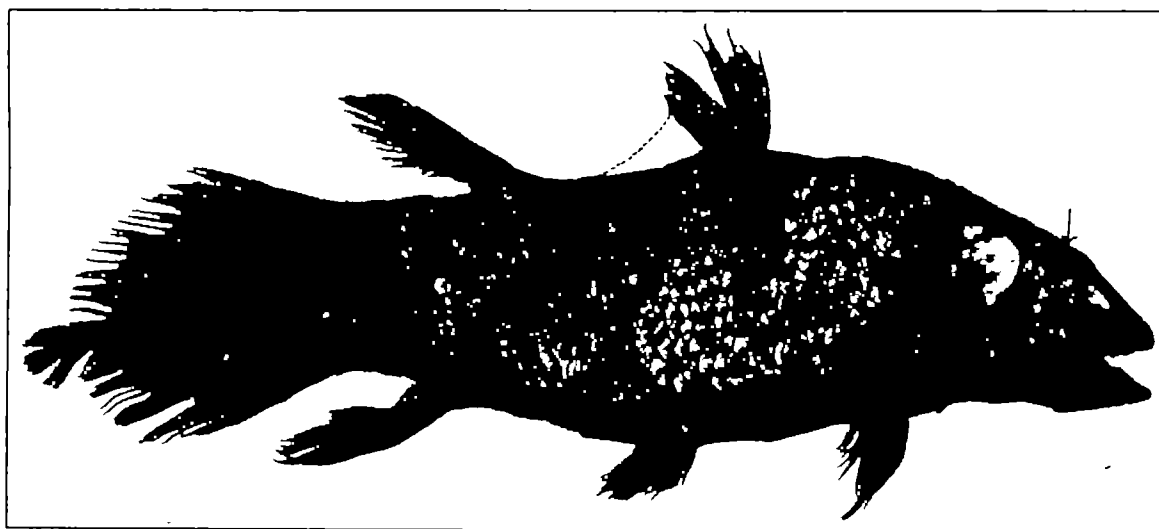
THE acorn-storing of the California woodpecker is of great interest, as storage of food for use at a distant date is very rare among birds. The woodpecker drills holes in the bark of a tree, and fits an acorn tightly into each—big end outward. Sometimes the natural corrugations of the bark are used, or the cracks in a telegraph pole. The drilled surface often becomes covered with a mosaic, of perhaps 50,000 acorns on a single trunk. This behaviour provides the starting-point of the present study, and the first part of the book is mainly ornithological. It then forms the basis of an essay in comparative zoology and psychology, in which bird and man are contrasted, and leads finally to a philosophical discourse under the caption "My Understanding of Men and Woodpeckers".

A Living Fish of Mesozoic Type

By Dr. J. L. B. Smith, Rhodes University College, Grahamstown

EX Africa semper aliquid novi. It is my privilege to announce the discovery of a Crossopterygian fish of a type believed to have become extinct by the close of the Mesozoic period. This fish was taken by trawl-net at a depth of about 40 fathoms some miles west of East London on December 22, 1938. It was alive when caught, and shortly after it died it was handed over to Miss Courtenay-

mounted specimen, a responsible citizen-angler of East London stated that about five years ago he had found precisely such a fish, only considerably larger (*sic*), partially decomposed, cast up by the waves on a lonely part of the shore east of East London. When he returned with assistance, the monster had vanished with a risen tide. With regard to the present specimen, fortunately both



COELACANTHID FISH FROM EAST LONDON, SOUTH AFRICA.

The small arrow shows the position of the spiracle, and the dotted line indicates the position of a membrane behind the first dorsal fin.

Latimer, curator of the East London Museum. Miss Latimer wrote to me, enclosing a sketch and brief particulars of the specimen. Owing to the seasonal disorganization of the postal services, the letter did not reach me at Knysna, some four hundred miles away, until ten days later. It was obvious from the sketch and notes that the fish was of a type believed long extinct. Immediate telephonic communication with the East London Museum revealed that, owing to lack of preserving equipment at that Institution, the putrefied body had been disposed of beyond any hope of redemption, and the fish had been mounted by the local taxidermist.

Since the fish was unquestionably alive when caught, there is at least a possibility that this zoological tragedy may be ameliorated by the capture of another specimen. This is not so remote as might appear. After careful inspection of the

Miss Latimer and the taxidermist were drawn to observe details of the carcass very closely, so that exhaustive independent questioning has left me with at least some definite information about the missing parts. Fortunately also, the terminal caudal portion of the vertebral column and part of the pectoral girdle remain. The skull is of course intact.

The specimen is 1,500 mm. in total length, and weighed 127 lb. when caught. The colour was a bright metallic blue, which has faded to brown with preservation.

In major characters this remarkable specimen shows close relationship with the Mesozoic genus *Macropoma* Agassiz, of the family Coelacanthidae, order Actinistia. The gephyrocoercal tail with protruding axial supplement, the normal first dorsal, the obtuse lobation of the remaining fins, the ganoin tubercle ornamentation on the scales and on some of the dermal bones of the head, the

nature and arrangement of the dentigerous bones of the mouth, and the form of the dermal armour of the head, are all typically coelacanthid.

The skeleton was cartilaginous, the vertebral column apparently tubular, and the whole fish extraordinarily oily. The fish has small spiracles situated as shown in the accompanying illustration, and a definite though not very obvious lateral line, which continues uninterrupted to the end of the supplementary caudal. Other differences from the known coelacanthid fishes are the pronounced pedunculation of the lobate pectorals, the reduction of the dermal armour of the head, and the presence of two small heavily ornamented bones at the anterior lower corner of the opercular plate, which probably correspond with the more fully developed inter- and sub-opercula of teleosts, also a similar posterior post-spiracular ossicle. Dermal parafrontals are not visible. There is a

free tongue composed of four fused segments covered with presumably ossified tubercles.

It is probable that systematists will wish to propose a new family (some even a new order) for this fish, but I am at present satisfied that it is close enough to the Mesozoic Coelacanthidae to justify its inclusion in that family. It has been noted that certain coelacanthid fishes underwent little apparent change from the Devonian to the Cretaceous. It is therefore not surprising that this species, which presumably has survived from the Mesozoic, should still retain most of the features which characterize that family.

For the fish described and figured above I propose the name *Latimeria Chalumnae* gen. et sp. nov.; the full account of the species and of its taxonomic relationships will be published in the *Transactions of the Royal Society of South Africa*.

A Tentative Land Fertility Map of England and Wales*

By Dr. L. Dudley Stamp,

Director of the Land Utilisation Survey of Britain

INDUSTRIAL and housing development in England and Wales is estimated to have absorbed since 1900 no fewer than 800,000 acres—an area equivalent to the counties of Buckingham and Bedford combined. This land has been taken mainly from that devoted previously to agriculture and, once covered with bricks and mortar, it is lost to agricultural production for ever. Not only is the area concerned 2 per cent of the total area of the country, but it is also largely the best quality land. The modern factory with its horizontal layout requires level or gently undulating land, preferably well-drained; such land is also that most easily and cheaply developed as building estates and is also of the type required for aerodromes. It is precisely the best ploughland which has these characteristics and which is therefore being absorbed with alarming rapidity. Amongst the assets of the nation, its good agricultural land is surely one of the most precious, and yet, at the present time, enjoys little or no protection.

First-class arable land, suitable for intensive use as market gardens, occupies a strictly limited area in Britain—probably not more than 5 per cent—yet the value of even this land for agricultural purposes is below its 'development' value

if it is so situated as to be suitable for housing or industrial purposes. Similarly, local and other public authorities take such land without hesitation for housing, recreation or public utilities (notably reservoirs), thus impoverishing national resources as a whole. Under the Town and Country Planning Acts, most agricultural land is 'zoned' for housing independently of its value for food production. Indeed, many town and regional plans completely ignore agricultural values and, as in the case of the South Essex regional plan, would result in the best land being devoted to housing and industry before the poorer land is touched. It is becoming increasingly apparent that, in the matter of land planning, local and national needs are in direct conflict, and that a National Planning Board is an urgent necessity.

If the national stability depends in any way on the maintenance and perhaps increase in home food production, and if the national health can be related in any way to a supply of fresh milk, vegetables and fruit, then the appropriate land must be preserved. The determination of the areas of best land thus becomes a problem of greatest urgency.

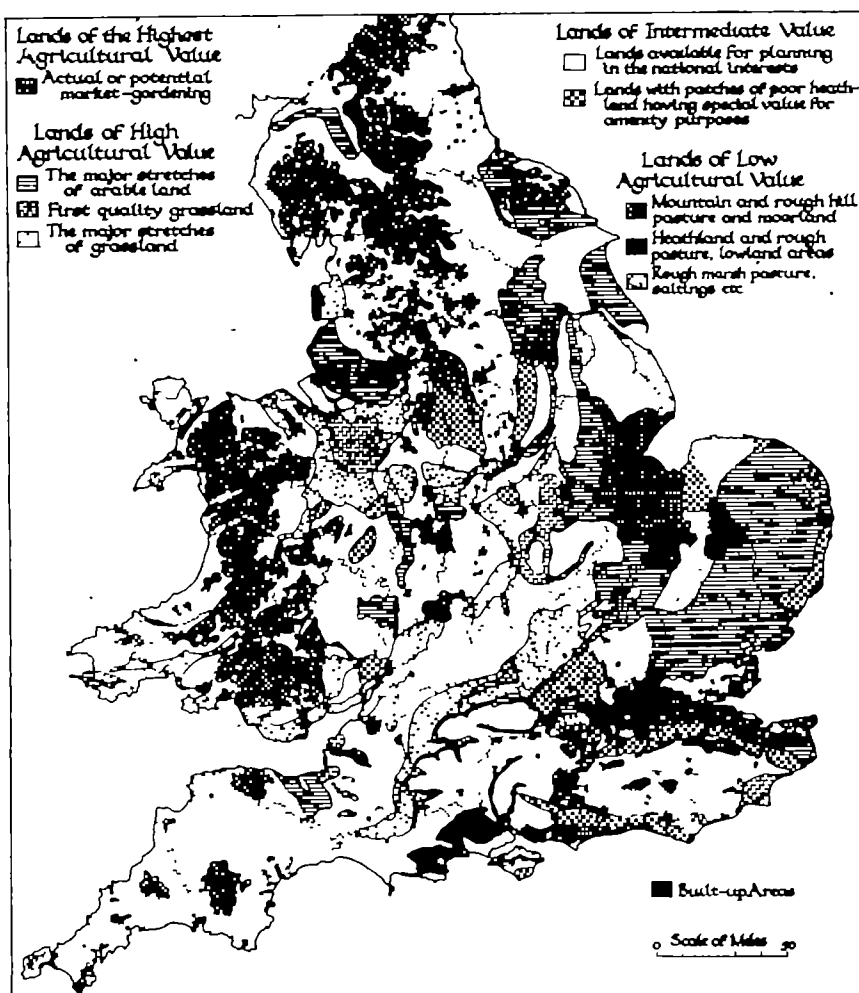
Several different bases might clearly be adopted in attempting a classification of the land of Britain. It might be made on the basis of a detailed soil survey, but this has not yet been made and there remain technical difficulties, including both finance

* Summarized, by permission, from a report prepared at the request of the Royal Commission on the Geographical Distribution of the Industrial Population and included in a public lecture delivered at the London School of Economics on January 31.

and personnel. Another method is to take agricultural productivity, but this is only valid if crop yields are studied on a field-to-field basis or carrying capacity of grassland on similar small units. Conclusions based on statistics available—even if individual farm or parish figures are used—are far too generalized because of the inherently heterogeneous character of the units. A survey of land values at a given time might seem to indicate a suitable basis were it not that these are related too closely to considerations of accessibility and to amenity or 'development' values. In a country where natural or semi-natural vegetation is still dominant an ecological survey may well, as F. E. Clements has urged, assess the combined total influence of all natural factors—of elevation, aspect, drainage, soil, climate. This method can be applied to the great moorland and 'rough grazing' areas of Britain and has been extended by Stapledon and his co-workers to the whole of Wales by using 'index species' and the floristic composition of the widely distributed grassland.

It is possible to devise a classification based primarily on existing land use provided that natural, historical and economic factors are all adequately considered. The Land Utilisation Survey has completed a field-to-field survey of present land use over the whole of England, Wales and Scotland. The six-inch field maps and the one-inch coloured maps (of which eighty sheets have now been published) form the starting point for comparison with the past. Over large areas of the country, a direct comparison can be made with the period 1837–1845 by plotting on to modern six-inch maps the information collected in parish surveys made under the Tithe Redemption Act of 1836—a tedious and laborious though illuminating exercise. In some areas, eighteenth century enclosure, manorial and other medieval maps carry

back the story much farther. Contrary to popular belief, the natural factors exercise a greater influence now than they did in the past in the determination of land use. With the improvement of internal communications and the development of overseas supplies, it is no longer economic to use land for the production of commodities (such as wheat in much of the West and Midlands) for which it is, for climatic or edaphic reasons, unsuited.



Most of Britain has been settled and farmed for hundreds, if not thousands, of years. Recent land-use is often the result of a long continued process of determination by trial and error. Our investigations have stressed what might therefore be expected, though which is constantly denied, that there is a remarkable stability of land use in Britain. This applies to the poorest land—moorland and wasteland now and in the past; and to the best land—selected for ploughland in the past and remaining under the plough to the present day despite economic vicissitudes. The maximum of change has taken place on lands of intermediate

quality—under certain economic conditions it may pay to plough them; under others to put them down to grass; under others to abandon them entirely or in part.

Thus the classification of the land of Britain now proposed is based on a variety of considerations. The accompanying map is a first attempt to show the approximate distribution of each type. It has been prepared on incomplete information and is published now for the first time in order to secure constructive criticism.

(1) *Land of the highest agricultural value—actual or potential market-garden land*, capable of intensive cultivation, with deep, fertile, easily worked loamy soils, retentive of moisture and of manure and often naturally rich in humus and mineral salts. Most of this land has long been tilled, though some (for example, Fenland and south Lancashire) has been made available by careful drainage. This is the land above all other needed by the nation for the production of fresh fruit and vegetables, and which needs protection from the inroads of housing and industry. Its protection near towns is especially desirable to secure local supplies of fresh vegetables. Some at least might be reserved for allotment gardens.

(2) *Land of high agricultural value—the major ploughlands*. For climatic reasons this land is mainly in eastern and southern England and is the land from which Britain must obtain the bulk of her ordinary farm crops for direct human consumption. Whilst from its position and character some may be needed for aerodromes and other national requirements, it should be protected so far as possible from housing and industrial development. Most has shown great stability in use as crop land.

(3) *Land of high agricultural value—first quality grassland*. This includes the best 'fattening pastures', capable of fattening one bullock per acre (or equivalent in other animal units) and usually managed as permanent grassland. Soils are often heavy though fertile and surface water is available. The land is the basis of the home-killed beef industry and much of the dairying industry and should be preserved as far as possible.

(4) *Land of high agricultural value—the major stretches of good grassland*. The carrying capacity is lower than on the first quality grassland and the pastures are not normally fattening pastures without the aid of auxiliary feeding stuffs. The land should be regarded as primarily agricultural but not debarred from other uses under adequate safeguards or control.

(5-7) *Lands of intermediate value*. In the present state of information available no attempt has been made on the map to subdivide this land,

though clearly two or three major types can be separated; for example, the broad stretches of downland, normally under mixed farming, contrasting with the hilly lands of western England and Wales under alternate husbandry. Quite apart from detailed soil studies (the soils are extremely varied) most of this land can be detected when its utilization is studied historically. Much of it to-day is under pasture (often of second quality with reeds, rushes, bracken, etc.); in past times of prosperity or under economic stimulus, much of it was ploughed and cropped; with the advent of times of depression, it became in part agriculturally sub-marginal and much is allowed to lie idle. This is land which should be the especial concern of national planning, where an integration of agriculture, housing, industry, including garden cities, recreational areas, high-speed parkways and other requirements of present and future, should really be planned.

(8) *Land of low agricultural value—moorland and rough hill pasture*. This is land with immature mountain soils, usually thin, or stony podsolized soils, which is of limited economic value as rough grazing, as sporting estates or as gathering ground for water supply. Because of its hilly or mountainous character it is rarely suitable for industrial development, but its greater use in the national economy can be found by a careful division into areas suitable for (a) improvement to good pasture, (b) afforestation, (c) recreation (national parks, etc.), (d) water supply and (e) rough pasture as at present.

(9) *Land of low agricultural value—heathland and lowland areas of rough pasture*. These are the old 'wastelands' of the medieval farmer, usually with 'hungry' light soils, and most of the 'commons' of south-eastern England, as well as larger areas such as the New Forest and Breckland, are of this type. Where occurring near towns, this land is ideal for those parts of 'green belts' designed primarily as public open spaces—scenically attractive with heather and pine woods and drying quickly after rain. If abundant (for example, parts of Surrey) the land is very attractive for good types of residences, provided the owner does not look for a substantial return from the cultivation of his garden or small-holding. The more extensive or remote areas are suitable for coniferous afforestation, military training grounds, and even in some areas for industrial purposes.

The driest and least fertile tracts of downland and limestone pasture are allied in value and utilization; for example, parts of the Chilterns and South Downs.

(10) *Land of low agricultural value—rough marsh pasture, saltings, etc.* Although the reclamation of such land often provides good grazing

(Thames marshes) or even good arable land, it is expensive and difficult to justify commercially; on the other hand, the waterside location, ease of excavation for docks, wharves, etc., and the possibility of building up the land by dredging silt from neighbouring watercourses and thus

improving the river channels, makes this cheap land attractive to heavy industry. There is every reason to encourage industry to use such land; for example, Tees-side, Teemouth, Thames-side; banks of Lower Medway, certain parts of Southampton Water, etc.

National Nutrition Policies

By Sir John Boyd Orr, F.R.S.

IT has been known for many years that faulty diet is the direct cause of a heavy mortality throughout the world through deficiency diseases such as pellagra and beriberi, and, even in the wealthiest countries, of a great deal of ill-health. It has also been known that diseases due to faulty diet are possibly the easiest of all to prevent. Yet we are only now beginning to make a survey of the extent of the damage being done to the human race by malnutrition, and of our food resources available to prevent that damage.

Through the action of the League of Nations, this is now being done on an international basis*. Following the recommendation of the League's Mixed Committee on Nutrition, twenty-one countries have set up national nutrition committees to collect information regarding the state of nutrition in the different countries and to ascertain what is needed to make national dietaries fully adequate for health. The committees are conducting inquiries on what foods and what amounts of each are consumed by people of all classes and living under all sorts of conditions. This information, got by family budget inquiries and dietary surveys, enables estimates to be made of the nutritive value of the diet of different classes and also gives an indication of the level of income necessary for adequate nutrition. A parallel investigation of the state of nutrition of the families whose diets are determined will give some indication of the extent to which ill-health and poor physique can be attributed to deficiencies in the diet.

It is difficult, however, to assess the relative influence on health of faulty diet and of other factors inimical to health which usually accompany faulty diet. Useful information on this can be obtained by feeding experiments on children on poor diets, the deficiencies of which are made good by the addition of supplements of high nutritive value, and comparing the subsequent health of these children with that of children on similar diets and under comparable conditions but not receiving supplementary feeding. A further line of inquiry

recommended is a survey of total national food supplies, home products plus imports, and a comparison of total food available with total national nutritional requirements. The information obtained in all these investigations will show what changes are needed in national food policies in the interest of health.

Governments were requested to furnish to the League annual reports on the work of their nutrition committees and the secretariat was instructed to publish an annual summary of these statements and of the proceedings of meetings of the representatives of the national committees. This survey of national nutrition policies now available gives the first annual report on the statements received and of the proceedings of the first meeting held last October, at which sixteen countries were represented.

Though the work of most of these committees is still in the initial stage, this report promises well for the success of the difficult work which they have undertaken. The information brought out in the preliminary inquiries shows the great need for a world-wide investigation and the immense possibilities of promoting human welfare by the application of "the newer knowledge of nutrition". The facts already revealed are sufficiently startling to warrant immediate changes in national food policies. Even in a country like Australia, where the standard of living is high compared with European countries, it was found that clinical survey with modern scientific methods revealed a quite unexpected amount of malnutrition. Of more than three thousand children examined in four inland areas, 17.9 per cent were recorded as showing evidence of unsatisfactory nutrition. An inquiry among pre-school children in Melbourne revealed evidence of malnutrition in 21.7 per cent of those examined. It is suggested that the malnutrition is due to a lack of dairy products, fruit and vegetables. The Australian Government has been trying to find a market for the export of these. It looks as if she has a market within her own borders which could be exploited to the great benefit of the people of Australia. In the United States, more than 60 per cent of the diets of Negro

* League of Nations. *Survey of National Nutrition Policies, 1937-38.* (Official No.: C478.M.321.1938.IIA.) Pp. 120. (Geneva: League of Nations; London: George Allen and Unwin, Ltd., 1938.) 2s. 6d.

families in the south were found to be in need of improvement. In Hungary it was found that if requirements are to be fully met and exports maintained at the present level, milk production would need to be increased by 120 per cent and eggs by 470 per cent. In Jugoslavia, the peasant's winter diet consists almost solely of bread and beans. In summer, it provides nearly all the necessary elements, with the result that, in the autumn, there is a noticeable improvement in nutrition. Under the existing economic conditions, the peasant is obliged to sell his milk and eggs, and farm workers and children suffer from all kinds of deficiency diseases. Rickets and pellagra are specially common. During the Easter fast, epidemics of night-blindness and other eye diseases occur in certain regions. It is stated that some villages observe practically all orthodox fasts, which may amount to as many as 206 in the year.

These are examples of the kind of facts being brought to light by the work of these national nutrition committees. They are dealing with an urgent world-wide problem. They are showing the direction in which modern science can be most easily applied for the promotion of human welfare, pro-

vided Governments can devise ways and means to increase production of the 'protective' foods, to facilitate distribution and adjust the economic system to bring a diet adequate for health within the reach of all and, at the same time, carry on educational campaigns so that families may be able to adjust their expenditure on food to the best advantage.

The work which the League of Nations has done in initiating and carrying on this work for the improvement of nutrition on an international basis is sufficient alone to justify its establishment. The League provides an international organization which can mass the world's scientific knowledge on the problem, and bring together the representatives of all the different countries once a year to get the mutual benefit of the exchange of information and the discussion of difficulties. The enthusiasm for the work would be increased with the knowledge that the information obtained is being used for the evolution of agricultural, trade and economic policies, designed to adjust national food supplies to national requirements and so bring the work of the national committees to full fruition.

Element 43

By Prof. E. Segrè

EVERY time that physics has offered a new analytical tool to chemistry, the most striking success has been the discovery of new elements. Rubidium and caesium are thus offsprings of the use of the spectroscope, polonium and radium were discovered through the new methods of radioactivity, hafnium and rhenium were recognized through their X-ray spectra.

Mendeléeff's work, on the other hand, by classifying the chemical types, has in a way set a limit to the possibility of further discoveries and gives also a method of predicting rather exactly the properties of the missing elements. These are element 43, a lighter homologue of rhenium; element 61, a rare earth; element 87, a halogen; and element 89, an alkali. The search for these elements in the minerals, the only source at our disposal until a few years ago, has not been successful, and none of them seems to have been recognized with certainty in the earth's crust, in spite of considerable effort¹.

Artificial radioactivity has supplied chemistry with a powerful new instrument, and from the point of view of the discovery of new elements its most striking feature is that one is able now to create, by transmutation from other elements, the element one wants to study. The first achieve-

ment in this type of investigation was the discovery of transuranic elements by Fermi and his co-workers, continuing the periodic system above uranium (No. 92), although, in view of recent work, confirmation of their existence is needed.

In the search for the four missing elements lower than uranium, we have now been able to prepare element 43 and study its properties in detail. The substance was produced in the Berkeley cyclotron, which thus remains for the time being the only 'mine' of the element. It was made by bombarding molybdenum with deuterons or with neutrons².

At least five radioactive isotopes of atomic number 43 have been recognized³ among the products of the bombardment, and some of them have a half-life long enough to permit a rather complete investigation of the chemical behaviour of element 43. Actually perusal of the periodic table may help to predict many of its chemical properties but, on the other hand, the finer details, often very important from the analytical point of view, may be found only by direct experiment.

The first properties to be studied obviously should be the analytical ones, in order to be able to identify the new element and separate it from all the others. Many of the separations are quite

elementary and there is no need of any special study to devise them, but for the separation from the neighbouring elements things are more complicated, and emphasis has to be put on the separation from manganese, molybdenum, ruthenium and especially rhenium, which are the four elements closest to element 43 in the periodic table, and have most resemblance to it. The methods and principles of the chemistry of minute amounts of substance and of radioactive detection, as worked out by Curie, Rutherford, Soddy and others in their classical work on the natural radioactive elements, have been employed throughout and satisfactory methods of separation have been worked out. The fundamentals of the analytical chemistry of this element have thus been secured and can now be utilized for further progress.

Practically none of the many physical constants of the new element can be determined using amounts of the order of magnitude of 10^{-10} gm. of substance as produced artificially; but this situation prevails also for some of the natural radioactive substances, and there is at present no possibility of overcoming this difficulty. On the other hand, properties such as the volatility of certain compounds, partition coefficient in frac-

tional crystallization, etc., can be determined even with such tiny amounts of substance, and some of these have actually been measured.

A fortunate circumstance allows us to detect even the K_{α} line of the X-ray spectrum of element 43, though the amount of substance would not be sufficient to show, by ordinary methods of external excitation, this spectral line, or any optical line. One of the radioactive isotopes of 43 exists in two isomeric states and the upper state decays into the lower. By the mechanism of internal conversion of the gamma rays, these transitions eject the K electron of the atom 43, which is now in a condition to emit the characteristic X-ray line. This line has been identified by its absorption discontinuity in neighbouring elements¹, and more recently it has even been possible to photograph it in a bent crystal spectrograph². This is the first time that the X-ray line of a new element, synthesized artificially, has been directly observed.

¹ See, however, Noddack, W., and Tacke, I., *Stsb. Preuss. Akad. der Wissenschaften*, 19, 400 (1936).

² Perrier, C., and Segrè, E., *J. Chem. Phys.*, 5, 712 (1937); and in the *Press.*

³ Gaudapodi, B., and Segrè, E., *Phys. Rev.*, 53, 1252 (1937); and unpublished results.

⁴ Segrè, E., and Segrè, G. T., *Phys. Rev.*, 54, 772 (1938).

⁵ Abelson, P., unpublished results.

Obituary Notices

Prof. Henry Louis

THE death of Prof. Henry Louis at his home in Newcastle-upon-Tyne on February 22 at the age of eighty-three years marks the passing of a period in the life of the Royal School of Mines, as he was the last survivor of the students who were present at the first annual dinner held in 1873.

Louis was born in London, and after receiving his preliminary education in London and Germany entered the Royal School of Mines in 1873, where he studied mining under Warrington Smyth and metallurgy under John Percy. He became remarkable for the wide scope of his learning, and won fame as a mining engineer, a metallurgist, a teacher and a linguist.

After graduating first of his year, Louis worked for some time in Percy's laboratories and then commenced his professional work in association with Sir William Siemens. For twenty years he was entirely engaged in reporting upon and managing metalliferous mines in different parts of the world, including South and West Africa, South and North America, Malaya, California and Spain. Thus his knowledge of mining practice became almost encyclopaedic.

During this period, Louis never lost his early interest in primary metallurgy, both ferrous and non-ferrous, so that when he was appointed to the joint posts of professor of mining and William Cochrane lecturer in metallurgy in Durham College of Science, Newcastle-upon-Tyne, now King's College,

Newcastle-upon-Tyne, in 1895, there could have been no more fitting choice. As a teacher he was outstanding. His personality impressed itself on his students and inspired them in a remarkable way, his fund of knowledge and experience being a perpetual source of joy to all those who had the good fortune to work under his direction.

Louis was the author of many publications, in which the breadth of his knowledge is admirably displayed. While he was a persistent and usually kindly critic of the work of his fellows, his comments at times could be devastating. He took a very active part in the life of many professional institutions and was elected president in 1927 of the Institution of Mining Engineers, and in 1929 of the Iron and Steel Institute, which awarded him the Bessemer Gold Medal in 1932. A year later he was elected a fellow of the Imperial College.

The last forty years of Louis' life centred around the northern coalfield, where his work as professor and emeritus professor, as well as his twenty-five years' association as secretary, with the North of England Institute of Mining Engineers will long be remembered. He was a member of various Government Commissions, of which two—the Royal Commission on Mining Subsidence, 1923–1927, and the Commission to inquire into the practicability of gold mining in Merionethshire, 1930—were of particular interest to him.

J. A. S. RIMSON.

Dr. W. E. Grimshaw, O.B.E.

THE Research Department, Woolwich, has suffered a serious loss through the untimely death of Dr. W. E. Grimshaw, deputy director of ballistics research, at the age of fifty-eight years.

Dr. Grimshaw originally joined the department in 1916 as an assistant proof and experimental officer, remaining at Woolwich until September 1919, and then left to resume his pre-War employment as one of His Majesty's inspectors under the Board of Education. He rejoined in 1921 and at once took a leading part in the investigations into fundamental ballistic problems which had, of necessity, to be kept in abeyance during the War period. For this work he was peculiarly fitted as he could combine his wide knowledge of mathematics and physics with the practical artillery experience gained during his War service.

A long series of researches, experimental and theoretical, on the burning of propellants in a closed vessel culminated in the joint publication with Dr. A. D. Crow of two important papers, "The Equation of State of Propellant Gases", (*Phil. Trans. Roy. Soc., A*, 230; 1931) and "The Combustion of Colloidal Propellants" (*Phil. Trans., 230*; 1932). The first paper greatly extended Petavel's early work on the subject (*Phil. Trans. Roy. Soc., A*, 205; 1905) while the second put forward the theory that the rate of burning of a propellant (such as service cordite) is conditioned by the density of the surrounding gases rather than by their pressure (Cf. Mansell, *Phil. Trans. Roy. Soc., A*, 207; 1908). The mathematical consequences of this theory as applied to internal ballistics were examined in two further papers, with Dr. Crow, on "The Combustion Problem of Internal Ballistics" (*Phil. Mag.*, 15, 529, 729; 1933).

Another problem to which Grimshaw turned his attention was that of the behaviour of plastic metals under stress. The determination of the maximum gas pressure in a gun is a matter of great importance for ordnance design, and the service (crusher-gauge) method is to measure the amount of compression experienced by a small copper cylinder enclosed in a steel container fitted with a piston. This gauge, whilst giving reliable comparative results, is known to record less than the true pressure by amounts which vary with the nature of the gun and propellant employed. Grimshaw examined the problem afresh in his paper "The Plastico-Viscous Deformation of Right Circular Cylinders of Soft Metal under Variable Load Axially Directed" (*Phil. Trans. Roy. Soc., A*, 233; 1934), and intended afterwards to make practical use of the theory developed therein. The foregoing papers represent only a portion of his work, as it must be remembered that much of it had, of necessity, to remain secret; but it may be said that there was not one of the many and various problems connected with ballistics to which he did not make some contribution.

Grimshaw's earlier career at Oxford had been a brilliant one. A scholar of Corpus Christi, he took first classes in the Final Honour Schools both of mathematics and of physics, and he was junior and senior mathematical scholar of the University

graduating B.A. in 1904 and M.A. in 1907. The degree of D.Sc. was conferred on him in 1936, and he was a foundation fellow of the Institute of Physics. His duties as an inspector of schools gave him no opportunities for research, but he got his chance in later life, although of recent years the burden of administrative work left him little but his leisure time for investigation. He had a very wide knowledge of modern mathematical physics and kept abreast of the times by incessant reading.

To his younger colleagues, Grimshaw was always generous with encouragement and help, and was consulted by them in any difficulty as a matter of course. He will be greatly missed as a most valuable member of the Research Department, and as a very loyal friend.

C. A. C.

Dr. G. H. Carpenter

THE REV. DR. GEORGE HERBERT CARPENTER died at Guildford, Surrey, on January 22, at the age of seventy-three years. Born at Peckham in 1865, he was the son of George Carpenter and Phoebe Hooper. His early education was private; later he carried on his studies at King's College, London, and at the Royal College of Science, Dublin. After a period as clerk in the Natural History Museum, South Kensington, he became, in 1888, assistant naturalist at the Dublin Museum. He gave up this post in 1904 on being appointed professor of zoology at the Royal College of Science (Dublin), where he stayed until 1922. On leaving Ireland he became keeper of the Manchester Museum (1923-34). A few years after his return to England he became a deacon of the Church and a priest a year later. He was honorary curate at Christ Church, West Didsbury, from 1926 until 1934 and was transferred to a similar position at St. Augustine's, Broxbourne, from 1935 until 1937. He was editor of the *Irish Naturalist* for thirty years, secretary of the Royal Zoological Society of Ireland from 1911 until 1919 and afterwards secretary of the Royal Irish Academy.

Most of Carpenter's published work was in connexion with entomology. Of his books, "Insects, their Structure and Life", first published in 1899, is an admirable elementary manual. This was followed by his "Insect Transformation" (1921) and the "Biology of Insects" (1928), both of which are characterized by accuracy and clearness of exposition. He made a special study of the order Collembola and became the leading authority on this group in Great Britain. On the morphological side, he was specially interested in segmentation among arthropods and wrote several papers on this topic which were noteworthy in their day. For a number of years, he was consulting entomologist to the Royal Dublin Society, and in this capacity wrote a series of reports on injurious insects in Ireland. He was especially interested in the warble fly problem, and on this subject he contributed valuable papers based on carefully planned experiments.

Carpenter's death removes from our midst a kindly and generous personality. He is survived by his wife and son.

A. D. I.

Dean L. P. Reinhold Matsson

THE death last summer of Dean Reinhold Matsson, botanist, geneticist and churchman, at the relatively early age of sixty-eight years, is a distinct loss to rhodology and systematic botany in Europe.

Since the time of Linnæus, there has been a traditional line of systematic botanists in Sweden—Afzelius, Swartz, Hartman, Wahlenberg, Fries, Scheutz, Winslow, Almquist and Matsson—who have worthily upheld the torch first lighted by the Swedish father of systematic botany. The last two, Sigfrid Almquist and Dean Matsson, both specialized in the genus *Rosa*, and although their methods were so original and diverse from one another, their results were complementary.

Dean Matsson had the good fortune to be born on the famous island of Gotland and to attend school in the medieval town of Visby, well known as the 'city of ruins and roses'. The abundance of wild and naturalized roses in the district no doubt attracted the natural curiosity of a born researcher like Matsson who, though destined for the church, was by nature a naturalist and man of science. At the University of Uppsala he happily combined the studies of theology and botany, and at an early age, under the direction and supervision of the world-famous Belgian rhodologist, Prof. Crepin, he made a thorough study of the genus *Rosa* and afterwards continued his researches on his own original lines. His first scientific paper was published in 1895 after two years' research in Gotland, Öland and Småland, followed by papers in 1900 and 1901.

In the latter year, Matsson achieved a European reputation by his conspectus of *Rosa* in Neuman and Ahlfvengrens' 'Flora of Sweden'. Further contributions appeared in 1912, 1915 and 1916, culminating in his *magnum opus* of 1934–35, 'Examen Rosarum Suecicæ', published in *Kungl. Svenska Vetenskapsakademiens Handlingar*, 14, No. 3, pp. 1–380 (1934), Stockholm. In the course of his numerous collections, Matsson accumulated an extensive herbarium of valuable rose material. Like all practical botanists, Matsson was an enthusiastic gardener and geneticist, and in his gardens at Hudiksvall, in the Province of Hälsingland, he cultivated and experimented genetically with the forms of *Rosa* collected in his expeditions. In 1912, his remarkable genetical experiments in breeding various species of Canine true to type, after the flowers had been carefully castrated, demonstrated, for the first time on a large scale, the existence of apomixis in the Canine roses. This important fact, since confirmed genetically and cytologically, has led to the generally accepted theory of the hybrid origin of all the Canine species of *Rosa*.

Matsson also gave considerable assistance to Tackholm in identifying the material used by him in his important work on the chromosomes of *Rosa*, and he was fully alive to the advantages of combining genetical with systematic work.

As a systematic botanist, Matsson was more analytical than synthetical, and the permanent value of his systematic work lies in his minute and accurate

analyses of the character-combinations of the multitudinous forms, varieties, subspecies, and natural hybrids of the Canine species of *Rosa*.

O. C. HURST.

Mr. C. H. Jenkinson

MUCH of the success of modern experimental research depends upon the quality of the instruments that are available, and it often happens that in the apportionment of credit for work done, the share of the workshop is comparable with that of the laboratory. Mr. C. H. Jenkinson, who died on March 6 after a short illness, was one of those artistic instrument-makers to whom science is in debt. He was trained in the works of the Cambridge Scientific Instrument Co. Nearly thirty years ago, he was given charge of the physics workshop of the University of Leeds. He made the first X-ray spectrometer. As the X-ray analysis of crystal structure developed and greater demands were made upon his skill, he never failed to respond, and to better the instructions given to him. Researches in various branches of physics, carried out at Leeds, at University College, London, and finally at the Royal Institution were greatly facilitated by his ingenuity in design, his judgment of material and his beautiful technique. In the reconstruction of the Royal Institution buildings his advice was of material value. He acted as a judge at the Physical Society's exhibitions in recent years. He will be sadly missed by the staff of the Davy Faraday Laboratory, and by all who are responsible for the effectiveness of the Royal Institution.

W. H. B.

We regret to announce the following deaths:

Prof. Giuseppe Cesàro, formerly professor of mineralogy in the University of Liège, a past-president of the Belgian Academy of Sciences and *correspondant* for the Section of Mineralogy of the Paris Academy of Sciences.

Prof. H. M. Dawson, F.R.S., professor of physical chemistry in the University of Leeds, on March 11, aged sixty-three years.

Marcel Godchaux, professor of chemistry and doyen of the Faculty of Sciences of the University of Montpellier and *correspondant* for the Section of Chemistry of the Paris Academy of Sciences, known for his work on the heterocyclic carbon compounds, on February 11, aged fifty-nine years.

Prof. A. M. Hocart, professor of social anthropology in the University of Cairo, on March 9, aged fifty-five years.

Dr. Ivan C. Jagger, senior pathologist in the Bureau of Plant Industry, U.S. Department of Agriculture, on February 16, aged forty-nine years.

Prof. C. M. Jessop, emeritus professor of mathematics in the University of Durham, on March 9, aged seventy-six years.

Prof. E. B. Wilson, For. Mem. R. S., Da Costa emeritus professor of zoology in Columbia University, on March 3, aged eighty-three years.

News and Views

Discovery of a Living Crossopterygian Fish

THE discovery of a living crossopterygian fish of the order Actinistia, described and illustrated on p. 455, is an event of outstanding importance. There can be no doubt that Dr. J. L. B. Smith, who is to describe this specimen, is correct in placing it in the family Coelacanthidae, of which it would appear to be a typical member. In some respects, the present specimen seems to bear a closer resemblance to genera of the early Mesozoic era such as *Undina* than to the later coelacanths of the *Macropoma* type from the Upper Cretaceous. The fact that no traces of fossils referable to this family have been found in rocks later than those of the Cretaceous period makes the discovery of a living representative in South African seas even more remarkable. It is stated that the skeleton of the living fish was found to be cartilaginous and the vertebral column apparently tubular. In the fossils the central part of the vertebral column has disappeared, and was probably cartilaginous, but the neural and haemal spines were ossified. A unique feature of the fossil coelacanths is the ossified air-bladder, which can be seen clearly in many specimens, and it will be of interest to learn whether this character was observed in the living fish. The photograph of the South African fish seems to show paired nostrils just in front of the eye; but this is another feature of which we must await confirmation. Dr. Smith's detailed report will be awaited with great interest by zoologists and paleontologists alike, and it is little short of a tragedy that the unfortunate disposal of the body of the fish after skinning will make this report very far from complete. An article relating to the discovery of this fish by Dr. E. I. White, of the British Museum (Natural History), accompanied by a large photograph, appeared in the *Illustrated London News* of March 11.

Prof. J. L. Myres, O.B.E., F.B.A.

ON October 1 of this year, Prof. John Linton Myres, Wykeham professor of ancient history in the University of Oxford, will retire, and will be succeeded by Mr. Henry Theodore Wade-Gery, fellow of Wadham College, Oxford. Prof. Myres has occupied this chair since its inauguration in 1910, returning to his own University after three years as Gladstone professor of Greek and lecturer in ancient geography in the University of Liverpool—a chair which also he was the first to hold. His tenure of the Wykeham professorship had already expired under the age limit, but was extended for a further period of five years. His appointment to this chair, which his pre-eminence as a research worker and original thinker in the field of the ancient history (or as it would now be termed the pre- and proto-history) and geography of the Mediterranean region had made almost inevitable, was otherwise appropriate in that he was both a Wykehamist and a member of New College.

BEFORE his appointment to the Gladstone chair at Liverpool, Prof. Myres had been a student of the British School of Archaeology at Athens and had held a fellowship at Magdalen College and a studentship at Christchurch, Oxford; and he had travelled widely and excavated in various parts of the Mediterranean, Greece and the Aegean, Cyprus, Crete, northern Africa and Asia Minor—activities which have continued to occupy much of his periods of vacation. Apart from his reputation as archaeologist, geographer, and historian—many of his discoveries and conclusions are classics of reference—Prof. Myres is known throughout the scientific world for his energy and abilities as an organizer. There are few fields in the economy of science in which he has not intervened to the advantage of men of science and their work. It was during his tenure of office as general secretary of the British Association in the years succeeding the Great War that the organization and working methods of that body were reformed and brought up to date, mainly on his initiative, with the co-operation of the late Prof. H. H. Turner and later of Sir Frank Smith, his fellow secretaries. During the War, Prof. Myres served in the Naval Intelligence in the eastern Mediterranean, where he combined the duties of an intelligence officer with more aggressive tactics, modelled, it was said, on the raids of Homeric heroes. For his services he received the O.B.E. and the Order of King George I of Greece.

Early Civilization and Cultural Relations in Cilicia

EXCAVATIONS at Mersin in Cilicia by the Neilson Expedition to the Near East of the University of Liverpool during the present season have more than justified the anticipation of last year that this site would afford evidence of settlement and early cultural development equal in antiquity to, if not surpassing, anything yet recorded in the Mesopotamian region. According to Prof. Garstang's preliminary report on this season's work (*The Times*, March 10), the sixteenth level of excavation has been found to contain the well-preserved remains of a fortified city—a whole group of great buildings laid out with plan and purpose. This level lies twenty feet below the imperial Hittite fortress uncovered last year; and in it chalcolithic deposits lie beneath a stratified series of building levels, in which the culture is related to the early predynastic Mesopotamian cultures of Uruk and Tell Ubaid. The cultural affinity with predynastic Mesopotamia of the sixteenth level itself is demonstrated by evidence of direct contact with the polychrome phase of the still older Tell Halaf culture. Prof. Garstang's approximate dating assigning this cultural level at Mersin to 3600 B.C. is therefore to be regarded as by no means excessively high; while the line of fortifications with its abutting 'married quarters', and the chief's residence, all brick-built and not of stone, it is to be noted, thus constitute the oldest known example of architecture.

THIS level of chalcolithic occupation, however, lies at a depth of no more than 35 ft. from the summit of a mound which rises to a height of 80 ft. above water level; and it is known that there is a further ten feet of chalcolithic deposits below it before the neolithic strata are attained. In these, the accumulated relics of the original neolithic settlers extend downward for more than 30 ft. Here, Mr. Miles Burkitt, whose expert examination has been invoked, has found evidence, extending from below the painted pottery down to the 12 ft. level, of two main phases of neolithic culture, in which black or brown pottery is associated with tools of obsidian. To the beginning of the later of these two phases he assigns an antiquity which "can hardly be later than 5000 B.C., while the lowest level reached must date a thousand years earlier". As Prof. Garstang points out, the elaboration of the fortifications and dwelling site point to a well-advanced and highly organized existence at Mersin when Egypt, Babylonia, Crete and Europe were still in infancy. Impressive as the chronological range of this Cilician culture must appear to be, its significance for the archaeologist is enhanced, when Prof. Garstang finds in certain details of his ceramic material evidence which appears to point not only to the East, but also to the West, forming a possible link with the Danubian area. Should further examination endorse this suggestion, Mersin will afford something approaching decisive evidence on a crucial problem of European prehistoric chronology of late much under discussion.

Exhibition of Cypriote Antiquities

AN exhibition of pottery of the Early Bronze Age at the Institute of Archaeology of the University of London was opened by the Earl of Athlone, Chancellor of the University, on March 10. This pottery was excavated at Vounous in Cyprus by an expedition sponsored by the British School of Archaeology at Athens and under the direction of Mr. James Stewart. The exhibition, as was pointed out by the Chancellor in declaring it open, is the first to be held in England of the results of an important excavation of purely British origin in Cyprus; and this fact is indeed of special significance in view of the attempts which have been, and are being, made to arouse interest in Great Britain in the early history and antiquities of Cyprus. The cost of the excavation was defrayed by subscription, among the principal subscribers being the University of Cambridge, Sir Charles Hyde, and Sir Charles Marston. The last-named has presented the main part of the finds allotted to him to the Institute of Archaeology, and they form the nucleus of the present exhibition with supplementary loans from the Fitzwilliam Museum, Cambridge, and the Birmingham City Museum and Art Gallery. After the exhibition had been declared open Mr. Stewart gave an account of the site and its excavation. The Vounous site is a cemetery on the east and north sides of a low hill in the foothills of the Kyrenia Mountains. The north side had already been excavated by Dr. Dikaios, and the present work was confined to the east side. The tombs are open caves approached from a forecourt. Burial is in a contracted position, with burial gifts

of pottery and food. The entrance was sealed with a single stone and covered in. Sometimes graves had been opened by an iron age grave-digger, who had again sealed the tomb after inserting a votive offering, with, as Mr. Stewart said, "confusing effect". The chronology of the site falls into three periods, dated tentatively from 2900-2500 B.C., 2500-2300 B.C. and 2300-2050 B.C.

Approach to the Absolute Zero

THE second Poynting Memorial Lecture in the University of Birmingham was delivered by Dr. H. B. G. Casimir, of Leyden, on March 7, on "The approach to the absolute zero of temperature and some properties of matter at the lowest temperatures at present attainable". Dr. Casimir remarked that the subject, being one in which the combination of the theoretical and experimental had been so fruitful, was an appropriate one with which to commemorate a man who had in himself so remarkably embodied this combination. The definition of temperature in terms of an ideal gas enables us to say that the ice-point is 273.15° K., but in practice the gas scale cannot be used directly below 1° K., for at such temperatures gases cease to exist. It is possible, however, by other methods, for example, the resistance of phosphor bronze, to extrapolate to 0.2° K., and very small temperature changes can be measured by using the magnetic properties of substances, so that measurements down to a few hundredths of a degree absolute or even less can be made with a good deal of confidence. Methods of experimenting were explained and the remarkable properties of helium II were described.

It appears likely that it is impossible to solidify helium II, because the solid state requires stability of lattice, and if the helium atom cannot have less energy than $h\nu/2$, this may be sufficient to prevent the formation of a stable lattice no matter how low the temperature. Some special advantages of working at low temperatures were mentioned: Electric insulation is enormously improved; exceedingly high vacua can be attained—if care is taken to exclude helium, vacua down to 10^{-10} or perhaps 10^{-12} mm. of mercury can be attained. Thermal insulation is greatly improved by the almost complete absence of radiation and of gas. Calorimetry is rendered relatively easy, for heat capacities are small, whereas by using the magnetic properties of a salt such as $\text{KCr}(\text{SO}_4)_3 \cdot 12\text{H}_2\text{O}$, temperature changes of the order of 0.001° can be measured, so that the surprising conclusion emerges that the heat generated by allowing a mass of 1 gm. to fall through 0.01 mm. would be capable of detection. The facts of superconductivity suggest the possibility of construction of galvanometers of prodigious sensitiveness and there would be no Brownian motion to cause trouble.

Necker's Map of Scotland

THE first geological map of Scotland, made by Louis Albert Necker in the year 1803, was exhibited by Mr. V. A. Eyles, of the Geological Survey, at a meeting

of the Edinburgh Geological Society on March 9. The map, which belongs to the Geological Society of London, is based in part on information supplied to Necker by other geologists and in part on his own extensive travels in Scotland. The map has never been published, and in view of its historical importance, it is hoped to reproduce a colour facsimile. Mr. Eyles said that Necker, who was born in Switzerland, went to Edinburgh in 1808, and studied geology under Prof. Jameson at the University. He was a grandson of de Saussure, the famous Alpinist and geologist; he was related to Madame de Stael, the novelist, and to Necker, the financier, a minister of Louis XVI. After leaving Edinburgh in 1808, he became professor of mineralogy at Geneva, and travelled extensively in Europe. In 1821, he published an account of his travels in Scotland in a three-volume work entitled "*Voyage en Ecosse et aux Iles hébrides*". He returned to Edinburgh on several occasions. In 1841 he retired to Skye for reasons of health, and remained there until his death in 1861. He was buried at Portree.

Comfort in Travel

At the annual joint meeting of engineering and technical societies organized by the Institution of Automobile Engineers and held on March 10 at the Institution of Civil Engineers, three short papers were read on "Comfort in Travel". The first paper was on road travel by S. Garcke, the second on rail travel by Lord Stamp, and the third on air travel by Capt. E. W. Percival. Mr. Garcke pointed out that much of the improvement in the comfort in travel by road is due to the improvements of the surface of the roads. The invention of the railway was essentially the product of necessity, and was mainly due to finding something better than the water-bound flint or stone road. It seems improbable that further marked improvements in road surfaces can be anticipated. The discomfort due to nervous reaction imposed upon a driver by the presence on the road not only of many signals, but also of advertisements, lights and other contrivances, readily confused with official signs, is very real. Such signs are now greatly on the increase and will have to be controlled.

LORD STAMP laid stress on two elements in rail travel: mental ease and physical ease. Mental ease is promoted by removing difficulties in the way of finding out how to go and when to go. Throughout the United States and Canada many agencies have been established by the British railways, all with the object of easing matters for the customers. Physical ease is promoted by absence of disturbing vibration and noise and by the provision of adequate heating, ventilation and lighting. The L.M.S. Co. has employed eminent men of science in Great Britain to solve some of their problems, and both here and in the United States the motion of tyres of different profiles have been studied by means of cinematograph records. It has been found that a profile as nearly cylindrical as possible gives the greatest freedom from high-frequency lateral oscillations.

Captain Percival considers that the development of the aeroplane has progressed more rapidly than that of any other form of transport vehicle. For very large cities it will soon be essential to have several main aerodromes so as to take care of the ever-increasing traffic.

Social Survey of Bristol

A PRELIMINARY report on the standard of living in Bristol, by H. Tout, has been issued by the University of Bristol Social Survey, of which Mr. Tout is director ("The Standard of Living in Bristol: a Preliminary Report of the Work of the University of Bristol Social Survey." By Herbert Tout. Pp. 64. Bristol and London: J. W. Arrowsmith, Ltd., 1938. 1s. net). The comprehensive social survey of Bristol which is nearing completion has been made possible by the Colston Research Society, which has assumed entire financial responsibility, while the University undertook responsibility for the conduct of the research work and the appointment of the Survey staff. The preliminary report is only concerned with incomes which fall below middle-class levels, and covers four fifths of all Bristol families. The report indicates that, on the whole, the typical Bristol family is fortunately placed and probably better off than the families of many other towns. There are estimated to be 12,000 families in the Survey area which are very comfortable by the prevailing standards, which are not high, in the classes covered. At the other end of the scale there are 11,000 families in poverty. Between these extremes there are 58,000 families whose standard of living calls for no special remark, and some of these have a small margin for saving or pleasure. Beneath them come 21,000 families who, whilst not in poverty, have a hard struggle and whose lot is far from comfortable. Probably 40,000 people in the area live in actual poverty, and among them a disproportionate number of children, so that one out of five working-class children comes from a home that is unable to give it a fair start in life.

THE inquiry upon which the report is based was conducted from May to October 1937, coinciding roughly with the peak of the revival of business which started in 1932. The standard of minimum needs adopted in the survey in assessing poverty closely follows that used by Mr. R. F. George (*J. Roy. Statistical Soc.*, 100, 74 (1); 1937). The average Bristol working-class family has a standard of living more than 100 per cent above its minimum needs, and the average size of the family is only slightly above that of the middle class (3.73 in the poorest groups as against 2.94 in the most comfortable group). The rate of poverty is highest for those under fifteen and lowest for those in their twenties, being only 4.1 per cent in the age group 20-24. Unemployment is outstandingly the most important reason for family income falling below 'needs', and affects nearly one third of the families. Old age ranks third in importance, rather less than one sixth of the cases being assigned to it. Broken families, in which there is no adult male earner, account for 10 per cent of

the cases and sickness for 9 per cent. Insufficient wages account for 21.3 per cent of all families below the standard.

British Chemical Plant

THE reference in the leading article in *NATURE* of January 28 to the report of the Association of Scientific Workers, and more particularly to the urgent need for more State assistance for fundamental research, receives further emphasis from a recent discussion by the British Chemical Plant Manufacturers Association, following an earlier meeting in May 1938. In the report above-mentioned it was specifically indicated that among the more urgent and important cases where State support is required is that of chemical engineering, notably in connexion with raw materials and unit operations. Although the discussions of the B.C.P.M.A. were at first intended to be limited to the question of closer collaboration between chemical manufacturers, chemical plant manufacturers and consultants, with the view of quoting for and providing complete process units, it soon became evident that the scope of debate would have to be extended to include co-operation on much wider grounds, including not only fundamental scientific research but also the economic question of meeting foreign competition effectively. It was not easy to come to any definite decision or formulate a constructive policy of basic research: this is a matter for further discussion between the main sections of the chemical industry and the Government. When one considers, however, the strenuous and for the most part successful efforts of recent years to place chemical engineering in Great Britain on a sounder basis, it is to be hoped that the matter will not be left where it is, in view of its supreme importance in regard to national well-being, export trade and defence.

ON the question of more effectively meeting foreign competition, some plant manufacturers find that there appears to be a tendency both on the part of certain Government departments and of some of the chemical manufacturers to assume too readily and complacently that the British makers of chemical plant and apparatus are sometimes unable or unwilling to tender for complete process units, especially in connexion with new processes; and that this assumption has apparently formed the ground, or one of the grounds, for applications for licence to import foreign plant. The real truth, as was clearly shown at the last informal discussion of the British Chemical Plant Manufacturers Association, is that the need for these complete tenders from one firm is more infrequent than commonly supposed, and that, when it really does arise, the British manufacturer of plant is quite as well able as his foreign competitor to supply complete tenders if the inquiries are genuine and are accompanied by full details and complete designs. The allegation therefore that, whilst German or American firms will supply complete specifications and prices for the whole plant, it is necessary to apply to several different British firms for the various parts, with

consequent greater delay, inconvenience, and enhanced cost, is not quite fair. Nevertheless the fact remains that much foreign plant has been and is still being imported. In addition to this discouragement, the British maker has to face ruthless Government-subsidized competition in foreign markets, and should therefore receive the greater support from his colleagues in the chemical industry and from the Government at home.

Some Earthquakes Registered in 1937

WE have received from Dr. W. Hiller the data concerning earthquakes registered at Stuttgart, Ravensberg and Meestetten-Ebingen in 1937. Stuttgart is now equipped with three Galitzin-Wilip seismographs orientated north-south, east-west, and vertical, one Wiechert vertical seismograph of mass 1,320 kgm., two Mainka seismographs of mass 450 kgm. set north-south and east-west, a seismograph of mass 80 kgm. orientated east-west and a horizontal Wiechert instrument of mass 17,000 kgm. Ravensberg has two Mainka pendulums of mass 450 kgm. orientated north-south and east-west, and two Conrad seismographs of 23 kgm. also set north-south and east-west. Meestetten-Ebingen is equipped with one vertical Wiechert instrument of mass 80 kgm., and two horizontal pendulums of mass 80 kgm. orientated north-south and east-west. The full list of constants for all these instruments is given. The main part of the report concerns the 428 earthquakes registered at these stations during 1937. For each shock recorded a full list of readings, including date, registering station, component, phase, arrival time, period, amplitude in μ , and remarks chiefly concerning the epicentre and epicentral distance from the station, is given. Lastly, there follow two valuable additions to the compilation. First comes a tabulation of microseisms registered on the Galitzin-Wilip seismometers at Stuttgart, including the period and amplitude in μ on the three components, and secondly a careful study of the Hohenzollernalb earthquake of June 17, 1937. The epicentre of this is found to be $48^{\circ} 15.3' N.$, $9^{\circ} 12.4' E.$, ± 2.3 km., depth of focus 19-20 km. $\pm$ about 4 km., and T , 9 h. 56 m. 41.8 s. ± 0.3 s. The publication forms a very valuable addition to the data and literature of seismology.

'Commercial' Water Culture of Plants

AN amusing example of the way in which the publicity of the Press may embarrass scientific workers is provided by the need for Circular 347 of the Agricultural Experiment Station, Berkeley, California, in which D. R. Hoagland and D. I. Arnon have to try to dispel illusions about the commercial possibilities of growing plants by water culture. The authors point out that the technique of water culture contains nothing new and has indeed been employed for more than a quarter of a century by this experiment station, whilst the method was, of course, described by the German physiologist Sachs in his text-book about 1860. The California Experiment Station must rue the day that Dr. W. F. Gericke conceived the idea that the method might have some

commercial application. A Sunday supplement article pictured a housewife opening a small closet off the kitchen and picking tomatoes from vines growing in water culture with the aid of electric lights, whilst a large chain of restaurants in New York City were credited with growing their own vegetables in basements. Actually, as the authors of this circular make clear, whilst very good yields may be obtained under glass from many crops grown in water cultures, with equal attention, similar or better crops may be grown in soil by methods which are more familiar to the amateur and professional grower.

Foam on the Dead Sea

A PECULIAR phenomenon often to be seen on the northern waters of the Dead Sea is that of arcs of foam, more or less semicircular, spreading out fan-wise from certain points of the west and east shores. The arcs seem to spread from the shores in early morning and often meet and even cross during the forenoon. These lines of foam often bear reeds and other vegetation debris that have reached the Dead Sea by inflowing rivers, and, at the seasons of migration, the foam may attract flocks of birds searching for food. Dr. D. Ashbel has recorded some of his observations on this phenomenon and offers an explanation (*Geog. Rev.*, Jan. 1938). The arcs originate from springs on the two shores, and they make discontinuities between bodies of water of different salinity and density. When the outflow of the springs is strong, the arc is frequently not smooth but zig-zag. This explanation contradicts the earlier one of Blanckenhorn that the lines of foam originate from warm water arising along lines of fault on the sea floor. That suggestion does not explain lack of replacement of the lines as each moves forward, which Dr. Ashbel thinks is due to the gentle winds that frequently blow from the land on to the sea during the night and early morning. These winds do not ruffle the water and so mixing does not occur. Gusty west winds such as often occur in the afternoon cause mixing and so the lines of discontinuity disappear.

The Imperial College of Tropical Agriculture

THE Imperial College of Tropical Agriculture in Trinidad is now the recognized centre for post-graduate training in tropical agriculture for the agricultural services of the Colonial Empire. The governing body in its latest report for the year ending August 31, 1938, record that 159 past students of the College have been appointed to the Colonial Agricultural Service and allied services, posts being now held in thirty different parts of the British Empire. The year under review was marked by the retirement of Sir Geoffrey Evans, who had filled the office of principal with much distinction since 1926, and who left the College with its function in the development of agriculture throughout the Colonial Empire firmly established, and with an international reputation as a centre of education and research. Mr. Odin Tom Faulkner, lately director of agriculture

in the Straits Settlements and adviser on agriculture in the Malay States, was appointed to succeed Sir Geoffrey Evans. During 1937-38 the work of the College proceeded on normal lines. Research was mainly concerned with problems relating to cacao, sugar, bananas and citrus fruits, and the cost of much of the work was met by contributions from firms connected with the appropriate industry. The governing body is anxious to raise a substantial endowment fund; but its hope that the grant of £32,000 made by the Carnegie Corporation in 1932 towards this object would be followed by contributions from British firms and others interested in tropical agriculture has yet to be realized. Capital is also required for the purchase of more land for the college farm, for additional laboratories and the reconstruction of the biological building.

The British Association: Engineering Section

AT the Dundee meeting of the British Association, 1939, the Engineering Section proposes to repeat the arrangement which proved so satisfactory during the meeting in Cambridge last year and to devote some time to the delivery of a number of short communications by junior engineers or research workers (under the age of thirty years). Each speaker will be allotted a total of 20-30 minutes, which may, at his option, include, say, ten minutes for very short discussion. It is hoped that each author will describe some item of special interest or novelty upon which he may be engaged. This innovation seems to us important as enabling the Association to know something of the work of younger men, and enabling those men to gain experience of summarizing their work and putting it forward for criticism without having to undertake the much more laborious task of preparing a paper of the stature necessary for a full meeting of one of the engineering institutions or of a scientific society. Although *Engineering* publishes *in extenso* the text of all main papers delivered to the Section, it is not proposed that these short papers should similarly be published. This arrangement seems desirable, partly because authors may be prepared to describe engineering work upon which they hope later to publish a full-scale paper, and partly because authors may not feel justified in preparing a text of the completeness which would be desirable if proper publication is to be made. Those wishing to submit such papers should communicate immediately with the recorder Wing-Commander T. R. Cave-Brown-Cave, University College, Southampton.

Spectrochimica Acta

THE first number of a publication under the above title will shortly be issued by Messrs. Julius Springer, Berlin, under the editorship of W. Gerlach and G. Scheibe, Munich; A. Gatterer, Vatican Observatory; R. Breakpot, Louvain; F. Twyman, London. It will deal solely with spectrochemical analysis, and a useful feature will be the publication of abstracts and reviews of books and articles on the subject. A number of authorities on the subject have agreed to collaborate, and those in the English-speaking

countries who have already consented to act in that capacity include Prof. A. Fowler, Prof. H. Dingle and Dr. S. Judd Lewis of London; and Prof. O. S. Duffendack, Prof. J. A. Harrison and Dr. Lester W. Strock of the United States. The first number of the journal will probably be published in May. The English editor will be pleased to receive papers in English on the subject, which should be addressed to: The Editor, *Spectrochimica Acta*, 98 St. Pancras Way, London. N.W.1.

University Co-operation

THE recently published report of the Executive Council of the Universities Bureau of the British Empire announces preliminary steps towards bringing about an informal conference between some of the heads of universities in the United States of America and those of universities in the British Empire. In the course of a trans-Atlantic tour undertaken last spring, primarily with the object of cultivating helpful relations with the Canadian universities, the secretary of the Bureau got into touch with the presidents of Harvard and Yale, the president of the Carnegie Corporation of New York and the director of the Institute of International Education, and discussed with them the possibility of a visit to England of some of the heads of universities in the United States in 1941, when the sixth quinquennial congress of the Universities of the British Empire will be held in Manchester.

Announcements

THE Secretary of State for Air, Sir Kingsley Wood, on the recommendation of the Director of Medical Services, Royal Air Force, has appointed the following standing committee to investigate and advise him on the medical aspects of all matters concerning personnel which might affect safety and efficiency in flying: Sir Edward Mellanby (chairman), Prof. F. O. Bartlett, Mr. E. A. Carmichael, Mr. C. S. Hallpike, Dr. B. H. C. Matthews, Sir John Parsons and Prof. L. J. Witts. The representatives of the Air Ministry on the Committee will be Air Vice-Marshal A. V. J. Richardson, director of Medical Services, and Air Commodore H. E. Whittingham.

THE following have been elected officers of the Physical Society for the year ending March 1940: *President*, Prof. Allan Ferguson; *Vice-Presidents*, Prof. G. I. Finch, Dr. Exer Griffiths, Dr. L. Hartshorn, Mr. R. W. Paul; *Hon. Secretaries*, Mr. J. H. Awbery, Dr. W. Jevons; *Hon. Foreign Secretary*, Prof. O. W. Richardson; *Hon. Treasurer*, Dr. O. C. Paterson; *Hon. Librarian*, Dr. J. H. Brinkworth.

THE following have been elected officers of the Geological Society of London for the ensuing year: *President*, Prof. H. H. Swinnerton; *Vice-Presidents*, Dr. E. B. Bailey, Prof. W. G. Fearnside, Prof. O. T. Jones, and Prof. C. E. Tilley; *Secretaries*, Dr. L. Hawkes and Prof. W. B. R. King; *Foreign Secretary*, Sir Arthur Smith Woodward; *Treasurer*, Mr. F. N. Ashcroft.

THE following have been elected officers of the Quekett Microscopical Club for the ensuing year: *President*, W. E. Watson Baker; *Vice-Presidents*, H. G. Brown, C. H. Caffyn, D. J. Scourfield, P. K. Sartory; *Hon. Treasurer*, Dr. C. L. Odam; *Secretary*, Miss C. Arnold; *Reporter*, A. Morley Jones; *Curator*, C. J. Sidwell; *Assistant Curator*, W. F. Reeve; *Librarian*, H. C. G. Best; *Editor*, W. P. Sollis.

THE following appointments and promotions have recently been made in the Colonial Service: A. J. Hans, veterinary officer, Kenya; Dr. S. E. Piercy, veterinary research officer, Kenya; Dr. R. B. McConnell, assistant field geologist, Tanganyika Territory; P. A. Loixides, agricultural chemist, Cyprus; R. J. Lathbury, senior plant breeder, Agricultural Department, Kenya; R. G. H. Wilshaw, senior chemist (soils), Malayan Agricultural Service; H. G. Pudney, senior inspector of produce, Agricultural Department, Nigeria.

THE Leslie Dana Gold Medal awarded annually by the Association for Research in Ophthalmology and the St. Louis Society for the Blind was recently presented to Prof. Ellice M. Alger for his contributions to ophthalmology during the last thirty years and his work as a teacher. For many years he had been professor of clinical ophthalmology at the New York Postgraduate Medical School.

A CONFERENCE and working demonstration on "Pure Fruit Juices and Syrup" will be held at the Long Ashton Research Station of the Department of Agriculture and Horticulture, University of Bristol, on March 23. Further information can be obtained from the Director, Research Station, Long Ashton, near Bristol.

THE French Association for the Advancement of Science will meet this year at Liège on July 17-22, under the presidency of Prof. O. Fabry, director of the Optical Institute, Paris. The local committee for the meeting is under the chairmanship of Prof. Dehali, of the University of Liège.

A FLEMISH Academy of Medicine, consisting of six sections, has recently been founded at Brussels.

THE fifth International Congress for First Aid will be held at Zurich and St. Moritz on July 23-28.

THE eighteenth Congress of the German Association for Microbiology will be held in Vienna on March 27-30. Further information can be obtained from the Secretary, Prof. Wohlfeil, Führerstrasse 2, Berlin, N.15.

REPRESENTATIVES of thirty-five countries will attend the tenth International Congress of Military Medicine and Pharmacy, which is to be held at Washington on May 7-15. Further information can be obtained from the Secretary-General of the Congress, Army Medical Library, Washington, D.C.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 478.

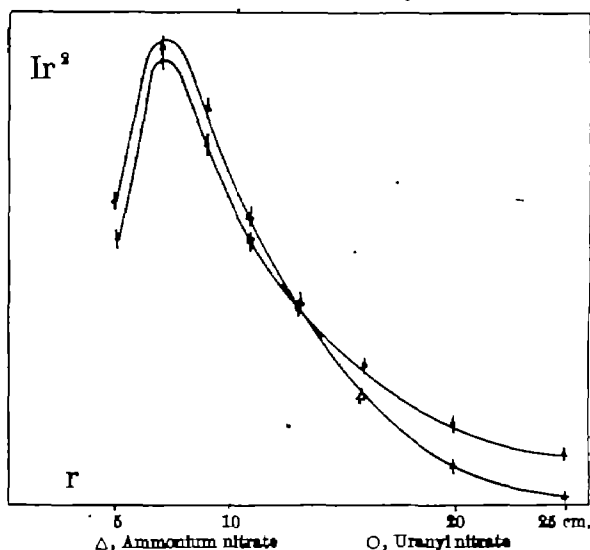
CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Liberation of Neutrons in the Nuclear Explosion of Uranium

RECENT experiments^{1,2} have revealed the existence of a new kind of nuclear reaction: neutron bombardment of uranium and thorium leads to an explosion of the nucleus, which splits up into particles of inferior charge and weight, a considerable amount of energy being liberated in this process. Assuming a partition into two particles only, so that the nuclear mass and charge of uranium have to be distributed between two lighter nuclei, the latter contain considerably more neutrons than the heaviest stable isotopes with the same nuclear charges. (A splitting into, for example, ⁹²Rb and ¹⁴¹Ce means an excess of 11 neutrons in the first, and of 8 neutrons in the second of these two nuclei.) There seem to be two possibilities of getting rid of this neutron excess. By the emission of a β -ray, a neutron is transformed into a proton, thus reducing the neutron excess by two units; in the example given above, five and four successive β -activities respectively would be needed to restore the neutron-proton stability ratio. In fact, the explosion products have been observed to be β -active and several periods have been recorded, so that a part, at least, of the neutron excess is certainly disposed of in this way. Another possible process is the direct liberation of neutrons, taking place either as a part of the explosion itself, or as an 'evaporation' from the resulting nuclei which would be formed in an excited state.

In order to find some evidence of this second phenomenon, we studied the density distribution of the thermal neutrons produced by the slowing down of photo-neutrons from a Ra- γ -Be source in a 1.6 molar solution of uranyl nitrate and in a 1.6 molar solution of ammonium nitrate (the hydrogen contents of these two solutions differ by only 2 per cent). Plotting $I\tau^2$ as a function of r (where r is the distance between the source and a given point, and I is the local density of thermal neutrons at the same point, measured by the activity induced in a dysprosium detector), a curve is obtained the area of which is proportional to $Q\tau$, Q being the number of neutrons per second emitted by the source or formed in the solution and τ the mean time a neutron spends in the solution before being captured^{3,4}. Any additional nuclei, which do not produce neutrons, brought into the solution, will increase the chances of capture and therefore decrease τ and the area. If, however, these dissolved nuclei are neutron-producing, Q will be greater and the area of the curve will tend to increase. Evidence of neutron production, as indicated by an actual increase of the area, will only be obtained if the gain through Q (neutron production) is greater than the loss through τ (neutron capture). This loss can anyway be studied separately, since it has been shown⁵ that the introduction of nuclei which act merely by capture or by increasing the hydrogen

content of the solution can affect the shape of the density curve only in a characteristic way: the modified curve can always be brought to coincide with the primitive curve by multiplying all abscissae by a suitable factor and all ordinates by another factor.



The accompanying graph shows the two curves obtained. At small distances from the source the neutron density is greater in the ammonium solution than in the uranyl solution; at distances greater than 13 cm., the reverse is true. In other words, the decrease of the neutron density with the distance is appreciably slower in the uranyl solution.

The observed difference must be ascribed to the presence of uranium. Since the two curves cannot be brought to coincide by the transformation mentioned above, the uranium nuclei do not act by capture only; an elastic diffusion by uranium nuclei would have an opposite effect: it would 'contract' the abscissae, instead of stretching them. The density excess, shown by the uranyl curve beyond 13 cm., must therefore be considered as a proof of neutron production due to an interaction between the primary neutrons and the uranium nuclei. A reaction of the well-known ($n, 2n$) type is excluded because our primary neutrons are too slow for such a reaction (90 per cent of Ra + Be photo-neutrons have energies smaller than 0.5 Mev. and the remaining 10 per cent are slower than 1 Mev.).

The degree of precision of the experiment does not permit us to attribute any significance to the small increase of the area in the uranyl curve (as compared to the ammonium curve), which we obtain by extrapolating the curves towards greater distances. In any event, an inferior limit for the cross-section for the production of a neutron can be obtained by

assuming that the density excess due to this production is equal throughout the whole curve to the excess observed at $r = 25$ cm.; this limit, certainly inferior to the actual value, is 6×10^{-22} cm.³.

Our measurements yield no information on the energy of the neutrons produced. If, among these neutrons, some possess an energy superior to 2 Mev., one might hope to detect them by a (n, p) process, for example, by the $^{32}\text{S}(n, p)^{32}\text{P}$ reaction. An experiment of this kind, Ra γ - Be still being used as the primary neutron source, is under way.

The interest of the phenomenon observed as a step towards the production of exo-energetic transmutation chains is evident. However, in order to establish such a chain, more than one neutron must be produced for each neutron absorbed. This seems to be the case, since the cross-section for the liberation of a neutron seems to be greater than the cross-section for the production of an explosion. Experiments with solutions of varying concentration will give information on this question.

H. VON HALBAN, JUN.

F. JOLIOU.

L. KOWARSKI.

Laboratoire de Chimie Nucléaire,
Collège de France,
Paris.
March 8.

¹ Joliot, F., *C.R.*, 208, 341 (1939).

² Frisch, O. R., *NATURE*, 143, 276 (1939).

³ Amaldi, E., and Fermi, E., *Phys. Rev.* 50, 896 (1936).

⁴ Amaldi, E., Harkstad, L., and Tuve, M., *Phys. Rev.*, 51, 896 (1937).

⁵ Frisch, O. R., von Halban, Jun., H., and Koch, J., *Deutsche Wissenschaft.* 18, 10 (1938).

Products of the Fission of the Uranium Nucleus

O. Hahn and F. Strassmann¹ have discovered a new type of nuclear reaction, the splitting into two smaller nuclei of the nuclei of uranium and thorium under neutron bombardment. Thus they demonstrated the production of nuclei of barium, lanthanum, strontium, yttrium, and, more recently, of xenon and caesium.

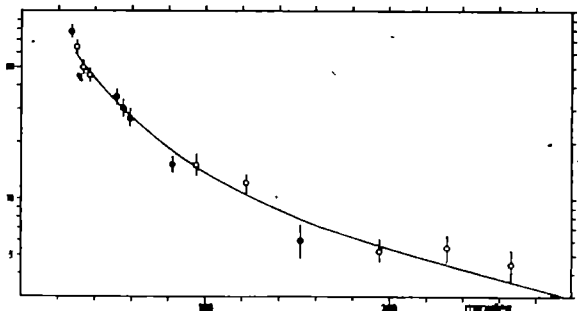
It can be shown by simple considerations that this type of nuclear reaction may be described in an essentially classical way like the fission of a liquid drop, and that the fission products must fly apart with kinetic energies of the order of hundred million electron-volts each². Evidence for these high energies was first given by O. R. Frisch³ and almost simultaneously by a number of other investigators⁴.

The possibility of making use of these high energies in order to collect the fission products in the same way as one collects the active deposit from alpha-recoil has been pointed out by L. Meitner (see ref. 3). In the meantime, F. Joliot has independently made experiments of this type⁵. We have now carried out some experiments, using the recently completed high-tension equipment of the Institute of Theoretical Physics, Copenhagen.

A thin layer of uranium hydroxide, placed at a distance of 1 mm. from a collecting surface, was exposed to neutron bombardment. The neutrons were produced by bombarding lithium or beryllium targets with deuterons of energies up to 800 kilovolts. In the first experiments, a piece of paper was used as a collecting surface (after making sure that the paper did not get active by itself under neutron bombardment). About two minutes after interrupting the irradiation, the paper was placed near a

Geiger-Müller counter with aluminium walls of 0.1 mm. thickness. We found a well-measurable activity which decayed first quickly (about two minutes half-value period) and then more slowly. No attempt was made to analyse the slow decay in view of the large number of periods to be expected.

The considerable intensity, however, of the collected activity encouraged us to try to get further information by chemical separations. The simplest experiment was to apply the chemical methods which have been developed in order to separate the 'transuranium' elements from uranium and elements immediately below it⁶. The methods had to be slightly modified on account of the absence of uranium in our samples and in view of the light element activities discovered by Hahn and Strassmann¹.



In these experiments, the collecting surface was water, contained in a shallow trough of paraffin wax. After irradiation (of about one hour) a small sample of the water was evaporated on a piece of aluminium foil; its activity was found to decay to zero. It was checked in other ways, too, that the water was not contaminated by uranium. To the rest of the water we added 150 mgm. barium chloride, 15 mgm. lanthanum nitrate, 15 mgm. platinum chloride and enough hydrochloric acid to get an acid concentration of 7 per cent. Then the platinum was precipitated with hydrogen sulphide, in the usual way; the precipitate was carefully rinsed and dried and then placed near our counter.

The results of three such experiments were found to be in mutual agreement. The decay of the activity was in one case followed for 28 hours. For comparison, a sample of uranium irradiated for one hour was treated chemically in the same way. The two decay curves were in perfect agreement with one another and with an old curve obtained by Hahn, Meitner and Strassmann under the same conditions. In the accompanying diagram the circles represent our recoil experiment while the full line represents the uranium precipitate. A comparison of the activity (within the first hour after irradiation) of the precipitate and of the evaporated sample showed that the precipitate contained about two thirds of the total activity collected in the water. After about two hours, however, the evaporated sample was found to decay considerably more slowly than the precipitate, presumably on account of the more long-lived fission products found by Hahn and Strassmann¹.

From these results, it can be concluded that the 'transuranium' nuclei originate by fission of the uranium nucleus. Mere capture of a neutron would give so little kinetic energy to the nucleus that only a vanishing fraction of these nuclei could reach the water surface. So it appears that the 'transuranium'

periods, too, will have to be ascribed to elements considerably lighter than uranium.

In conclusion, we wish to thank Dr. T. Bjerge, Dr. J. Koch and K. J. Broström for putting the high-tension plant at our disposal and for kind help with the irradiations. We are also grateful to Prof. N. Bohr for the hospitality extended to us at the Institute of Theoretical Physics, Copenhagen.

LISE MEITNER.

Physical Institute,
Academy of Sciences,
Stockholm.

O. R. FRISCH.

Institute of Theoretical Physics,
University,
Copenhagen.
March 6.

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Radioactive Organic Bromo-Compounds

CONSIDERABLE attention has recently been focused on the use of artificially radioactive substances in biological work. The radioactive isotope ⁸²Br has been chosen by us because it has a conveniently long half-life (34 hours), it is chemically reactive, it gives off gamma-rays which aid in its detection, and finally, it can be prepared from ⁸¹Br either by the action of slow neutrons or deuterons. Slow neutrons are easily available from the radon-beryllium reaction. Fast deuterons from the cyclotron or any other suitable high-energy source may be used either as projectiles themselves or for the production of slow neutrons as in the lithium reaction below. The relative abundance of ⁸¹Br in natural bromine is 49.3 per cent. Contamination of radioactive ⁸²Br by other isotopes is of no consequence since bromine forms no non-bromine radioactive elements on bombardment by slow neutrons or deuterons¹.

Two reactions have been studied. The first is the Sandmeyer reaction for the introduction of bromine into the benzene ring. 345 c.c. of water containing 50 gm. Cu₂Br₂, 175 gm. NaBr.2H₂O and 30 c.c. HBr (density 1.49) was bombarded by slow neutrons produced from lithium with 900 kev. deuterons. 250 gm. of CHBr₃ was also bombarded. The glass vessels were surrounded by thick blocks of paraffin. Two experiments were then performed. 115 c.c. of the solution called the Sandmeyer solution was shaken with the whole of the bombarded CHBr₃ to concentrate the radioactivity², then separated off and extracted with CHCl₃. 14.5 gm. of C₆H₅NH₂ was diazotized in the usual manner and 11.8 gm. of C₆H₅Br prepared, called C₆H₅Br (1). Another sample, called C₆H₅Br (2), was made from a second 115 c.c. of the Sandmeyer solution, not shaken with the CHBr₃. As expected, attempts to exchange the radioactive bromine in C₆H₅Br by shaking with NaBr were wholly unsuccessful.

Table 1 shows the radioactivity per gram atom of bromine compared to that of the Sandmeyer solution before concentration of the radioactivity. Measurements were made with a thin-walled Geiger-Muller

counter. The samples were in glass vessels and the measurements were made nearly simultaneously to obviate corrections due to radioactive decay. It is to be emphasized that, although care was taken to keep the geometry constant, the results can only be taken as qualitative.

TABLE 1

	Relative radioactivity per gram atom Br.
Sandmeyer solution	1.0
CHBr ₃ before enrichment of Sandmeyer solution	2.5
CHBr ₃ after enrichment	1.4
C ₆ H ₅ Br (1)	4.2
C ₆ H ₅ Br (2)	0.5
C ₆ H ₅ Br (1) after shaking with NaBr	4.2

The second technique is the addition of bromine to a double bond. 100 gm. CH₃Br₂ was irradiated with slow neutrons and after irradiation 0.2 c.c. of bromine was added. Three hours later 1.2 gm. of cholesterol in 12 c.c. of ether was added, and the CH₃Br₂ distilled off in vacuum. The crystalline residue was dissolved in ether and recrystallized. Table 2 shows the relative radioactivity per gram atom of bromine compared with the irradiated CH₃Br₂. Experiments with CHBr₃ in place of the CH₃Br₂ yielded an oil from which the cholesterol dibromide could not be separated.

TABLE 2

	Relative radioactivity per gram atom Br.
CH ₃ Br ₂ before enrichment	1.0
CH ₃ Br ₂ after enrichment	0.5
Cholesterol dibromide	300

The first method does not yield such a high concentration of radioactive material. It may be of use in the labelling of halogenated molecules and the determination of their fate in the body. The second technique gives a very high concentration of radioactivity. It is hoped to obtain concentrations high enough to enable us to study the effect of artificial radioactivity on normal and pathological tissues. Further work will be done along these lines.

We wish to express our thanks to the members of the Cavendish High Tension Laboratories for help in the slow neutron bombardments.

E. FRIEDMANN.
(Biochemical Laboratory)
A. K. SOLOMON
(Cavendish Laboratory)
N. T. WHETHAMEN.
(School of Agriculture)

Cambridge.

Feb. 14.

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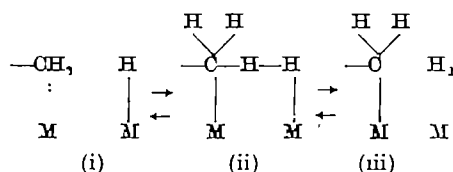
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Catalytic Exchange of Deuterium and Hydrogen in Hydrocarbons

IN a recent communication¹, L. and A. Farkas have followed the exchange of deuterium for hydrogen in cyclohexane and hexane on platinized foil at relatively low temperatures. They suggest that the catalytic mechanism for both saturated and unsaturated hydrocarbons involves the primary detachment of a hydrogen atom from the hydrocarbon. We have had occasion to examine the mechanism of catalytic exchange with olefines by a number of different methods, and have come to the definite conclusion that the primary act in the case of olefines is the addition and not the loss of a hydrogen atom.

This conclusion is supported by experiments on the effect of hydrogen both on double bond migration and on ring closure in olefines.

Further, in the case of saturated hydrocarbons, catalytic exchange, degradation and dehydrogenation all appear to involve hydrogen in the chemisorption process, but the experimental data are not as yet so conclusive as is the case for the olefines. If further experiments support this point of view, it might be suggested that the simplest representation of the hydrocarbon catalyst hydrogen system is as follows:



where (i) chemisorbed hydrogen reacts with a Van der Waals adsorbed saturated hydrocarbon group, or (iii) a chemisorbed olefine reacts with a Van der Waals adsorbed molecule of hydrogen each producing the common transition complex, (ii).

This simple formulation offers a ready interpretation of the various reactions observed in these systems. It is hoped that opportunity will present itself in the forthcoming meeting of the Faraday Society for an adequate discussion on the elementary steps operative in hydrocarbon catalytic reactions, reactions of far-reaching importance, and on the nature of which there is clearly as yet no unanimity.

S. R. CRAXFORD.
G. H. TWIGG.
ERIC K. RIDGAL.

Laboratory of Colloid Science,
Cambridge.

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Chemical Aspects of the Cyclol Hypothesis

CONSIDERABLE discussion of the structure of proteins, especially in relation to the cyclol hypothesis, has recently appeared in NATURE^{1,2,3}. This theory assumes that globular proteins consist of a space-enclosing arrangement of diazine and triazine rings. Most of the evidence produced (including the X-ray diagrams^{4,5}) is, however, not specific for the cyclol theory; many of the points made by Langmuir⁴ could be equally well used as an argument in favour of any regular geometrical structure which joins peptide chains to form a globular molecule. It is indeed possible to suggest bonds between peptide chains of types already known to exist; thus we are familiar with compounds containing the linkages S—S, CO—S, NH—S or CO—NH—CO, all of which might occur in proteins; in addition, the possibility exists of linkages between hydroxyl groups of hydroxy-amino acids and free carboxyl groups.

The more specific points of evidence in support of the cyclol theory are: (a) it claims to predict molecular weights of the order of magnitude found with the ultracentrifuge; (b) it conforms with the regularities in the amino acid composition of proteins (Bergmann and Niemann); (c) it gives a reasonable picture of denaturation as 'deacyclization' or change from cyclol to chain structure.

(a) Wrinch assumes that egg albumin contains 288 residues; on the other hand, Svedberg⁶ finds a

molecular weight of 40,500 or 43,800, which would lead to average residue weights of 159 and 170 respectively. Since it is known that egg albumin does not consist mainly of 'heavy' amino acids, such as tyrosine, tryptophane or arginine, the value of 288 cannot be accepted for the number of residues in egg-albumin.

(b) The regularities in amino acid composition deduced by Bergmann and Niemann are based on analytical results which are not sufficiently accurate to be statistically significant⁷.

(c) If denaturation consists of deacyclization, it should occur in all globular proteins having a cyclol structure and not in fibrous proteins. Actually, insulin, a globular protein which has been extensively studied in connexion with the cyclol theory, cannot be denatured in the usual sense of the word; it is very resistant towards heat or acid, and it can even be recovered in crystalline form after esterification with acid alcohol followed by treatment with dilute alkali⁸. On the other hand, a fibrous protein, like myosin, for which no cyclol structure can be claimed, denatures easily at temperatures above 40°.

Further, it seems difficult to reconcile the reversibility of denaturation^{9,10} found for serum albumin with the supposed instability of cyclol rings. Another difficulty is that low-molecular peptides or diketopiperazines would be expected to be found when the cyclol structure breaks down. Actually, no such low-molecular compounds are liberated on denaturation. It follows, therefore, that the cyclol theory cannot satisfactorily explain the facts of denaturation.

To explain the behaviour of proteins towards enzymes, Langmuir and Wrinch¹ assume that denaturation occurs before the enzyme can attack the protein molecule. This may be the case for many proteins; but insulin is hydrolysed by pepsin or trypsin under conditions in which the insulin molecule is perfectly stable. Here enzymic hydrolysis must take place without previous denaturation. In order to explain these facts, the unwarranted assumption would have to be made that the enzyme not only hydrolyses the protein, but also deacyclizes it.

Attempts to prove the cyclol structure in proteins have failed so far (see, for example, Haurowitz¹¹), nor has it been possible to synthesize simple models of the cyclol type in the laboratory; the physical evidence for the hypothesis is most uncertain¹², and the lactam-lactim tautomerism of peptides, which is the chemical basis of the cyclol theory, has never been demonstrated by either physical or chemical methods. Is it surprising, therefore, that chemists are reluctant to accept a structure for which no analogue in organic chemistry can be found?

A. NEUBERGER.

University College Hospital Medical School,
University Street, Gower Street,
London, W.C.1.

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[See also p. 433 of this issue.]

Chromatographic Fractionation of Whale-Liver Oil

Pritchard, Wilkinson, Edisbury and Morton¹ have already reported striking disagreement between the biological activity and the absorption at 328 m μ of the concentrates of mammalian liver. As we had formerly used the Carr-Price reaction to a great extent for practical determinations, we were interested in its relation to ultra-violet absorption and to biological activity. We therefore fractionated whale-liver oil and determined the blue colour with trichloride of antimony, the curve for the ultra-violet absorption, and the biological activity, of the various fractions thus obtained.

The fractionation was carried out in the following way: The oil was first saponified, after which the part that could not be saponified was given further treatment. (We offer our best thanks to Messrs. Ferrosan and Co., Ltd., Copenhagen, for so kindly supplying a large quantity of the unsaponifiable part of whale-liver oil.) The sterols were eliminated by crystallization from methyl alcohol, first in an ice-box, and then by freezing in solid carbon dioxide and acetone. The soluble part was dissolved in petroleum-ether and submitted to chromatographic separation with calcium hydroxide as an adsorbent. Painting with antimony trichloride, as described by Zechmeister, Chohnoky and Ujhelyi², gave a positive reaction for the whole length of the column, and the adsorption column was, therefore, divided arbitrarily into four parts, from which vitamin A was eluted by petroleum-ether containing a little methyl alcohol. The top fraction gave a red-violet reaction towards antimony trichloride, which, according to our standard curve, would have meant about 101,000 I.U. per gm. activity of vitamin A. Biological assay, however, showed that it was quite inert. The next fraction should have contained 3,160,000 I.U. per gm., according to the antimony trichloride reaction, but the biological activity was 1,160,000 I.U. per gm. It has been impossible, unfortunately, up to the present to evaluate the ultra-violet absorption on account of lack of material. All three determinations are, however, available for the third and fourth fractions:

	III	IV
Biological activity ..	531,000 I.U./gm.	531,000 I.U./gm.
Antimony trichloride value ..	950,000 "	1,160,000 "
Ultra-violet absorption at 328 m μ ..	384,000	382,000 "

The biological activity is thus considerably lower than would have been expected from the antimony trichloride reaction. The biological activity is greater than might have been expected from the ultra-violet absorption, but not so much, when the number of animals used for the biological assay is taken into consideration. The absorption maxima for the ultra-violet curve are not, however, at 328 m μ , but are displaced towards the short-wave part—more exactly, at 293 m μ .

The investigations of Gillam, Heilbron, Jones and Lederer³ showed that there is a substance in the liver of freshwater fish with vitamin A activity, the absorption maximum of which is at 344 m μ . This substance does not occur alone, but together with the ordinary vitamin A. It has, however, not been possible to produce the actual substance in pure form, though the English investigators were able to determine the chemical constitution of the new substance by preparing suitable derivatives.

According to our experiments, whale-liver oil does

not contain this substance. The ultra-violet absorption at wave-lengths longer than 328 m μ is weak even for our chromatographic fractions, and we cannot find a maximum for the antimony trichloride reaction at 690 m μ . On the other hand, the maxima for the ultra-violet absorption of our fractions III and IV agree well with the results given by Pritchard, *et al.*

It has already been shown many times that the maximum absorption occurs at 570–580 m μ for the antimony trichloride reaction of vitamin A. Chromogen 610 and chromogen 570 were separated by adsorption on to fuller's earth⁴ in Wolff's laboratory. Karrer, Morf and Schöpp⁵ isolated the so-called hepaxanthin, the absorption maximum of which is at 270 m μ . Hepaxanthin is not thought to have any biological activity.

Since our highly purified products, however, show greater absorption for the antimony trichloride reaction at 570 m μ than at 610 m μ , have a distinct maximum in the ultra-violet field at about 290 m μ , and possess biological activity which, as has been mentioned, is considerably greater than that corresponding to the absorption at 328 m μ , it does not seem to be impossible that our preparations contain a hitherto unknown substance with the biological action of vitamin A.

HARRY WILLSTADT.
HANS BEHRENTS JENSEN.

University Institute of Hygiene,
Copenhagen,
and

The State Vitamin Laboratory,
Copenhagen.
Feb. 6.

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Formation of Negative Ions by Negative-Ion Bombardment of Surfaces: a New Process

EXPERIMENTS with a double mass-spectrograph have been described recently by one of us and R. Press¹. These show conclusively that bombardment of a gas-contaminated surface with positive ions of one species can produce a spectrum of negative ions. In this work particular attention was directed to the process involved. We have now extended these experiments, in the first place, to identify some light ions, the identity of which was not definitely established in the earlier work. By calibrating the mass-spectrograph with a Kussman alkali ion source, used in such a way that the magnet current did not have to be altered from the value used during the negative ion runs, we have identified accurately the main negative ion peaks, with results in general accord with the early work of Woodcock² (which we had previously overlooked), and with that of Arnot and Beckett³.

We have also studied the emission of negative ions from oxide-coated cathodes, which can be liberated either by heating⁴ or by positive ion bombardment⁵. During an investigation of the energy distributions of these ions, an interesting effect was observed. A wire gauze had been inserted between the cathode

and the first slit of the mass-spectrograph to permit of the electric field at the cathode being held constant, while the energy of the ions entering the first slit was varied. A diffuse negative ion peak in the region of mass numbers 24-26 was found to be multiple, with some of the ions showing energies in excess of those imparted to them by the accelerating electric fields. When the potential difference between the gauze and cathode was increased, the two main components separated, but one remained in the original position in the mass spectrum ($M = 26$). This shows that it was due to ions from the cathode, while the other was due to ions from the gauze. If the latter had been produced by positive ion bombardment of the gauze, then one would expect the cathode and its supports to have been similarly bombarded and negative ions to have been liberated from them with large initial energies. However, investigation of the energy distribution of the ions liberated from the cathode revealed that no ions were present with mutual energies, so indicating the absence of any appreciable positive ion bombardment of this electrode, since such bombardment is known to liberate ions with initial energies¹. In the absence of positive ion bombardment, we are forced to the conclusion that the negative ions from the gauze are emitted as a result of bombardment of the latter by negative ions from the cathode. The ions so emitted, like those produced by positive ion bombardment, show excess energies.

The peak from the gauze in the region $M = 26$ is complex, and is found when examined under sufficient resolution to consist of three peaks due to ions of masses 24, 25 and 26, possibly C_2^- , C_2H^- and CN^- . Cl_{35}^- and Cl_{37}^- have also been detected from the cathode, but not from the gauze under the same conditions.

This new process seems to account for an effect observed by Bachman and Carnahan², who have published photographs of the negative ion spectrum which they were able to produce on the screen of a cathode ray oscillograph. In one case, when an oxide-coated cathode was broken down after the tube was sealed off from the pumps, they recorded a circle surrounding the spot due to the ion of mass 26. Since this tube was slightly soft, due to liberation of gas during the activation of the cathode, it is possible that the ring was produced by positive ion bombardment of one of the apertures in the vicinity of the cathode. However, in the case of a hard tube containing a hairpin tungsten filament, they obtained several circles in the spectrum. It is almost certain that these are due in part to bombardment of an aperture by negative ions from the filament. Unfortunately, Bachman and Carnahan do not give details of their focusing fields, so that a quantitative check is not possible.

A similar negative ion emission is to be expected from some of the grids of commercial multi-electrode thermionic valves with oxide-coated cathodes.

R. H. SLOAN.

Department of Physics, ELIZA B. CATHCART.
Queen's University,
Belfast.
Feb. 15.

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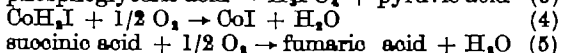
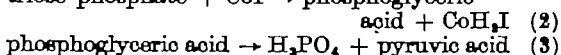
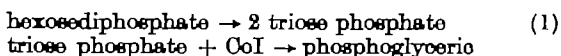
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Oxidation of Reduced Codehydrogenase I

THE discovery of an enzyme^{1,2} capable of catalysing the oxidation of reduced codehydrogenase I (cozymase, CoI) at an extremely rapid rate³ naturally raises the question as to what part this enzyme plays in hydrogen transport. There is considerable evidence^{1,2,4,5} that this enzyme (diaphorase) catalyzes the reaction between dihydrocozymase and the cytochrome system, and Dewan and Green⁶ have suggested that cytochromes *A* and *B* (but not *C*) and cytochrome oxidase are involved. The method of preparing diaphorase is such that succinic acid dehydrogenase is also present in large amounts. With the possible exception of the recent announcement⁷ that diaphorase had been obtained in highly purified form, it seems fairly certain that most of the data in the literature regarding either enzyme were obtained with preparations containing both enzymes. This statement has a very important bearing on the 4-carbon acid catalysis theory of Szent-Györgyi, since it raises the question as to the possibility that succinic acid dehydrogenase is an intermediary hydrogen carrier between diaphorase and cytochrome.

The present work was begun with the purpose of finding the path by which hydrogen proceeds from dihydrocozymase over diaphorase to molecular genoxy. The succinic acid dehydrogenase preparation of Stotz and Hastings⁸ was used as a source of diaphorase. This preparation is an alkaline phosphate extract of washed pig heart muscle, with fumarase inactivated (enzyme *A*). This enzyme is in the form of a dispersion which does not settle out. It was shown to contain diaphorase, succindehydrogenase, cytochrome, and cytochrome oxidase, and small amounts of triose phosphate dehydrogenase. In addition, a dialysed extract of acetone powder from rabbit skeletal muscle⁹ (enzyme *B*) was used as a source of triose phosphate dehydrogenase and xymohexase. Considerable work was done with dry preparations but in these there was no reaction between CoH_2I and oxygen until dye was added.

The reactions involved in this work may be written as follows:



By using an excess of enzyme *B*, cozymase, and hexose diphosphate in the presence of fluoride, and determining the amount of enzyme *A* which limited oxygen uptake, it was possible to study reaction (4) using amounts of enzyme *A* which gave approximately half maximum rates of oxygen uptake. Parallel experiments were always run with an equal amount of enzyme *A* using succinic acid as substrate. This demonstrated the presence of succindehydrogenase and the cytochrome system.

It was found that fresh preparations of enzyme¹⁰ *A* were capable of bringing about reactions (4) and (5) at an extremely rapid rate; but that after about five days at 4° C. the activity was nearly completely destroyed. Crucial experiments were therefore performed at various times after the enzyme was prepared. Since neither the diaphorase nor the succindehydrogenase were appreciably destroyed in this period, it appears that the destruction occurs in the cytochrome oxidase or possibly in cytochrome *B*.

This point is being studied further. The fact that the rate of reaction (4) appears to decrease faster than the rate of reaction (5) suggests that different cytochromes may be involved.

EFFECT OF STANDING ON THE ENZYME SYSTEMS WHICH OXIDISE CoH_2I AND SUCCINIC ACID. 0.2 C.C. OF ENZYME A IN ALL CASES. HEXOSE DIPHOSPHATE SUBSTRATE FOR CoH_2I OXIDATION.

Expt. No.	Hours since preparation	CoH_2I oxidation		Succinate oxidation 0-30 min.
		0-30 min. no dye	30-60 min. + brilliant cresyl blue	
14 IA	24	cub. mm. O_2 205	cub. mm. O_2 63	cub. mm. O_2 182
14 IIA	30	197	65	176
14 IIB	48	195	—	168
14 IIC	90	40	72	70 (+ cytochrome, IIS)

The accompanying table also shows the effect of adding brilliant cresyl blue to the CoH_2I oxidation. It appears that the ability of the dye to inhibit or activate the CoH_2I oxidation depends on the state of activity of the natural carriers in the preparation. A similar observation has been made in the case of the succinoxidase system⁶, in which brilliant cresyl blue was found to be the dye which transported hydrogen most rapidly in the inactive system and inhibited an active system the least. Although cytochrome C increased the oxygen uptake in the case of succinate plus the ninety-hour preparation, it had virtually no effect on the CoH_2I oxidation at ninety-six hours. This is in agreement with the findings of Dewan and Green⁵.

With reference to the possibility of reaction (5) as an intermediate step in reaction (4), it is highly significant that $M/150$ malonate had absolutely no effect on CoH_2I oxidation as observed in the conditions in the table, while it produced 100 per cent inhibition in the case of succinate oxidation using the same enzyme preparation. Furthermore, it was found that fluoride strongly inhibited succinate oxidation in these experiments but had no effect on the initial rate in the case of CoH_2I oxidation. Fluoride does not inhibit CoH_2I oxidation; the rate of oxygen uptake actually becomes somewhat greater in this system when CoH_2I is oxidized in the presence of fluoride. This is quite likely due to the fact that in the absence of fluoride, reaction (3) can proceed yielding pyruvic acid which can compete for the dihydrocozymase hydrogen. This explanation is further borne out by the fact that addition of magnesium ions, which are known to activate reaction (3), in the absence of fluoride, gives a further decrease in the rate of CoH_2I oxygen uptake.

Additions of fumarate had no effect on the CoH_2I oxidation in the conditions shown in the table, in the presence or absence of fluoride. These negative results can be explained by the probability that cytochrome was the limiting reactant in the fresh enzyme; but it must be observed that in the ninety-hour preparation there was enough succindehydrogenase and its carrier system to give an oxygen uptake of 70 cub. mm. in comparison with the 40 cub. mm. observed for the CoH_2I oxidation. It is of course true that as the oxidase system becomes weaker, the competing effect of the α -glycerophosphate dehydrogenase in enzyme B probably becomes more pronounced.

These observations do not suggest that the 4-carbon catalysis theory of Szent-Györgyi is wrong. They merely

point out that the enzyme diaphorase is a widely distributed, powerful, malonate-insensitive enzyme which catalyzes the transport of CoH_2I hydrogen to natural carriers which are capable of bringing this hydrogen ultimately to oxygen. The known facts of fumarate catalysis and malonate inhibition in muscle respiration must somehow be reconciled with this observation. The fact that factors tending towards pyruvate formation lessen the oxygen uptake of the system studied here may be a clue as to the mechanism of fumarate catalysis and malonate inhibition. It is possible that fumarate catalysis is to be explained in terms of pyruvate removal. It should also be pointed out that the observation that rapid CoH_2I oxidation can proceed without the action of succindehydrogenase does not prove that the oxidation of CoH_2I does not involve succindehydrogenase in the intact system. Further work is being done in an attempt to establish the nature of the fumarate catalysis in the light of these results.

I am indebted to Prof. Hans v. Euler and to Dr. Erich Adler for laboratory facilities and helpful criticism during this work.

V. R. POTTER
(National Research Fellow).

Biokemiska Institutet,
Stockholm, Sweden.
Feb. 2.

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³ Straub, Coman and Green, *NATURE*, 142, 119 (1938).

⁴ Green and Dewan, *Biochem. J.*, 31, 1060 (1937).

⁵ Needham and Lu, *Biochem. J.*, 23, 2040 (1938).

⁶ Stolz and Hastings, *J. Biol. Chem.*, 118, 479 (1937).

⁷ Green, Needham and Dewan, *Biochem. J.*, 31, 2327 (1937).

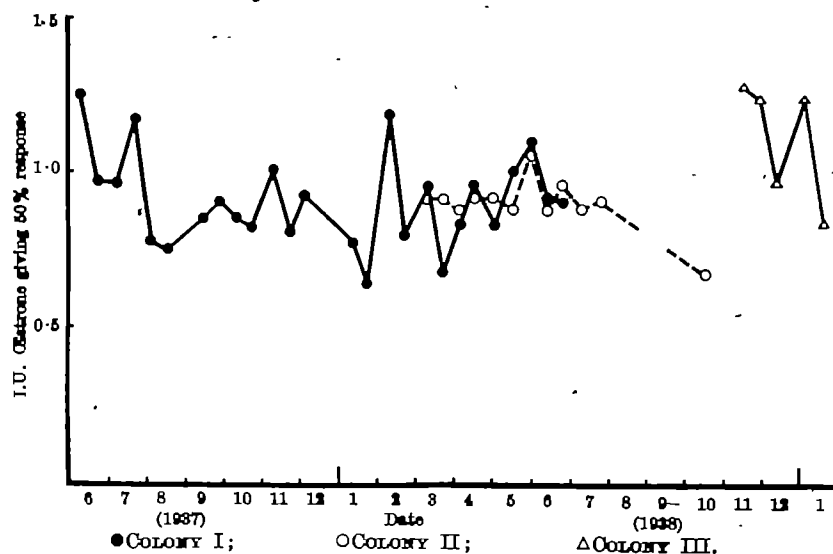
Time-to-Time Variation in the Response of Ovariectomized Mice to Oestrone

IN *NATURE* of October 8, 1938, Duszyńska gave an account of seasonal variation in the response of ovariectomized mice to oestrone, and described an annual cycle of sensitivity which was greatest in spring and lowest in autumn. In the accompanying figure, I have plotted the variations in the dose of international standard oestrone needed to give 50 per cent positive responses when given by injection to groups of ovariectomized mice belonging to colonies kept at this Institute during the past twenty months.

A standard assay technique has been adhered to throughout the whole of this period, most of the determinations having been made with two or three groups of twenty mice each; but some with only a single group of twenty mice (notably those in which determinations for the first colony, denoted by black dots, overlap those for the second colony, denoted by open circles). Whilst an undoubted time-to-time variation in sensitivity occurs, it does not in this instance seem to follow any regular trend. It has been shown that mice which receive sufficient oestrogen to elicit a positive response within six weeks before use are fully 'primed'. The mice in question were therefore uniform in that all groups had received oestrogenic material in sufficient amount within the necessary period before their use as controls.

The colonies have been kept at a fairly uniform temperature, but were exposed to the normal changes in daylight. Attempts to discover the causes of sensitivity changes have shown, however, that mice

kept in an ice-chest and in continuous darkness give the same response as the normal controls, while those continuously illuminated throughout the test period



Terminology in Biology

DR. C. D. DARLINGTON¹ raises a very important point in his condemnation of words which should be dead but are still in biological currency. Every teacher and every author of a text-book will sympathize. The beginner in biology has a hard enough task without having to be plagued by a spate of alternative terms, an infliction which too often leads him to think that all he has to do is to learn these terms and their synonyms in order to 'know' his subject. To many students, a thing is known and understood as soon as a label has been attached to it. There is little wonder that biology is so subject to the reproach that it is nothing but a jumble of difficult words.

Unfortunately we are in a vicious circle. The teacher feels bound to give the alternative terms in case the student comes across them in his reading, and the author of a text-book considers it his duty to give the synonyms because teachers vary in their usage. Unless something is done, we shall have with us for evermore 'anterior vena cava', 'superior vena cava' and 'precaval vein'; and 'antherozoid' and

'spermatozoid'; and the host of alternative names for the female gametes of plants.

Cannot biologists get together and draft a list, with clear definitions, of the technical terms in common usage in botany and zoology? The selection should not be based on priority of introduction, but on commonsense suitability and expressiveness (for example, 'neural tube' is surely more understandable to the student than is 'medullary tube', and 'antheridium' is certainly preferable to 'pollinodium'). Possibly the British Association could take up this matter, or maybe the Association of British Zoologists would be willing to co-operate with a group of botanists in an attempt to clean up the present confusion.

B. BARNES.

C. C. HENTSCHEL.

Chelsea Polytechnic,
Manresa Road,
London, S.W.3.
Feb. 7.

¹ NATURE, 143, 206 (1939).

Points from Foregoing Letters

THE possibility of an evaporation of neutrons in connexion with the recently discovered explosion of the uranium nucleus after neutron impact is discussed by Dr. H. von Halban, jun., Prof. F. Joliot and Dr. L. Kowarski. The density distribution of thermal neutrons obtained by slowing down photo-neutrons from a Ra γ - Be source was studied in a solution of uranyl nitrate and in an equivalent solution of ammonium nitrate. At great distances from the source the uranyl solution showed an excess interpreted as a proof of the existence of the effect discussed.

Prof. L. Meitner and Dr. O. R. Frisch have collected recoil nuclei resulting from the fission of uranium nuclei, by placing a water surface near the bombarded uranium layer. From chemical tests and decay curves, the authors conclude that a considerable part of the collected activity corresponds to the 'trans-uranium' elements previously studied by Hahn, Meitner and Strassmann. Consequently the 'trans-uranium' decay periods must result from a fission of the uranium nucleus and therefore have to be assigned to elements considerably lighter than uranium.

Experiments are described by Prof. E. Friedmann, A. K. Solomon and N. T. Wertheessen which give the relative amounts of radioactive bromine ⁸²Br introduced into organic compounds by means of two processes—Sandmeyer's reaction and the addition of bromine to a double bond. The second method yields a higher concentration of radioactivity.

S. R. Craxford, G. H. Twigg and Prof. Eric K. Rideal point out that, contrary to the views of L. and A. Farkas in the catalytic exchange reaction between deuterium and olefines, the elementary step involves the addition of a deuterium atom and not a loss of a hydrogen atom. There is also evidence that in the chemisorption and rupture of saturated hydrocarbons on a catalyst surface, chemisorbed hydrogen plays a part. If this receives confirmation, a simple mechanism can be proposed permitting an inter-

pretation of the great variety of chemical reactions which hydrocarbons can undergo at catalyst surfaces.

Dr. A. Neuburger contends that the evidence for the cyclol hypothesis, derived from the phenomena of denaturation, of molecular weights and regularities in the amino acid composition of proteins, can be otherwise interpreted. He claims that one may arrive at a globular structure for the protein molecule by postulating, instead of cyclol bonds, other types of bonds which are already known to exist. A reply to Neuburger's suggestions is given by Dr. Dorothy Wrinch on p. 482.

The biological activity of various fractions of a whale-liver oil concentrate (fractionated by adsorption in a calcium hydroxide column) is found by H. Willstaedt and Dr. H. B. Jensen to be considerably lower than would have been expected from the antimony trichloride reaction, but greater than shown by the ultra-violet absorption. Apparently the whale-liver oil does not contain the active substance with an absorption maximum at 344 m μ but may contain another hitherto unknown substance having the biological action of vitamin A.

The liberation of negative ions from a wire gauze inserted between the cathode and the first slit of a mass-spectrograph is reported by R. H. Sloane and Miss Eliza B. Cathcart. The ions so emitted under negative ion bombardment, like those produced by positive ion bombardment, show excess energies.

The role of the enzyme diaphorase as a hydrogen carrier is discussed by V. R. Potter, who concludes that diaphorase is a widely distributed, powerful, malonate-insensitive enzyme which catalyses the transport of hydrogen from dihydrooxymase I to natural carriers capable of bringing this hydrogen ultimately into combination with oxygen.

C. W. Emmans reports that, while his colonies of ovariectomized mice exhibit time-to-time variation in sensitivity to injected oestrone, the variations do not show any regular trend.

Research Items

Early Settlers in Virginia

In the course of the recent meeting of the American Association for the Advancement of Science, at Richmond, Va., during December 27-31, R. Bennett Dean presented a study of early settlements of various nationals in the Colony. Of the French the first to land came with the Governor, Lord De la Warr, in 1610. They planted vines and mulberry groves and were responsible for the establishment of the silk industry. In succeeding years of the seventeenth century, great numbers of Huguenots followed, especially from Saintonge, Languedoc and the Gironde; but the greatest single movement took place about 1700, when on one occasion four boats with about eight hundred passengers sailed from London. After the revocation of the edict of Nantes in 1685 more than 1,000 settled at Mannakin on the upper James. By 1800 the French had spread to nearly every community in Virginia. The highest percentage is now in Powhattan county. Four Germans were in the first boat to arrive at Jamestown. By 1623 there were at least 109 German, Swiss and Dutch, chiefly, artisan, settlers in Virginia. Two thousand immigrants from the Rhenish Palatinate in 1707 were the ancestors of the settlers in the Valley of Virginia. Between 1690 and 1716, the persecution of the Protestants in Germany brought settlers to the forks of the Potomac. Some afterwards moved into the Shenandoah valley. These now are the areas with the highest percentage of Germans. One of the earliest settlements of the Scots was in 1649, when 320 Royalists arrived. In 1732 Scots, largely from Pennsylvania, entered the Valley, founding Presbyterianism in the United States. More numerous and more active than the Germans, they spread over and outside the State, and were an effective buffer against the Indians along the Alleghenies, enabling the colonists to consolidate their gains. In the earlier period of its history, Richmond was entirely occupied by Scots.

Mbali of Southern Angola

The designation 'Mbali', according to the interpretation given by the people themselves, means 'civilized black'. These people may be defined, according to the Rev. P. E. C. Estermann (*Africa*, 12, 1; 1939), as descendants of former slaves, who through employment on plantations, have assimilated a large number of the cultural elements of their old masters, and at the present day readily take to earning their livelihood among the Whites as domestics and artisans. The language of this people, originally of a mixed origin, is Kimbundu, mingled plentifully with Bantuized Portuguese terms. Their material culture has almost completely given way to elements which have been imported from Europe; but in mentality and in beliefs they are still predominantly Bantu. This appears especially clearly in their behaviour in relation to sickness and death. Belief in the incidence of sickness as due to the action of sorcerers is general. The medicine man is as much diviner as healer. The Mbali resort to them no less readily than do other natives, though the ritual employed differs in details, more especially in

the introduction of certain Christian features. The healing ceremonial culminates in a sacrifice of a victim which is killed by the patient after the onset of 'possession'. As the victim falls, the patient throws himself upon it and drinks the warm blood. In burial ceremonial, before the body is committed to the grave, the widespread Bantu rite of interrogation of the dead is performed. Two men raise the shroud, while a third asks the deceased who has been responsible for his death, slaying him by sorcery. If the sorcerer is present, this will be indicated by the movement of the shroud. If the person indicated is a man of courage or position, the accusation may be ignored. If, however, it should be a person of inferior standing, it may be that to avoid the consequent unpleasantness he will have to leave the country. Mourning lasts a fortnight and is brought to a close by a feast held at night, in which dances are accompanied by obscene songs.

Double Monsters

PROF. TAKU KOMAI and his colleagues have issued a series of four papers (*Mem. Coll. Sci. Kyoto Imper. Univ.*, B, 19, 155-253; 1938) dealing with the various types of twins and double monsters which occur in fishes, reptiles, birds and mammals. The literature is reviewed, and several new instances are given. The problem of situs inversus viscerum is recounted in some detail for fish embryos, and Komai comes to the conclusion that this curious derangement is associated with a disturbance of the normal developmental process and is due to a general, rather than a local, cause. There would appear to be a physiological gradient passing from the left to the right side of a fish embryo; and the derangement of this gradient brings about the situs inversus viscerum. Craniopegus, a rare form of duplicity in snakes, is described for *Hemibungarus japonicus*. The numerous types of katadidymi in chicks and ducklings are surveyed and tabulated in detail. Five specimens of mammalian double monsters are recorded. The many illustrations add to the usefulness of these papers.

Hæmoglobin Production in Anæmia

P. F. Hahn and G. H. Whipple (*J. Exp. Med.*, 69, 315; 1939) find that a low protein intake causes limited hæmoglobin production in anæmic dogs. The dog on a limited protein intake was unable to produce the usual amount of globin and therefore of hæmoglobin even in the presence of a large amount of iron. The same result was obtained whether the iron was given by mouth or intravenously, the dog, made anæmic by withdrawal of blood, being unable to produce the expected new hæmoglobin related to the iron intake when the protein intake was kept at low levels. The dogs could be kept in perfect health and weight equilibrium during these long periods of limited diet intake and anæmia. Under the stress of protein limitation, the proteins of salmon muscle, banana and carrot were well utilized, and only 7-8 gm. of these food proteins were required to produce 1 gm. of new hæmoglobin. These experiments clearly showed that the iron content of liver was not wholly responsible for its potency in anæmia due to hæmorrhage.

Reptiles and Amphibians of the Sahara

WE think of the Sahara as a region in which vegetation and, along with it, animal population are reduced to a minimum, yet in his two missions of exploration (1929-32 and 1934-35) H. Lhote contrived to capture alive 35 specimens of snakes, 115 lizards and 78 amphibians. His journeys traversed the Sahara from north to south, but they also touched the Sudan, and that to some extent accounts for the numbers of his specimens. With F. Angel he now describes the collections as representing the following numbers of species and subspecies: one crocodile and one chelonian, 25 lizards, 17 snakes, 8 frogs and toads (*Bull. Com. d'Etud. Hist. Sci. Afrique Occ. Française*, 21, 345; 1938). Several of the species are described as new to science. Perhaps the most interesting part of an ecological region of great diversity is the area Tanazrouft and Ténéré, the most desert of all the Sahara, forming a belt from Atlantic to Red Sea, which is an impassable barrier to all small species. Here the fauna is reduced to small forms able to subsist upon the sparse and scattered tufts of vegetation. The oases also constitute regions of ecological interest, for these isles of man-planted vegetation, lost in a vast sea of sand, form the only areas which can preserve the amphibians still persisting in the Sahara.

Evolution and Relationships of Elasmobranchs

J. A. MOY-THOMAS has recently reviewed the considerable amount of modern work on early fossil fishes and put forward his views regarding the evolution and relationships of the elasmobranchs (*Biol. Rev.*, Jan. 1939). Elasmobranchii has been used as synonymous with Chondrichthyes and not in the sense that it is used by some authors, who include in it a number of other early groups which the author, with justification, considers to be not closely related. The group arose in the Upper Devonian, and *Cladocelache* represents an approximation to the ancestral form. They early differentiated into two lines separable, *inter alia*, by their tooth structure, the Selachii and the Brachyodonti; the former having been derived from the Cladocelachii and including the living elasmobranchs, sharks, skates, rays, etc. The origin of the latter is not so clear, and their living representatives are the Holocephali. Reasons are given for regarding the Acanthodii, Arthrodira and other placoderms as not closely related to the elasmobranchs. They are a diverse group, with a number of characters in common, and are at a lower grade of evolution than the elasmobranchs.

Effect of Eupolyploidy on Chloroplasts

EUPOLYPLIDY in plants induces certain hereditarily changes such as increase in amount of nucleolar substance, increase in size of nucleus, amount of cytoplasm, volume of cells, etc. The size of the plants themselves is also affected; but the relation between euploid chromosome alteration and size varies, since some euploid plants are larger whereas others are smaller. The effect of eupolyploidy on the size of the chloroplasts has recently been studied by D. Kostoff and A. Orlov, working on *Nicotiana* and *Solanum* (*Ann. Bot.*, New Series, 2, No. 8, 883; 1938). From the data obtained, it is clear that chloroplasts do not increase with an increase in the chromosome number. In fact, there is a tendency to smaller size than in the diploids or in the parental species. In only one case (*N. rustica* × *paniculata*) was the average diameter of the chloroplasts of the amphidiploid larger than the average diameter of

those of the parent species. Since tetraploids are usually deeper green in colour, the colour difference is probably due to a larger number of chloroplasts in the cell.

Seeding from Severed Shoots

A DISCOVERY of importance to the farmer and gardener is the fact that once the flowers are open some of the common weeds can ripen their seeds on the severed shoot just as well as on the growing plant. N. T. Gill has carried out investigations into this question (*Ann. App. Biol.*, 25), and an account of his results is also given in the *Gardener's Chronicle* (No. 2716, 105). The most dangerous weeds in this respect are ragwort and sow thistle, for seed from out shoots of these species showed as good viability as when allowed to ripen completely on the parent plant. Out shoots of groundsel, on the other hand, gave only 35 per cent germination compared with 90 per cent from ripened seed. Other weed seeds such as dandelion, cat's-ear, creeping thistle, curled dock and stinging nettle can only germinate if the seeds are fully developed, but the inconspicuous nature of the flowers in some of these plants makes it unwise to assume that it is safe to leave out portions on the ground. The stage of maturity may also exert an influence on the length of dormancy of the seed. In the case of shepherd's purse, mature seeds can germinate in the autumn or spring, but half-ripe seeds wait until the spring. Corn speedwell and chickweed showed the same behaviour. *Datura stramonium*, on the other hand, behaved quite differently, for ripe seeds either germinated at once or lost their viability after four weeks, whereas immature seeds retained their germinative capacity for a year or more.

Frost Damage to Fruit Trees

THE serious reductions in crop suffered by fruit growers in recent years have led the Ministry of Agriculture to institute an inquiry into the effect of meteorological factors on the distribution of frost damage. Preliminary results obtained by C. E. Cornford have recently appeared (*J. Pom. and Hort. Sci.*, 16, 291; 1939). A study of micro-climate in relation to topography has brought out several interesting facts which may be of importance in attempts to combat frost injury. On certain clear nights when a calm exists in valleys, the occurrence of a light and relatively warm 'hill-top wind' has been demonstrated. This is able to influence the force and direction of a local katabatic wind on a neighbouring slope, producing a calm belt or 'neutral zone' across the slope, or a movement of air along the contours, according as the wind blows directly or obliquely on the slope. Such a calm belt may be a suitable site for orchard heaters. It was shown that on most radiation nights the air temperature over undulating country varied with altitude, the highest places being the warmest. The temperature, however, measured at a height of 3 ft. above the ground, was equally affected by the nature of the vegetation. The lowest minimum temperatures occurred over grassland, whilst the air above bare soil and that in woods with a complete leaf canopy was relatively warm, often 6° F. above that over grassland. Only exposed grass was able to produce relatively cold air above it on a radiation night, grass under trees in a leafy apple orchard causing no reduction. It is suggested that risk of frost damage in an orchard in the blossoming period may be reduced by reducing the amount of long grass exposed to the sky.

Anomalous Dispersion of Rayleigh Waves

THIS is the subject of a second paper on "Anomalous Dispersion of Elastic Waves" by K. Sezawa and K. Kanai (*Bulletin Earthquake Research Institute, Tokyo Imperial University*, 14, Part 4, November 1938). The densities and elastic constants of the surface layer and the subjacent material are symbolized, and the velocity equation of dispersive Rayleigh waves is determined in terms of these. Six cases of μ'/μ ranging from 1 to 0.4 are then assumed and the consequences investigated. It is found that when the stratification approximates to Wiechert's condition ($\varphi'/\varphi = \mu'/\mu = \lambda'/\lambda$), the velocity of Rayleigh waves for an intermediate value of L/H is considerably higher than that of the usual Rayleigh waves. In this particular instance there is a second dispersion curve that passes through the point corresponding to the velocity of Stonely waves. As the stratification approaches the usual type, the dispersion curve tends to assume the normal dispersion type. When density increases with depth more rapidly than elasticity, as may often occur in the earth, the dispersion curve becomes quite anomalous, and beyond a certain critical condition there should exist a range of L/H within which no surface waves of permanent type can exist.

Deep-Focus Earthquakes in Central Asia

S. P. LUN has made a study of four of these shocks occurring between 1933 and 1935, using data obtained from seismograms (*Seis. Bull.*, Chiufeng, China, Seismic Station, 3, Nos. 2 and 3; 1935 [received 1938]). The shocks were chosen by their characteristics as enumerated by Scrase and chiefly by their lack of notable l and m phases. The method of investigation was first to find the epicentre by assuming the travel time (T) of the P wave to be connected with the epicentral distance (Δ) by the formula $T = A + B\Delta + C(\Delta/10)^2$ and fitting in the constants A , B and C by the method of least squares, afterwards applying the Geiger method to correct the approximately determined epicentre. The depth of focus was then determined by four methods: (1) from first principles, (2) by the Brunner chart, (3) by Scrase's method, (4) by the time interval between $PKKS$ and P' . The results for the four shocks obtained by the author were as follows: (1) Epicentre φ 35° 29', λ 70° 05', T , 1933 Jan. 9d. 2h. 1m. 38s.; depth of focus, 0.045 of earth's radius. (2) Epicentre φ 36.1°, λ 70.7°, T , 1935 Feb. 3d. 2h. 10m. 42s., depth of focus 0.023 of earth's radius. (3) Epicentre φ 36.4°, λ 70.8°, T , 1935 April 3d. 11h. 11m. 56s., depth of focus 0.031 of earth's radius. (4) Epicentre φ 38.1°, λ 70.9°, T , 1935 Oct. 11d. 4h. 20m. 31s., depth of focus 0.047 of earth's radius. The author notes that the epicentres are all near φ 36°, λ 70°, near the inflexion of the Hindu Kush, and proposes to investigate the method of origin further.

Crystal Structure of Ammonium Cadmium Chloride

In crystalline cadmium chloride CdCl_2 , there are octahedral CdCl_6 groups condensed into layers, each chlorine atom being adjacent to three cadmium atoms. Tetrahedral co-ordination is shown by cadmium with cyanide groups in $\text{K}_4\text{Cd}(\text{CN})_6$, and with sulphur, selenium and tellurium atoms in the sphalerite and wurtzite type crystals CdS , CdSe and CdTe , and might occur with chlorine also. There are hence two types of structures which might well occur for the complexes $(\text{CdCl}_6)_n$, the first involving

octahedra with shared corners, as in the cubic crystal KMgF_3 , and the second involving rings or chains of tetrahedra as in the metasilicates. H. Brasseur and L. Pauling (*J. Amer. Chem. Soc.*, 60, 2886; 1938) have determined completely the structure of the orthorhombic crystal NH_4CdCl_4 , and find it to be based on octahedral configuration about the cadmium atoms. The CdCl_6 complexes occur in the crystal in infinite polymers in the form of double rutile strings of CdCl_6 octahedra parallel to the c -axis. These complexes are held together by the ammonium ions, each of which has nine chlorine atoms co-ordinated about it. Interatomic distances in the crystal are found to be closely related to those in CdCl_2 and NH_4Cl .

Large Cosmic Ray Showers

P. Auger, R. Maze, P. Ehrenfest and A. Fréon (*J. de Phys.*, 10, 39; 1939) have investigated very large showers of particles produced in the atmosphere by the cosmic rays. They find that Geiger counters separated by quite large distances (up to 75 m.) show occasional coincident discharges. The frequency of these extensive showers increases with altitude at much the same rate as the ordinary showers produced in heavy metals. It was concluded from the counter experiments that the density of particles in a shower was of the order of 50 per sq. metre, and a very similar result was obtained by the use of an expansion chamber released by the coincidences (cf. Jánosy and Lovell, *NATURE*, 142, 716; 1938). A great part of each shower consists of electrons, as shown by absorption and by the cascade multiplication of the particles in a lead plate. The authors consider that there are some penetrating particles present, though it seems possible that their absorption curves are not incompatible with a shower containing only electrons of fairly high energy. There seem to be some protons produced by nuclear interaction. The showers observed are probably part of large cascades produced by the multiplication in the atmosphere of an incident electron of very high energy. Assuming that this is so, the initial energy must be of the order $10^{13} - 10^{14}$ electron volts. It may be remarked that this is much larger than the energy which could be obtained by the complete annihilation of the heaviest atoms.

An Improved Liquid-Filled Prism

F. J. HARGREAVES has recently described his hollow liquid-filled prism of about 3½ in. effective aperture, the glass plates constituting the refracting sides of the prism being joined at their edges to the cell by goldbeaters' skin (*Mon. Not. Roy. Astro Soc.*, 99, 2; 1938). The object of this flexible connexion is to prevent stresses in the plates, each of which presses against external stops and is held there by the pressure of the dispersing liquid within the cell. A difficulty arose in supporting the weight of the glass plates, more especially as it is necessary to invert the prism to empty it. To prevent too much tension on the goldbeaters' skin supplementary support was provided by the use of slings made of phosphor-bronze wire. Another prism is under the process of construction on the same principle but with minor modifications in detail. The author sees no reason why much larger prisms should not be made on similar lines, though there is the difficulty of constructing large disks that are thin and homogeneous. Hargreaves thinks that this difficulty can easily be overcome.

The Structure of the Globular Proteins

By Dr. Dorothy Wrinch

ON recent occasions a number of objections to the cyclol theory have been raised, to many of which replies have already been given, explicitly or implicitly, in a number of publications, notably in Langmuir's lecture to the Physical Society on December 20, 1938¹. In view of the prominence which has been given to these criticisms, it seems desirable to summarize the replies.

It has been suggested that the number of theories such as the cyclol theory is so large that the *a priori* probability of any one is not sufficiently great for it to merit consideration^{2,3}. It is difficult to give much weight to objections of this type until it proves possible to formulate, or failing this to establish the existence of, a sufficiently large number of independent theories, each of which leads to structures accounting for the definite and discretely arranged molecular weights of the native proteins, their capacity to denature, to form spontaneously from solution highly insoluble monolayers and so on. So far as we are aware, no alternative structures have yet been proposed. Meanwhile, "the very large number of independent properties which are correlated by the cyclol theory and the extreme simplicity and the small number of postulates from which it is derived by purely logical processes"⁴, seem to give it a considerable *a posteriori* probability.

It is suggested that there are grave objections on chemical grounds to the postulate of the four-armed unit $>N-CHR-COOH<$ and indeed to the cyclol structure itself owing to the lack of precedent in organic chemistry for this diazine-triazine type of structure⁵. Proteins are so different from other substances that it is surprising that there is a reluctance to accept for them a structure for which no analogue in organic chemistry can be found. Globular proteins have not yet been synthesized in the laboratory. The fact that it has not proved possible to form ring structures from peptides⁶ is therefore scarcely to be regarded as evidence against the cyclol hypothesis. Furthermore, we would not regard the lactam-lactim tautomerism of peptides as the chemical basis of the cyclol theory⁴. At present, we do not know whether polypeptide chains constitute an intermediate stage in protein synthesis, nor is it clear that the cyclization of chains, if it occurs, entails the postulate of lactam-lactim tautomerism of peptides.

Further criticisms of the cyclol hypothesis are as follows: (a) the theory is incompatible with the findings of enzyme chemistry^{7,8}; (b) it cannot explain certain facts of denaturation⁹; and (c) it has not proved possible to synthesize in the laboratory certain "simple models of cyclol type"⁴, or to induce the formation of cyclol links between simple molecules⁴.

(a) In accordance with the current ideas in the kinetics of reactions, it was suggested by Langmuir¹ that there is a tautomeric equilibrium in the globular proteins between some of the four-armed units $>COH-CHR-N<$ and the two-armed units $-CO-CHR-NH-$, by means of which cyclol bonds are continually opening and reforming. Thus at any one time there

are some points at which a peptide link, $CO-NH$, can be attacked directly. The cyclol theory therefore does not, as has been suggested⁴, need to make the assumption that proteolytic enzymes open cyclol bonds. We know of no evidence which conflicts with the view that the enzyme can take advantage of the situation arising from the opening of these bonds, so that, if it is a fact that proteolytic enzymes act only on $CO-NH$ bonds, there is no incompatibility with the cyclol structure proposed for the globular proteins.

The objections (b) and (c) again raise the question of the nature of the cyclol bond. This bond in isolation may well be unstable; indeed the marked instability of the globular proteins in general and other considerations⁹ require it to be so. Failure to synthesize in the laboratory so-called "simple models of the cyclol type"⁴ (a phrase which may ultimately be found to be a contradiction in terms), or to induce the formation of isolated intermolecular cyclol links, is then no evidence against the cyclol hypothesis.

The stability of the globular proteins, under special conditions, in solution and in the crystal, we attribute to definite stabilizing factors^{7,8}; namely, (1) hydrogen bonds between the oxygens of certain of the triazine rings, (2) the multiple paths of linkage between atoms in the fabric, (3) the closing of the fabric into a polyhedral surface which eliminates boundaries of the fabric and greatly increases the symmetry, and (4) the coalescence of the hydrophobic groups in the interior of the cage. If these stabilizing factors are withdrawn the cage structure collapses. Denaturation on this theory (apart from the special type due to the dissociation of structures held together by hydroxyl or hydrogen bonds or salt or covalent linkages between *R*-groups^{10,11}), corresponds to any breakdown of the structure due to the opening of cyclol bonds^{4,12}. When few bonds are open they may re-form because of the multiple paths of binding holding the parts in position. Reversible denaturation (of either type) is thus not excluded by the cyclol theory. In the case of the fibrous proteins in which some cyclol bonds may be present,¹³ the first and second stabilizing factors may operate. The denaturation of myosin (which it is suggested is a difficulty for the cyclol theory⁴) thus seems to be easily interpretable.

The first stability factor also, it appears, may explain the fact that it has not proved possible to methylate or acetylate the peptide hydroxyls, which on the present hypothesis should be present in egg albumin and haemoglobin¹⁴.

It may be emphasized that whereas the first three stability factors are uniform for all the globular proteins, the strength of the fourth factor varies with the specific amino-acid composition of the individual protein. This point is demonstrated by the case of insulin, in which the exceptional behaviour (its resistance towards heat and acid, the stability of its crystals in the dry state, etc.) can perhaps be correlated with its abnormally high content of hydrophobic groups. The fact that insulin "cannot be denatured in the usual sense of the word"¹⁵ does not

provide evidence against the cyclol theory of denaturation: it illustrates the importance of the fourth stability factor. Incidentally, insulin, like many other globular proteins, spontaneously forms very insoluble monolayers from solution¹², a property which in itself indicates the likelihood of a cage structure^{1,13,14}. The spontaneous formation of monolayers from solution represents a very mild type of degradation, presumably involving no hydrolysis. It seems likely that much could be learnt about protein structure by studying the structure of the constituents of these protein monolayers. On the cyclol theory, fragments of fabric and closed polypeptide chains are to be expected when gentle methods of degradation are used which involve no hydrolysis¹⁵. The theory would not (as has been suggested⁴) make any predictions as to the nature of the products obtained when the usual gross methods of degrading proteins are used.

Other criticisms of the cyclol theory³ (dealt with in detail in other communications^{16,17}) relate to one particular point, namely, the suggestion that the insulin molecule has the cage structure *C*₁. It was shown at the outset¹⁸ that this structure satisfies the chemical and physico-chemical facts and also those relating to cell molecular weight, space-group and cell dimensions obtained in an X-ray analysis of a dry zinc-insulin crystal¹⁹. Controversy has, however, arisen as to whether it is consistent with certain vector diagrams of a dry zinc-insulin crystal published later²⁰. In view of authoritative opinions as to the inadequacy of the X-ray data²¹ (which make it highly uncertain how far the vector diagrams give even an approximately correct picture of the situation in the crystal) and as to the feasibility of making any deductions from such data in the absence of a chemical analysis of the crystal^{22,23}, it seems necessary at present to abandon the hope of reaching any final conclusion on this special point. Arguments can only revolve round the plausibility of subsidiary hypotheses.

THE GEOMETRICAL ATTACK ON PROTEIN STRUCTURE

It has been pointed out by Neuberger⁴ that many of the arguments in favour of the cyclol hypothesis could be used equally well in favour of any "regular geometrical structure which joins peptide chains to form a globular molecule", a theme which has already been developed in considerable detail^{24,25}. This remark, in focusing attention on the fundamental problem of protein structure, namely, the existence of megamolecules, puts into correct perspective the general investigations on protein structure of which those dealing with the cyclol theory form a part. These investigations have a wide scope. Given that protein molecules are polycondensation products of amino acids, interlinked by bonds between the nitrogen of one and the terminal carbon of another, there are only a certain mathematically determinate set of possible structures. The full and exhaustive formulation of these is the objective of this work^{24,25,26}.

Now the cyclol theory gives precise expression to this general point of view by postulating that these polycondensation products are built on the particular two-dimensional scheme exemplified by the cyclol network. No alternative comprehensive scheme has so far been forthcoming; but on the other hand, it has never been claimed that the cyclol pattern is the only design consistent with the chemical and stereochemical specifications²⁴. The characteristic

pattern must, of course, satisfy certain conditions; thus it must be such as to allow "the possibility of the regular and orderly arrangement of hundreds of residues"²⁴ (and herein lies the difficulty of attributing the fine structure of proteins to S-S, CO-S, NH-S or CO-NH-CO links as suggested by Neuberger⁴), and it must be capable of fragmentation into polypeptide chains. The cyclol postulate has been developed in considerable detail, since it was scarcely feasible to show the potentialities of the geometrical method by general statements alone.

It should, however, be recognized that there are broad deductions to be drawn from this point of view, irrespective of the particular form of the atomic pattern. Chief among these is the suggestion that the molecules of the globular proteins are cage-like structures, consisting of a characteristic fabric folded round to form a closed polyhedral surface^{13,27,28}. This simple corollary of the idea of a protein fabric, though in point of fact suggested by the cyclol hypothesis, is independent of this or any other postulate. Whether or not the cyclol hypothesis proves to be correct, it certainly establishes the existence theorem in the mathematical sense, proving that there are no intrinsic impossibilities in the cage type of structure, showing how the atomic pattern can determine size and shape, and proving also that the cages may be rendered highly specific by the conditions of linkage imposed on the individual atoms.

The present controversy—wholly concerned with details of the cyclol pattern—makes it clear that the determination of the atomic pattern of proteins is beyond the range of present chemical and physical techniques. It then seems all the more important to direct attention to this general issue as to the general nature of structures of the globular proteins. Whatever the atomic pattern may be, the fact remains that the defining characteristics of the native proteins not only fit in with the idea of a cage, but even seem to demand a structure of this kind for their molecules. On this point there seems indeed to be a growing consensus of opinion²⁴. In any case, the central problem is to explain the existence of very large but chemically and physically well-defined molecules. The idea of a cage structure has been offered for consideration, as an explanation of this striking fact. Is it not possible, by means of experimental techniques already available, to recognize a cage when we see one?

¹ This lecture was summarized in *NATURE*, 142, 24 (1939): it will be published in full in the *Proceedings of the Physical Society*.

² Bernal, Royal Institution, Jan. 27, 1939.

³ Bernal, *NATURE*, 143, 74 (1939).

⁴ Neuberger, *NATURE* (this issue p. 478).

⁵ Neuberger, *NATURE*, 140, 1024 (1938).

⁶ Bergmann and Niemann, "Annual Reviews of Biochemistry", 7, 11 (1938).

⁷ Cold Spring Harbor Symposium on Proteins, 6 (1938).

⁸ Wrinch, *NATURE*, 139, 241 (1936).

⁹ Langmuir and Wrinch, *NATURE*, 142, 40 (1939).

¹⁰ Wrinch, *Proc. Roy. Soc., A*, 161, 505 (1937).

¹¹ Wrinch, *Phil. Mag.*, 23, 215 (1938).

¹² Wrinch, *Phil. Mag.*, 25, 705 (1938).

¹³ Wrinch, *Proc. Roy. Soc., A*, 160, 81, 1937.

¹⁴ Haurowitz, *J. physiol. Chem.*, 236, 28 (1938).

¹⁵ Langmuir, Pilgrim Lecture, Royal Society, November 8, 1938.

¹⁶ *NATURE* [forthcoming].

¹⁷ Langmuir and Wrinch, *Proc. Phys. Soc.* [in course of publication].

¹⁸ Wrinch, *Science*, 86, 568 (1937); *Trans. Faraday Soc.*, 33, 1368 (1937).

¹⁹ Crowfoot, *NATURE*, 135, 591 (1935).

²⁰ Crowfoot, *Proc. Roy. Soc., A*, 164, 580 (1938).

²¹ Robertson, *NATURE*, 142, 76 (1939).

²² Bragg, *NATURE*, 143, 73 (1939).

²³ Wrinch, International Congress of Physics, Chemistry and Biology, Paris, 1937.

²⁴ Wrinch, Cold Spring Harbor Symposium on Proteins, 6 (1938).

²⁵ Wrinch, *NATURE*, 137, 411 (1936).

'Stump' Planting

AS regards modern developments of what is now widely alluded to as 'stump' planting, the method in all probability was first introduced to plant up new areas in connexion with the irrigated plantations in the Punjab plains, the species first utilized being the shisham (*Dalbergia Sissoo*). 'Stump' is really a misnomer; for the piece of the plant alluded to is a root and shoot or stem cutting. Its success and cheapness under certain conditions in the Punjab was striking, and this success has been repeated elsewhere in India, for example, in the Terai and Bhabar lands in the United Provinces, and in northern Nigeria in Africa with the same species.

But successful as has been the afforestation work with shisham stump planting, it has proved even more successful with teak in many parts of India, where artificial replanting or new afforestation work is being undertaken under certain types of condition. So valuable and cheap is the method that it has spread far beyond India, and interesting work has been obtained with stumps in the west coast and other forests of both British and French Colonies in Africa.

In the past there has been a good deal of controversy as to the best size (length and thickness) of the root and shoot cutting or 'stump'. An ordinary method of obtaining these for planting out purposes in both India and Africa is to sow seed in a nursery

and then root and shoot prune when one year old, leaving eight inches of root and one inch of stem. A. L. Griffith, the Madras sylviculturist, has now discussed an investigation into the best root length of stump to use when stump planting teak (*Tectona Grandis*) in areas having a general west coast type of climate (*Ind. For. Rec.*, New Ser., 3, No. 1. Govt. of India Press, New Delhi, 1938).

From the details of the localities given it is obvious that by "west coast" the author means the west coast of India and not the west coast of Africa. But the experiments here discussed will prove of equal use in the latter region, where the introduction of stump planting is of a more recent date. The climate had an average annual rainfall varying from 60 in. to 120 in., and elevations varying from the plains at the foot of the Ghâts up to 3,000 ft. The soils at all centres were light forest soils naturally well aerated. Briefly, Mr. Griffith carried out a series of experiments in different localities over a period of four successive years (1932-1935). His results may be summarized as follows: There are no appreciable differences in results, at the end of the first growing season after planting, from stumps within the root length range of 6 in. to 10 in.; but a root length of 4 in. gives definitely poorer results. It was also demonstrated that stumps of 0.7-0.8 in. diameter give appreciably better results than those of 0.3-0.4 in. diameter.

Intelligence and Birth-Rate

IN a paper entitled "Intelligence and Birth-Rate" read before the Industrial Section of the British Psychological Society on February 8, Dr. L. S. Penrose summarized the present position regarding differential fertility and the decline in intelligence alleged to be taking place in Great Britain. By examining the results of differential birth-rates within the community, he brings to light the trends of social selection that are taking place, and in doing so, he links together a number of facts not usually associated in considering these matters.

Although the general problems of a declining birth-rate, owing largely to the efforts of the Population Investigation Committee, are beginning to attract wide attention, the effects of a differential fertility upon the ability of the nation as a whole are far too little appreciated. Knowledge of the relation between intelligence and birth-rate, as Dr. Penrose says, is of great practical importance in "planning the conditions of an efficient civilization". Even the most critical writers have been compelled to admit the presence of some fall in national ability. Thus Prof. J. B. S. Haldane writes that we may "expect a slow decline perhaps of 1 or 2 per cent per generation in the mean intelligence quotient of the country". (*'Heredity and Politics'*, p. 117.)

The subject of a decline in the nation's intelligence is one that lends itself easily to sensationalism, and the presentation of Dr. Penrose is to be welcomed as a dispassionate and timely one. At the outset he points out that the fall in the birth-rate may be due to diminution in family size, which implies a larger

proportion of first-born children. Thus the average sibship in Great Britain now is said to be half of what it was fifty years ago.

Apparently, only in one type of mental defect, namely, that associated with lesions in the pyramidal tract, has Dr. Penrose been able to satisfy himself that primogeniture is a highly significant factor. But he admits the existence of evidence pointing to raised incidence, among the first-born, of abnormal confinements, still-births, and congenital malformations such as anencephaly, spina bifida and hydrocephalus. There is evidence also that first-born children more frequently tend to become problem children than the later born, though here other selective influences may be at work bringing the first-born children to the notice of the clinics. It has also been maintained that the first-born are more likely to become insane than the later born, and that the chances of being convicted of criminality are much greater in the first two members of a family than in the rest of the family.

Maternal age at the birth of a child is the next factor considered by Dr. Penrose. Where the birth-rate is falling, the average maternal age will probably become greater. Dr. Penrose estimates the average maternal age in England as 29 years; in Japan it is said to be 26 years. Maternal age is particularly significant in the etiology of mongolian imbecility, the chances of the occurrence of this kind of defect being more than doubled for every increase of five years after the age of twenty-five years. The chances of the birth of a mongolian imbecile before the maternal

age of 25 years are estimated by Dr. Penrose as about 1 in 6,000.

Other influences related to changes in intelligence level and discussed by Dr. Penrose are birth-rates in rural and urban populations. Fertility is higher in rural than in urban areas, and the average intelligence is generally found to be much lower in the country than in the towns. Actual mental deficiency is also found more frequently in rural than in urban districts. The main cause would presumably be the migrations of the more able people from the country to the town, where industrial development offers them greater economic inducement than is found in agricultural areas. An additional factor in the decline of fertility among certain classes has frequently been stressed. This is the high cost of education and general high standard of living. Yet another factor is the employment of women, usually the more intelligent ones, in industry and commerce.

Whatever effects social selection has upon the level and distribution of intelligence, it certainly seems to have favourable effects upon physique. Besides a marked reduction in the incidence of diseases like tuberculosis, a notable increase has taken place in the average height and weight of working-class school children. As regards the question of intelligence as an inheritable character, Dr. Penrose inclines to the

view that the presence of a favourable environment may make a significant difference to the scores made on an intelligence test.

Dr. Penrose leaves open the possibility of an I.Q. of 90 becoming normal with an improved environment. Some psychologists would consider this as somewhat too high an estimate of the possible effects of environment upon the scores of an intelligence test. He concludes that "on account of social selection, the intelligence level of the general community tends to move towards the point at which fertility is highest". He takes, however, a more moderate view of the point of highest fertility than other writers and regards it as lying in the region of 90 (Binet I.Q.). In his view the "fecundity of the mentally defective is largely mythical" and those with an I.Q. below 70 have a fertility about one quarter of the normal.

Finally, Dr. Penrose is inclined to believe that the most immediate causes of differential fertility and also of general trends in birth-rate are probably psychological in nature. In this connexion it might be worth mentioning that a very recent investigation of Prof. L. M. Terman on marriage revealed that orgasm inadequacy was present in one third of the women in his large sample. His analysis suggests that this inadequacy may be largely genetic in origin.

J. I. COHEN.

Protection of the Fauna and Flora of Africa

THE "Final Act" of the Second International Conference for the Protection of the Fauna and Flora of Africa, held in London in May last has now been issued.* The Conference was held under the chairmanship of the Earl of Onslow, and was attended by delegates of the following Governments: Union of South Africa, Belgium, Great Britain and Northern Ireland, Egypt, France, Italy, Portugal and the Netherlands. The interests of the Anglo-Egyptian Sudan were represented by the United Kingdom and Egyptian delegations jointly.

The delegates met, at the invitation of the Government of the United Kingdom of Great Britain and Northern Ireland, on May 17-24, the invitation having been issued in accordance with the terms of the protocol which formed part of the agreements concluded at the International Conference for the Protection of the Fauna and Flora of Africa, held in London in 1933. The Conference had before it a number of statements which had been circulated by delegations on behalf of the Governments represented, setting out the measures which had been taken in their territories to give effect to the provisions of the Convention.

The Act sets forth the names of the delegates and advisers of each Government represented; and a list of the committee of experts appointed to make suggestions for the addition of further species to the Annex to the Convention on the occasion of its next revision. Great Britain was represented by the Right. Hon. the Earl of Onslow, Sir William F. Gowers, Mr. E. B. Bowyer and Mr. B. F. Wright as delegates, and by Mr. T. Hoakyns Abraham, Captain Keith F. T. Caldwell, Mr. B. Cookram,

Captain J. G. Dollman, Mr. J. M. Ellis, Mr. G. G. Fitzmaurice, Dr. C. Forster-Cooper, Mr. Hugh Fraser, Sir Arthur W. Hill, Mr. L. W. N. Homan, Dr. Julian S. Huxley, Dr. P. R. Lowe, Sir Guy A. K. Marshall, Sir Peter Chalmers Mitchell, Mr. A. H. Stocks, and Mr. M. J. R. Talbot as advisers. The secretary-general was Mr. Francis Hemming, and the secretary, Mr. D. H. F. Rickett. It also reports the statements made by the various delegates, who briefly outlined the measures taken by their various Governments to give effect to the provisions of the Convention.

The Act is followed by eight annexes: (1) dealing with the report of the Committee of Experts relating to the species of mammals, birds and plants recommended for inclusion in the Annex to the Convention on the occasion of its next revision (pp. 38-69), and (2) memoranda submitted by the various Governments on the action taken by them to give effect to the provisions of the Convention (pp. 70-149).

The memorandum submitted by the Belgian Government (pp. 72-73) is followed by several enclosures (pp. 74-127) in which is set forth a full and complete exposé of a decree of April 21, 1937, on "La Chasse et La Pêche au Congo Belge", and a discussion of every article governing that decree and the motives which have suggested them. It is a very valuable contribution to the subject of international conservation of faunas and floras.

From the scientific, economic and biological points of view, the importance of the two African conferences which have already been held can scarcely be exaggerated, in that for the first time in history concerted international efforts have been made to ensure the preservation of the fauna and flora of an entire continent before it is too late.

* Second International Conference for the Protection of the Fauna and Flora of Africa, London, May 1938. Final Act. Pp. 149. (London: H.M. Stationery Office, 1938.) 2s. 6d. net.

For the first time in the history of the world, delegates of, and advisers to, the various Governments concerned have met together in council, armed with the knowledge and experience of the disastrous results which may follow the uncontrolled actions of blundering and profiteering man, in order to devise reciprocal measures designed to prevent such actions in the future and to conserve for all time, in so far as it is possible, the natural features and economic possibilities of a great continent.

It is true that as yet only the most elementary steps have been taken, but the important point is that a beginning has been made and definite steps in the right direction taken. Doubtless as more conferences are held, the necessity for enlarging the scope of the term 'flora' will be realized, until it comprehends the consideration of the far wider question of the preservation of the balance not only between forested and unforested areas, but also of the proper conservation of those essential areas which act like sponges for the storage of water and control the water supply of those areas of land

which can be properly utilized for agricultural purposes.

In this connexion, the deliberations and actions of future conferences will surely profit by the gross mistakes which were originally made in developing the agricultural resources of such countries as the United States of America, Australia and New Zealand. In America, for example, we now know that as a consequence of ignorant and thoughtless drainage schemes, thousands of square miles of good land have literally 'gone with the wind'; while in Australia the over-zealous clearing away of forested areas has upset the biological balance of Nature, with the inevitable and consequential appearance of various plagues of an animal or vegetable nature which may, and have, cost millions of good money to combat. We would venture, therefore, to make the suggestion that the work of future conferences would be enormously benefited and its scope very profitably enlarged by the inclusion in its general body of national advisers of a sufficiency of forestry experts.

PERCY R. LOWE.

The Morphology of the Carpel

AN important contribution to the vexed question of carpel morphology has recently been published in *La Cellule* (47, 287-452; 1938) by Prof. V. Grégoire, the late professor of botany at the University of Louvain (see *NATURE*, 143, 400; 1939); it is characterized by the remarkable number of fine illustrations, mainly photomicrographs (no fewer than 252 in fourteen plates). The problem is approached from the point of view of development, and it is more than a coincidence that both Prof. McLean Thompson, of the University of Liverpool, and Prof. Grégoire, approaching it from this angle, reject decisively the classical theory that the carpel may be regarded as a modified leaf. The "state of flowering" of McLean Thompson and the "reproductive apex" of Grégoire necessitate a new terminology to interpret their characteristics of form, as both authors are agreed that analogies from vegetative organizations are misleading and quite unjustified.

We owe to previous papers by Prof. Grégoire and his colleagues the concept of the vegetative growth apex as establishing, in successive time intervals, or plastochrones, a series of transversely expanded foundations, which are components of the axis (the *soubassements*), upon which are then raised new foliar primordia. This mode of growth necessitates a meristem organized in depth and constructed, in modern terminology, of a tunica overlying a corpus, both of which have a meristematic nature and contribute to these successive units of shoot organization.

Prof. Grégoire points out that neither tunica nor corpus can be identified at the reproductive apex. There is a superficial meristem of uncertain depth, covering both the summit and the flanks of the apex; but this is not identified as a tunica because of the frequency with which periclinal divisions alternate with anticlinal, thus adding to the depth of parenchyma below. Below it there is no meristematic corpus at all, but a parenchymatous mass homologous with the pith. The superficial meristematic layer can add no units of construction to the shoot; the floral parts are simply emergences from it with no axial founda-

tion such as is present with a leaf primordium. Not even the sepals are regarded now, in contradistinction to Grégoire's earlier views, as homologues of foliar structures.

The insertion of each new foliar primordium becomes the centre of a new impetus to procambial activity, the leaf-trace system of the new unit thus contributing basifugally to the vascular tracts spreading into the leaf and basipetally to the trace system linking this with the axis. In the reproductive axis, this basipetal contribution to procambial development is missing; from a procambial 'magma' often of considerable extent and sometimes spread solidly across the base of the reproductive axis, cordons of procambium, often anastomosing or bifurcating freely, spread basifugally into peduncles and then into floral parts; but there is no suggestion that this procambial activity contributes basipetally to an enlargement of the vascular system below the reproductive axis.

The two types of growth, the vegetative and reproductive, are fundamentally distinct and not reducible to a common plan. A reproductive apex does not even develop out of a vegetative apex by its gradual modification; it arises as a lateral growth on the side of the vegetative apex that it displaces, and if subsequent proliferation shows a return to foliar emergences then a vegetative apex has re-arisen adventitiously on a reproductive axis. Such a reproductive axis, always a layer of meristem tissue upon a parenchymatous plinth, still capable of some growth and extension (the *porte-méristème* of Grégoire) may be used up entirely in the production of floral parts, it may dichotomize by the development of a central groove, or divide into more fragments as the result of more grooves developing. Its floral members arise without plastochronic intervals and these members are local products of a portion of the meristem without the tendency to bilateral spread around the axis characteristic of the foliar primordium.

Grégoire distinguishes two types of carpels among those now described: the *Ramunculus* type, in which a

transverse or tangential slit separates a dorsal upcurving and enclosing segment from a ventral, or the abaxial face of which a single ovule arises in the median position; and the *Aquilegia-Rubus* type, in which a very narrow radial slit is present between two lateral walls, joined external by a strongly developed dorsal wall which runs up into the stigma. This type gives the follicle which is the basis of the foliar theory of the carpel, but Grégoire points out that the thin radial slit first formed does not agree at all with the concept of two incurving leaf margins joining to give the ventral suture. In the *Aquilegia-Rubus* type this thin slit later expands at its outer margin to give the cavity on which are formed the ovules, few in number but necessarily lateral in position, but in *Papaver*, *Butomus*, etc., the whole surface of the slit is meristematic and active in the production of ovules. Prof. Grégoire shows that perigyny is a natural development of the outer margin of the parenchymatous plinth upon which the reproductive meristem is carried; he thus excludes its interpretation as a concrescence of sepals. He emphasizes that from the new point of view perigynous forms are not to be interpreted as intermediate between epigynous and hypogynous.

The whole paper is a vigorous challenge to classical morphology in a field where there has been much activity in recent years. Prof. Grégoire refused to consider the palaeobotanical contributions to this problem and the cupule theory that has thus emerged; but apart from this there is a very full discussion of the bearing of his most recent observations upon the diverse interpretations that have been given to the carpel.

The S.S. *Archimedes*

IN March 1839, the historic little screw-driven vessel S.S. *Archimedes* began her trials in the River Thames. A month or two later she visited Portsmouth, and afterwards made voyages around the coasts of Great Britain and to Holland and Portugal. She was the first vessel to demonstrate effectively the suitability of the screw for ocean-going ships and she ushered in the revolution which led to the abandonment of paddle-wheel propulsion in the ships of both the Royal Navy and the Mercantile Marine.

The *Archimedes* was built of wood at Millwall by Henry Wimsurst (1804-84) for the Ship Propeller Company, a syndicate formed to further the use of the screw-propeller patented by Francis Pettit Smith on May 31, 1836. Smith had previously built a small screw-driven boat of 6 tons bearing his name. The *Archimedes* was 125 ft. long overall, 106 ft. long between perpendiculars, 22½ ft. beam and drew between 9 ft. and 10 ft. of water. Her tonnage was 240 tons. Her machinery consisted of a two-cylinder steam-engine driving the propeller shaft through spur gearing. The cylinders were 37 in. in diameter and 3 ft. stroke. With steam at 6 lb. pressure the engine developed about 80 horse-power. The engine speed was 26 revolutions per minute and the propeller speed 140 revolutions per minute. The first screw fitted was of 7 ft. diameter, 8 ft. pitch and 8 ft. long. This in 1840 was replaced by a double-bladed screw of 5½ ft. diameter, 10 ft. pitch but of greatly reduced length, but various other screw propellers were also tried. Her machinery was made at Greenwich by J. and G. Rennie. The total cost of the vessel was £10,500.

In accordance with Admiralty instructions early in 1840, Captain E. Chappell, who had been associated with the Steam Packet Service, took command of her and a series of trials were carried out at Dover between the steam packet *Widgeon* and the *Archimedes*. The *Widgeon* was 162 tons and was the fastest boat on the Dover station. The trials were attended by Thomas Lloyd, who afterwards became the first Engineer-in-Chief of the Navy. The joint report of Chappell and Lloyd dated May 2, 1840, was the first official report made to the Admiralty on screw-propulsion. In it it was stated that "it is evident in these vessels the power of the screw is equal, if not superior to that of the ordinary paddle-wheel. In this respect therefore Mr. Smith's invention may be considered completely successful." After some remarks on the noise and wear of the gearing, the teeth of which were of wood, the report went on to say that "It is, however, in propelling vessels of war that the value of Mr. Smith's invention will probably be experienced. . . . A ship fitted with a screw propeller may be used either as a sailing or a steaming vessel, or as both, if required; for we ascertained by experiment that the engine can be connected and disconnected with ease, and in any weather, in two or three minutes. In carrying a press of sail, the inclination of the ship does not diminish the propelling power of the screw nor lessen the ship's way, as with the ordinary paddle-wheel. The getting rid of the paddle-boxes also leaves the broadside battery altogether clear of obstruction, and in boarding an enemy's vessel would allow of the ships lying close alongside of each other".

Experiments with the *Archimedes* were also carried out at Bristol by Brunel, and it was through these that he was led to adopt screw-propulsion for the famous *Great Britain*, the first screw-driven ship to cross the Atlantic.

University Events

CAMBRIDGE.—The Jacksonian professorship of natural philosophy is vacant. The stipend of the professor is £1,200 a year or, while he holds a fellowship of a college with dividend, £1,000. The professorship is assigned for this turn to experimental atomic physics and will be associated with the Cavendish Laboratory. Candidates are requested to send their names to the Vice-Chancellor on or before April 11, 1939, with twelve copies of any statement or testimonial which they desire to submit to the electors.

The Smith's Prizes have been awarded to T. E. Easterfield, of Clare College and H. N. V. Temperley, of King's College; and Rayleigh Prizes to J. Corner, of Peterhouse, D. S. Evans, of King's College, R. A. Rankin, of Clare College and D. B. Schultz, of Magdalene College.

ST. ANDREWS.—Prof. E. Finlay Freundlich, formerly professor in the German University, Prague, has been appointed Napier lecturer in astronomy and director of the new Astronomical Observatory in the United College, St. Andrews. The lectureship owes its institution to a bequest made to the University by the late Miss Scott Lang, daughter of Sir Peter Scott Lang, formerly professor of mathematics in the United College. It was the desire of Sir Peter Scott Lang that the lectureship should bear the name of Napier of Merchiston, one of the early students of the University.

Societies and Academies

London

Royal Society (*Proc.*, A, 169, 451-590; 1939)

W. H. J. CHILDS and H. A. JAHN: A new Coriolis perturbation in the methane spectrum. (3) Intensities and optical spectrum.

W. H. B. CAMERON and A. ELLIOTT: Emission band spectrum of chlorine. (3) Continua.

A. ELLIOTT: A band spectrum attributed to NBr. G. TEMPLE: General theory of relaxation methods applied to linear systems.

W. C. PRICH and D. M. SIMPSON: Absorption spectra of carbon dioxide and carbon oxysulphide in the vacuum ultra-violet.

T. S. CHANG: Statistical theory of the adsorption of double molecules.

E. J. WILLIAMS: Concerning the scattering of fast electrons and of cosmic-ray particles.

W. HIRST and G. E. HARRISON: Diffusion of radon gas mixtures.

Paris

Academy of Sciences (*C.R.*, 208, 473-544, Feb. 13, 1939).

A. GOSSET, A. TOHAKIRIAN and J. MAGROU: Chemical composition of the bacterial tumours of *Pelargonium zonale* and of the tissues at the expense of which they develop. Content of potassium and phosphorus is higher, and that of silica, calcium and magnesium is lower, in these tumours than in stem tissue. Similar differences are said to occur in animal neoplasms.

H. VINCENT: Hepato-renal 'dysphylaxy' in relation to coli bacillary infection.

P. LUNAY: Isostasy and positive anomalies of gravity in certain mountainous massifs and in particular in the Zambales chain (Luzon, Philippines).

J. HAAG: Deformation of an elastic thread under the action of gravity.

F. CHÂTELET: Classification of curves of order one, in the *corps des réelles*, modulus p .

C. PAUC: Continua which are limits of definition of a continued function passing through each value a finite number of times.

J. TOUCHARD: Sines of the third order.

J. KUNTEMANN: Multiform systems and hypercomplex systems.

J. VIGNAL: Formulae for the evaluation of the precision of a method of levelling.

J. GÉRONIAU: Remarks on the densities of matrices and the non-Maxwellian magnitudes in the theory of the photon.

MLLÉ. M. MAUCHERAT: Vapour pressure of lithium between 402° and 642°. Extrapolation gives the boiling point under atmospheric pressure as 1,530° K.; the heat of vaporization is 36,600 cal./gm. atom.

J. TONNELAT: An automatic apparatus for correction for the displacement of the zero of a galvanometer.

W. UYTERHOVEN and C. VERBURG: Temperature of electrons (T_e) in a positive column discharge with alternating current (50 cycles); measurements in a neon-sodium mixture (sodium vapour lamp).

A. FORTIER: Viscosity of air and the electronic charge. Values obtained are $e_{13} = (1834.1 \pm 1.9) \times 10^{-7}$ c.g.s. units and $e = (4.813 \pm 0.010) \times 10^{-10}$ e.s.u.

J.-J. TRILLAT: A process for recording electron diffraction diagrams. Fine-grain photographic plates are solarized, and once developed and fixed, remain transparent uniquely at the places struck by electrons, thus avoiding the usual blurring caused by secondary X-rays. It is not necessary to handle the plates in darkness.

H. MURAOUR, A. MICHEL-LÉVY and J. ROUVILLOIS: Study of explosion luminosities.

G. DÉJARDIN: Luminous discharge in nitrogen in the presence of sodium chloride.

S. NIKITINE: Theoretical considerations on the sign of photodichroism.

R. DELAPLACE: Specific heat and density of castor oil and of a mineral oil, of aviation type, at different temperatures.

O. HOLTERMANN and P. LAFITTE: Formation and dissociation of strontium peroxide.

P. CASTEL: Trithoric orthophosphate.

J.-M. DUNOYER: Reduction and decomposition of chromic anhydride.

Y. DEUX: Pinacolic transposition in the course of duplicate reduction of mesityl oxide; migration of methyl.

MLLÉ. J. GUTMAN: Action of dimethylamine on methyl-1-dibromo-3-4-cyclohexane.

A. TOHITCHIRABINE and C. HOFFMANN: Contribution to knowledge of 6-methoxy-8-aminoquinoline and its derivatives.

O. K. HOVO: Preparation of β -ethylenic alcohols, branched at α .

F. BOURDIER: The Wurm, Ries and Mindel moraines in Bas-Dauphiné, their distinctive characters and their probable correlation with certain depots of human industries.

G. VIEL: Celluloses of some Algae.

R. SOULÈS: Embryogeny of the Begoniaceae; development of the embryo in *Begonia semperflorens* Link and Otto.

MLLÉ. C. SOSA-BOURDOUILL: Correlations between the protein nitrogen content of some pollens and the classification of the Ranunculaceae.

J. VELLARD: Variations *in vitro* of globular resistance under the influence of snake venoms.

J. REMBOUL: Action of X-rays on biological elements; the factor of recuperation.

M. VIOLLE and L. PLACIDI: A particular modality of phenomena of shock.

Amsterdam

Royal Netherlands Academy (*Proc.*, 42, No. 1, 1939).

J. G. VAN DER CORPUT: Contribution to the additive theory of numbers (5).

A. H. BLAAUW, IDA LUYTEN and ANNIE M. HARTSHIMA: Early flowering of Dutch irises (2). A further study of the effect of storage at various temperatures on the early flowering of the Dutch iris *Imperator*.

H. A. BROUWER: Leucite rocks of the active volcano Batoc Tara (Malay Archipelago).

C. U. ARIËNS KAPPERS and K. H. BOUMAN: Comparison of the endocranial casts of the *Pithecanthropus erectus* skull found by Dubois and von Koenigswald's *Pithecanthropus* skull. Further evidence of the close similarity of the two skulls.

C. U. ARIËNS KAPPERS: Index curves of Asia and the Great Sunda Islands.

E. M. BRUINS: Decay of the penetrating cosmic rays. The penetrating component is believed to consist of heavy electrons. According to Euler and Heisenberg, the latter decay to form electrons in a lifetime which can be estimated from absorption measurements. Calculations are here given of the modification of the energy spectrum of the heavy electrons as they pass through the atmosphere.

K. MAHLER: On the solutions of algebraic differential equations.

J. TEGHEM: Uniform distribution, mod. 1.

A. J. RUTGERS and E. VERLANDE: Flow potentials and surface conductivity (2). A calculation of the variation of the electrostatic potential in a fluid in the neighbourhood of a highly charged wall.

F. A. VAN BAREN: Petrography and mineralogy of some rocks and sand samples from the Gajo Loccus, Atchin (Dutch East Indies).

H. G. BUNGENBERG DE JONG and O. BANK: Behaviour of microscopic bodies consisting of biocolloid systems suspended in an aqueous medium. (3). Coagulation phenomena in droplets of biocolloid sols enclosed in a collodion film. Accumulation of basic dyes.

Budapest

Royal Hungarian Academy of Sciences, February 20.

J. MAREK: Bone disease as a consequence of irregularities in mineral metabolism.

E. NEMER: Preservation of the health of youth.

G. RADOS: Cyclic unitary substitution.

K. SCHAEFFER: Relation of the Tay-Sachs disease to metabolism.

G. ZEMPLEN: Synthesis of rubierythric acid.

I. VITALIS: Coal production in Hungary.

Gy. SZÓKHALVI-NAGY: Genus-number of one-sheeted surfaces of maximal index.

J. STILLER: Peritricha fauna of Heligoland.

A. ÁBRAHÁM: Microscopic innervation of the alimentary canal of snails.

L. JUGOVICS: Andesites from the Csérhát Mountains containing traces of asphalt (petroleum).

S. SZALAY: Observations upon the β P and γ N nucleus in their excited states.

Z. KASZAB: Zoological results of Miklós Vasvári's expedition to Asia Minor. (1) Tenebrionidae.

Rome

National Academy of the Lincei (*Atti*, 27, 609-716; 1938).

G. ARMOILLINI: Fundamental problems of cosmogony and Newton's law (2).

U. BARBIERI: (1) Large geoidic anomaly in the Valle Padana. (2) Extension of the geoidic anomaly in Val Padana, and the zero iso-anomalous line for gravity.

R. BADESCU: Simplifications and extensions of Picone's method of integrating linear equations to partial differential equations of the second order of hyperbolic type.

A. DE MIRA FERREDES: Structure equations of the groups of Lie.

M. HAIMOVICI: Totally geodesic surfaces in Finler's spaces.

J. O. VIGNAUX: Polygenic functions of a dual bicomplex variable (2).

F. VECCHIO: Contributions to the projective geometry of anholonomous varieties. (1) Topological theorem for the V_n varieties of the element S_n . (2) V_3 in S_3 : Darboux's quadrics, Lie's quadric, and Green's angles.

F. LEVI: States of coaction in an elastic system for exceeding the limit of elasticity.

E. PISTOLESI: Non-permanent motion of a solid in an incompressible indefinite fluid.

M. CIMINO: Definite orbit of Finlay's comet.

G. WATAGHIN: Quantum theory and the origin of some showers of cosmic rays.

V. ZAGAMI: Experimental researches on the seminal fluid. Osmotic pressure, electrical conductivity, and hydrogen ion concentration of the human seminal fluid (5). Osmotic pressure, electrical conductivity, and hydrogen ion concentration of the dog's seminal fluid (6).

S. DOJMI DI DELUPIS: Phenomena of activation in vegetable growth, (2) and (3).

G. GABRIELI: Re-discovered relics of Lincean scientific publications.

Atti, 28, 3-74; 1938.

M. VILLA: Characteristic differential property of cones projecting the varieties which represent the totality of quadrics of a linear space.

C. TOLOTTI: Equilibrium of solids and related transformations.

L. GIALANELLA: Motion of an electrically charged particle in presence of a magnetic dipole (1).

E. VOLTERRA: Researches on elastic arches: Resolution by the methods of 'coupled elasticity' of a special type of arch.

A. FRANCAVIGLIA: Contribution to the knowledge of the geological constitution of the edge of the Ethiopian plateau.

M. MITOLO: Possible synthesis of the antiscorbutic vitamin in guinea pigs.

E. FULCHIGNONI: Behaviour of the heart in epilepsy from cortical faradization.

A. CURATOLO: A method for the volumetric determination of small quantities of silver in tissues and fluids of an organism.

A. SALVATORI: Effect of endomuscular injections of aqueous extracts of liver, kidney and intestine on the chloroform content in the white rat.

G. CASTELNUOVO: Further researches on the influence of sex hormones on the maturation of carp.

E. MARIOTTI: Chemical composition of the muscular proteins of the trout in relation to sexual maturation.

D. FALLERONI: Differentiation of races of *Anopheles maculipennis* and its importance for the solution of the malaria problem.

Atti, 28, 75-116; 1938.

G. A. BLANC and T. MANTOVANI: Geochemical interpretation of the quaternary formations of Grotta Romanelli (Terra d'Otranto) (2). Colloidal complexes.

L. AMBRO: A typical example in the theory of the Laplace transformation.

C. AGOSTINELLI: First integrals of the equations of motion of an electrically charged corpuscle, in presence of a magnetic poles with superimposed axes.

G. BISCONCINI: A particular case of incipient motion, especially applicable to the gyroscope.

L. MONTI: Oxidizing action of selenium dioxide (3).

M. FINOGLIO: Two minettes from Val Nambrene (Adamello Group).

A. C. BLANC: New palaeolithic and mesolithic deposits in the Balzi Rossi of Grimaldi.

E. TOSATTI: Respiratory function of straight and crossed fibres in the anterior of the tract cervical chord.

Forthcoming Events

[Meeting marked with an asterisk is open to the public.]

Tuesday, March 21

ROYAL COLLEGE OF PHYSICIANS, at 5.—Prof. J. A. Gunn: "The Pharmacological Actions and Therapeutic Uses of some Compounds related to Adrenaline" (Oliver-Sharpay Lectures. Succeding lecture on March 23).

Friday, March 24

GEOGRAPHICAL DISCUSSION (at the Royal Astronomical Society) at 4.30.—"Recent Geophysical Investigations at Sea" (to be opened by Dr. E. C. Bullard).

PHYSICAL SOCIETY (at the Imperial College of Science and Technology), at 5.15.—Brigadier M. N. MacLeod: "Some Recent Developments in British Surveying Instruments" (Thomas Young Oration).*

INSTITUTE OF PHYSICS, March 23-25.—Conference on "Physics in the Textile Industries" to be held in the University of Leeds.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ASSISTANT (grade II) in the Balloon Development Establishment, Cardington—The Under-Secretary of State, Air Ministry (S.2.D), Berkeley Square House, W.1 (March 24).

JACKSONIAN PROFESSOR OF NATURAL PHILOSOPHY in the University of Cambridge—The Vice-Chancellor (April 11).

LECTURER IN PHYSICS in the Battersea Polytechnic, London, S.W.11—The Principal (April 21).

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Association of Technical Institutions: Association of Principals of Technical Institutions. Report of the Joint Committee on the Application of Psychological Tests in Technical Institutions. Pp. 20. Libraries in Technical Institutions. Report by a Joint Committee. Pp. 64. (Loughborough: Loughborough College.) [103]

Carnegie Trust for the Universities of Scotland. Thirty-seventh Annual Report (for the Year 1937-38) submitted by the Executive Committee to the Trustees on 15th February 1939. Pp. iv+208. (Edinburgh: Carnegie Trust for the Universities of Scotland.) [172]

The Journal of the Institute of Metals. Vol. 63 (No. 2, 1938). Edited by S. G. Griffin. Pp. 314+29 plates. (London: Institute of Metals.) 51s. 6d. net. [172]

University of Oxford: Bureau of Animal Population. Annual Report, 1937-38. Pp. 36. (Oxford: University of Oxford.) [202]

Empire Cotton Growing Corporation. The Work of the Experiment Stations, Season 1937-38; an Explanatory Review. By W. Nowell and Dr. J. W. Munro. Pp. 90. (London: Empire Cotton Growing Corporation.) 1s. 6d. [212]

Abstracts of Dissertations approved for the Ph.D., M.Sc. and M.Litt. Degrees in the University of Cambridge during the Academic Year 1937-1938. Pp. 152. (Cambridge: At the University Press.) [212]

Other Countries

Smithsonian Institution: U.S. National Museum. Report on the Progress and Condition of the United States National Museum for the Year ended June 30, 1938. Pp. li+131. (Washington, D.C.: Government Printing Office.) 30 cents. [102]

U.S. Department of the Interior: Office of Education. Leaflet No. 31: Government Publications of use to Teachers of Geography and Science. Pp. 16. (Washington, D.C.: Government Printing Office.) 10 cents. [102]

U.S. Department of Agriculture. Circular No. 504: Early Winter Food of Huffed Grouse on the George Washington National Forest. By A. L. Melson, Talbot M. Clarke and W. W. Bailey. Pp. 32. 5 cents. Technical Bulletin No. 643: The Field Oriole in relation to the Cotton Plant in Louisiana. By J. W. Wolcott and P. A. Woke. Pp. 23. (Washington, D.C.: Government Printing Office.) [162]

Smithsonian Miscellaneous Collections. Vol. 98, No. 1: Two Remarkable New Species of Marine Shells from Florida. By Paul Bartsch. (Publication 3524.) Pp. 4+1 plate. (Washington, D.C.: Government Printing Office.) [162]

Transactions of the New York Academy of Sciences. Ser. 2, Vol. 1, No. 3: The Late Physical History of the Rocky Mountains in the United States. By Dr. Wallace W. Atwood. Pp. 29-52. (New York: New York Academy of Sciences.) [162]

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 90. Zoological Results of the Second Dolan Expedition to Western China and Eastern Tibet, 1934-1936. Part 1: Introduction. By Brooke Dolan, II. Pp. 159-184+plates 12-20. Zoological Results of the Second Dolan Expedition to Western China and Eastern Tibet, 1934-1936. Part 2: Birds. By Ernst Schäfer and Rodolphe Meyer de Schauensee. Pp. 185-260. Zoological Results of the Second Dolan Expedition to Western China and Eastern Tibet, 1934-1936. Part 3: Mammals. By Glover M. Allen. Pp. 261-294+plates 21-24. A New Rodent of the Genus Rheomys from Chiriqui. By Robert K. Mearns. Pp. 295-296. (Philadelphia, Pa.: Academy of Natural Sciences.) [162]

Transactions of the Academy of St. Louis. Vol. 29, No. 4: Geological Aspects of Evolution. By Victor T. Allen. Pp. 99-106. (St. Louis, Mo.: Washington University.) [172]

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 40, Part 3: Structure and Function of the Female Genital System of *Bombyx mori* with Special Reference to the Mechanism of Fertilization; Studies on the Reproductive System of the Male of *Bombyx mori*. 2: Post-Testicular Organs and Post-Testicular Behaviour of the Spermatozoa. By Seinosuke Omura. Pp. 111-170+6 plates. (Tokyo: Maruzen Co., Ltd.) [172]

Annual Report of the Director of the Japan Institute for Science of Labour for 1937. By Dr. G. Teraoka. Pp. 37. (Tokyo: Japan Institute for Science of Labour.) 70 sen. [202]

Meddelande från Lunds Astronomiska Observatorium. Ser. 2, No. 103: Studies of Irregular Variable Stars. By Frida Palmér. Pp. 168. Ser. 1, No. 126: On the Influence of the Major Planets on the Meteoritic Tracks and a Criticism of the Meteorite Hypothesis of the Sunspot Periodicity. By Conrad Lonnquist. Pp. 12. (Lund: Astronomiska Observatorium.) [202]

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series A, No. 46: Technological Reports on Trade Varieties of Indian Cotton, 1938. By Dr. Nasir Ahmad. Pp. v+150. (Bombay: Indian Central Cotton Committee.) 1.8 rupees. [202]

Bergens Museum. Årsberetning, 1937-38. Pp. 114. (Bergen: A/S John Griegs Boktrykkeri.) [202]

Field Museum of Natural History. Geological Series, Vol. 7, No. 4: Additional Notes on the Grinnell Ice-Cap. By Sherat K. Roy. Pp. 59-70. 20 cents. Zoological Series, Vol. 20, No. 25: A New Woodrat from Mexico. By Wilfred H. Osgood. Pp. 475-476. 10 cents. Zoological Series, Vol. 20, No. 26: A New Pigeon from Colombia. By H. B. Conover. Pp. 477-478. 10 cents. Zoological Series, Vol. 20, No. 27: A New Wood Owl from Chile. By Leslie Wheeler. Pp. 479-482. 10 cents. (Chicago: Field Museum of Natural History.) [202]

Indian Forest Records (New Series). Utilization, Vol. 1, No. 7: Official List of Trade Names of Indian Timber. Revised third edition. Pp. iii+189-210. (Delhi: Manager of Publications.) 8 annas; 9d. [202]

Journal of the Indian Institute of Science. Vol. 21A, Part 18: Electrochromic Titration of Tannic Acids. Part 1: Electrochromic Titration of Ellagic, Milagittanic and Chebulinic Acids. By S. B. Suntharaker and S. K. K. Jaisankar. Pp. 189-208. 1.8 rupees. Vol. 21A, Part 19: Electrochromic Titration of Tannic Acids. Part 2: Electrochromic Titration of Gallic and Gallotannic Acids. By S. B. Suntharaker and S. K. K. Jaisankar. Pp. 209-222. 1.8 rupees. Vol. 21A, Part 20: Equilibrium in Electrodeless Discharge. Part 5: Equilibrium in the Dissociation of Oxygen and in the Formation of Ozone in Silent Electric Discharge. By B. Krishnan and S. K. K. Jaisankar. Pp. 223-236. 1.8 rupees. Vol. 21A, Part 21: Adsorption of Gelsolin by Pre-oxidized Hydroxides. By J. G. Kane. Pp. 237-244. 12 annas. Vol. 21A, Part 22: Supersonic Velocity in Gases and Vapours. Part 1: Absorption of Supersonic Interferometers in Gases. By S. K. Kulkarni. Pp. 245-272. 2 rupees. Vol. 21A, Part 23: Reactions of Chromates at High Temperatures. Part 7: Decomposition of Barium Chromate, and of Mixtures of Barium Chromate with Barium Carbonate. By V. T. Athavale and S. K. K. Jaisankar. Pp. 273-284. 1 rupee. (Bangalore: Indian Institute of Science.) [202]

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 123: A Soil Survey of the Merbein Irrigation District, Victoria. By F. Penman, J. K. Taylor, P. D. Hooper and T. J. Marshall. Pp. 44. Bulletin No. 124: The Wood Anatomy of some Australian Meliaceae with Methods for their Identification. By H. S. Dadswell and Dorothy J. Mills. (Division of Forest Products, Technical Paper No. 31.) Pp. 20+6 plates. (Melbourne: Government Printer.) [202]

Canada: Department of Mines and Resources, Mines and Geology Branch: Bureau of Mines. Petroleum Fuels in Canada: Deliveries for Consumption, Calendar Year 1937. Prepared by John M. Casey. (No. 704.) Pp. ii+20. (Ottawa: King's Printer.) 10 cents. [202]

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 18: Milk Records of Cattle in Approved Dairy Farms in India. Compiled by K. P. B. Kartha. Pp. vi+175. (Delhi: Manager of Publications.) 2.12 rupees; 4s. 6d. [202]

Union Géodésique et Géophysique Internationale. Sixième Assemblée générale, Edimbourg, Septembre 1938. Procès-verbaux des séances de l'Association de Méétéorologie. 2: Mémoires et discussions. Pp. 321. (Paris: Union Géodésique et Géophysique Internationale.) [202]

Mémoires du Musée Royal d'Histoire Naturelle de Belgique. Mémoire No. 85: Faune malacologique des Sables de Wemmel. 2: Gastropodes, Scaphopodes, Céphalopodes. Par Maxime Gilbert. Pp. 192+4 plates. Deuxième Série, Fasc. 14: Oligocènes Aroid Pelecypodes of the Genus *Anadara*. By Hubert G. Soenen and Philipp W. Reinhardt. Pp. 74+6 plates. Hors Série. Résultats scientifiques du voyage aux Indes Orientales Néerlandaises de LIL. AA. BB. Le Prince et la Princesse Léopold de Belgique. Vol. 3, Fasc. 19: Araneae. Von O. Fr. Roewer. Pp. 94. (Bruxelles: Musée Royal d'Histoire Naturelle.) [202]

Tanganyika Territory: Department of Lands and Mines, Geological Division. Bulletin No. 11: Explanation of the Geology of Degree Sheet No. 29 (Singida). By N. W. Bates and W. H. Beeve. Pp. 62+8 plates. (Dar es Salaam: Government Printer.) 4s. [212]

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Scientific and Industrial Research in Great Britain

WITH the increase in the number of reports issued by individual boards or departments under the Department of Scientific and Industrial Research, the value of the Department's own report, a survey of which appears on p. 499 of this issue, and especially that of the Advisory Council, is enhanced rather than diminished. Apart altogether from the broad picture it gives of the many-sided contributions made by the Department to the welfare of the whole nation, it has become increasingly a vehicle for the discussion of the more fundamental problems of co-operative scientific and industrial research, and of the factors upon which success or failure in this field depend.

An important section of the report of the Advisory Council is this year devoted to the position of the research associations, and this discussion is of the greater interest in view of the recently published report of the Parliamentary Science Committee on the Finance of Research (referred to in *NATURE* of January 28). Indeed it may be said that, taken as a whole, the report of the Department supplies a much more convincing answer to the arguments of that report than those in the observations of the Advisory Council on, and published with, that report. The practice of the Department is even more reassuring than the arguments advanced by the Advisory Council in defence of the policy upon which that practice is based. The straightforward narrative of the achievements of the Department contains encouraging evidence of flexibility and foresight, and some attempt to diminish those fluctuations of income which have such an adverse effect alike upon the conduct of long-range investigations and on the work of the staff responsible for their conduct.

Five years ago, the major part of the report of the Advisory Council was devoted to a historical

review of the research association scheme for developing the application of science by industry in Great Britain, and its criticism of the movement was directed to the inadequate scale on which it was financed. Recommendations then made for remedying this weakness were accepted by the Government, but subsequent discussions with the various associations led the Advisory Council to believe that to encourage them to embark on operations on a more adequate scale the basis on which grants were made must be definitely shaped with that primary purpose. Accordingly the Council recommended that the Department offer block grants of so substantial an amount that, with the contributions from industry upon which they should be conditional, they would secure an income adequate for each association to develop a really effective organization. To encourage further development, the Council recommended additional grants, on a sliding scale, within prescribed limits, on all income raised from industry in excess of a specified figure. The amounts of the minimum income, the specified figure and the limit of the grant were to be determined on the merits and needs of each case, and the normal period of these new arrangements was to be five years. The success of this plan is shown by an increase of nearly forty per cent in the total sum subscribed annually by industry on the amount provided before it came into operation, although it has to be admitted that that sum is still only a little more than a quarter of a million pounds.

The Advisory Council has now again reviewed the whole position, and arrangements have been made by which consideration of individual research associations will be spread over several years, thus keeping the general scheme under inspection and securing a thorough periodical examination

of each individual association. It is proposed to make a detailed review of the work and progress of each association at the end of the particular five-year period for which its grant has been made, before recommending grants for a further period.

This arrangement has brought under review in the present report the Wool Industries Research Association and the research association of the iron and steel industry. Grants have also been made to the newly formed British Coal Utilisation Research Association. The comments in the report of the position of these and other associations deserve some note as indicating some of the general tendencies and weaknesses of the research association movement.

It will be remembered that in observations on the memorandum of the Parliamentary Science Committee on the Finance and Development of Research, the Advisory Council reiterated the view which was expressed in its report for 1930-31 that the expenditure on research which is defensible in the national interest depends on the degree to which industry generally is prepared to apply scientific method and advances in scientific knowledge. The position of the Wool Industries Research Association illustrates the limitations and defects of that method. The admirable work already conducted at Torridon, with the light which it has thrown, for example, on the fundamental structure of animal fibres, has earned for the Association a high scientific reputation, and the fundamental knowledge and technique thus acquired have found application in fields well beyond the bounds of the woollen industry. It cannot accordingly be regarded as entirely satisfactory that such important contributions to the general body of scientific knowledge should be retarded by the failure of an industry to appreciate the importance of research.

It is, of course, realized that only an industry that is thoroughly research-minded can be expected to support such fundamental research, the bearing of which upon manufacturing technique or development is not immediately apparent. If, however, there is any force in the contention that fundamental or long-range research is pre-eminently the field of the research association, as distinct from the research departments of individual firms, the present policy of the Advisory Council has obvious limitations and design. That this is realized by the Advisory Council is indeed shown by its own recommendations in regard to the British Boot, Shoe and Allied Trades Research Association.

Failure of this Association to obtain and maintain an industrial income of only £7,000, which would have secured a total income of £12,000, led to it operating for two years without a grant. Impressed by the special limitations in the field of work open to this Association, owing to the almost complete monopoly in the supply of machinery to the industry, and in view of the importance of shoe-efficiency to the national health, the Advisory Council as an exceptional measure has recommended an offer of renewed grant aid which will secure for the Association a minimum income of £8,000 a year with a possibility of £12,000.

In a recent letter (*NATURE*, 143, 336; Feb. 28, 1939), Dr. W. H. Gibson stressed the importance of consideration of the position of research associations in a scientific spirit, and directed attention to some of the limitations which are commonly imposed on their work. If they are to confine themselves to research on the processes of their members, they will be limited in their work essentially to those fields which are the natural territory of the research departments of the individual firms. This means further limitation of the fundamental research which is the basis of all major industrial advance, but which is often beyond the resources of all but the very largest of industrial units, and indeed it may be added, is often a tax upon the resources of the best-equipped university departments, to which alone we can look further for assistance. It may be noted that the large industrial firms often prefer to support such investigations by specific grants to a university department rather than to embark on them in their own laboratories.

Even, however, if we could safely rely on the universities for the fundamental research which is required for the advance of industry—and there are very definite limits to the extent to which research at a university should be dictated even by national needs, let alone the requirements of industry—it is obviously unreasonable, if not impossible, to expect them to provide for a further need to which Dr. Gibson directed attention. Dr. Gibson stressed the importance of research upon the raw materials themselves, the price of which often constitutes a large proportion of the price of the finished article. Unless and until attention is paid to ensuring ample supplies of uniform quality and reasonable price, no amount of research on processes will overcome the difficulties of British industry.

Equally important is research in developing entirely new uses for raw materials outside existing

channels. Many notable advances have originated from the use of some raw material for a new purpose. Under present conditions, a research association which is working for members who are operating established processes cannot embark on such investigations. Accordingly a most fruitful field lies neglected and unfinanced.

As we have repeatedly urged in these columns, what is required is a scientific approach to the whole problem, and the orientation and distribution of the national research effort in accordance with a comprehensive survey of the resources available. This is essential, apart altogether from the question of the magnitude of the total effort or even of the relative contribution of industrial or national sources. Only as we can assess with some degree of accuracy the contribution which is being made in different fields and from different sources can we make any sound decision as to the magnitude of the contribution which should come from the national revenue. The observations of the Advisory Council on the position of the research associations emphasize the need for this comprehensive survey and for some attempt to delineate broadly the field between the various research organizations—private enterprise, research associations, Government research stations and the universities.

An authoritative survey of this type could scarcely be undertaken except under Government initiative and authority, although it is possible that something on these lines might come within the field of the newly formed Division for the Social and International Relations of Science of the British Association. At least it might facilitate the scientific approach to the problem which is badly needed, and the enunciation of principles upon which increased Government grants for scientific research could be indubitably justified, whether to the universities themselves, to Government research stations or institutions or to the research associations.

A step of this kind should not be without effect on a further aspect of the situation to which Dr. Gibson also directed attention—the position of the scientific worker. The great divergencies which exist between the position of scientific workers engaged in essentially similar duties in the universities, Government establishments, private firms and research associations are not to be defended. Co-operative research associations which are supported in part by an industry are at a disadvantage in retaining an experienced staff as

compared with an industry which for some reason or other may make no contribution towards co-operative research, either getting it done by a Government establishment or relying on individual and private effort. The results achieved in co-operative research depend not merely on the financial resources at the disposal of the research associations but also on the calibre of their scientific and technical staff. If the conditions of service are so inferior in remuneration or security to those which obtain elsewhere that they cannot compete on equal terms with private industry or Government departments in recruiting their staff, the quality of their work must ultimately be lowered.

The importance of this question to the industries concerned, no less than to the nation itself, need scarcely be stressed in view of the past achievements of the research association movement. It deserves closer attention than it has yet received from the professional associations of scientific workers, and any comprehensive survey and analysis of the research effort of the nation should have reference to this problem also. It should not be forgotten, of course, that mobility of staff within limits has its own advantages in stimulating the exchange of technique and ideas. A definite drawback of pension schemes is in fact the indirect discouragement which they give to the movement of staff, and there are other factors which in recent years have discouraged the movement of scientific workers from one firm to another, whether within the same industry or not. Such movement may be stimulating in ideas and technique as well as facilitating the growth of a wider judgment or experience of great value in the direction of research in industry and Government service.

A more liberal policy in regard to the exchange of pension rights might well prove a sound investment both to Government services and industry, and it should not prove beyond the national resources to devise some means of eliminating that factor of insecurity of tenure which in other fields of research besides that of the research associations tends to affect adversely the recruitment of scientific staff of the highest quality. Certain it is that if the research association movement is to find a definite place in the national organization for research, it will only make its full contribution if the same careful consideration is given to the broad fields in which it should operate, and to the conditions of recruitment and employment of its scientific and technical staff, as has been given in the past to the assessment of its financial grants.

Vitamin B₁ and Scientific Endeavour

Vitamin B₁ (Thiamin) and its Use in Medicine
By Dr. Robert R. Williams and Prof. Tom D. Spies. (Macmillan Medical Monographs.) Pp. xvi + . (New York: The Macmillan Co., 1938.) 21s. net.

"IT is doubtful whether the isolation and identification of any other substance in the history of biochemistry have cost as much labor as have these operations as applied to thiamin. The first gram of the pure vitamin must have cost an aggregate of several hundred thousand dollars. To mention all the names of those who have participated in some phase of the project is to call the roll of half the mature biochemists in England and the United States. The project has bulked equally largely upon the horizon of Dutch, Japanese and French Biochemistry. German participation has been relatively small until the current decade."

"One could be pardoned for hoping that a knowledge of the chemical structure of thiamin would promptly suggest the mode of its action and resolve many of the problems that have plagued us for a generation. The natural processes into which it enters are, however, so complicated that for the present at least this knowledge only opens up a vista of new problems. The progress of the past year has been such as to justify the optimism for the future, but the gratification of our most sanguine hopes must be deferred for a time."

VITAMIN B₁ is now the most important of a group of vitamins constituting the original vitamin B. These opening paragraphs to two of the chapters in this book indicate the magnitude of research effort in connexion with this one chemical substance, as well as the task set themselves by the authors; to this must be added that they have tried to make available the present knowledge in practical medicine. Of this value there is at the present time no doubt; as well as a complete cure of the disease of beriberi, we know that in neuritis of various origins (especially alcoholic) and other conditions, there may be involved a factor of vitamin B₁ deficiency. Even in pellagra, in which the mouth and skin symptoms are now known to be cured by nicotinic acid, nervous symptoms are found to respond to vitamin B₁. The pyrophosphoric ester of this vitamin, the so-called co-carboxylase, is essential in the production of the precursor of alcohol (acetaldehyde) in alcoholic fermentation from pyruvic acid. There is an element of romance which defeats the scientific approach when we realize that this very vitamin, which is responsible for the production of the alcohol in wines and spirits, must be administered to protect the subject from the neuritis due to excessive indulgence

in the alcohol so produced! In the nervous system as elsewhere, vitamin B₁ is required for the degradation of pyruvic acid, which forms an essential stage in metabolism of carbohydrate and may be concerned in one intermediary stage in the formation of fat

The tale which is told by the authors is viewed in the first instance as a problem in practical medicine and in the construction of diets which may be needed to save from the consequences of vitamin B₁ deficiency even in its milder forms; the conclusions here reached indicate that 1-2 mgm. of the vitamin are needed per diem to ensure health, and should do much to displace a facile optimism that the eating of an ordinary mixed diet is enough to ensure health. A particularly valuable feature of the work is the inclusion of the tables of the vitamin B₁ content of foods; these will form a basis for future research. This section of the work, in which Dr. Williams has had the advantage of Dr. Spies's present practical experience of nutritional deficiency, should be read by all those who are responsible for the maintenance of the health of the community, as well as being a guide in practical medicine.

The more medical part forms eight out of the twenty-nine chapters, the latter two-thirds of the book being devoted to the chemical nature and mode of action (biochemical and physiological) of this vitamin. In the final efforts to reach the constitution and synthesis, there is no doubt that Dr. Williams's discovery of the cleavage produced by sulphite was one of the major factors in chemical advance. Nevertheless it is interesting to reflect that there was a happy fitness in his successes; Dr. Williams's work started in 1912, and the final synthesis of the pyrimidine-thiazole compound by several people independently only took place some eleven years after the first isolation of practically pure crystals by Jansen and Donath. This was because the problem had not become one in pure organic chemistry until shortly before the end, even in spite of the international co-operation mentioned in the initial paragraph. Labels may be said to be rapidly disappearing in science as the boundaries of discipline become more fluid, but no group of workers can feel particularly conceited when the finish of their own work still leaves untouched so many essential problems. It has been seen that one prominent function of the vitamin (or of its esters) is decarboxylation. For the true insight into the mechanism by which this is effected we

may have to wait until a deeper knowledge of the structure of the atom is available; it is certain that the organic chemical structure does not enable us to predict the reason why the molecule (as the diphospho-ester) decarboxylates in yeast, but in higher organisms requires a simultaneous oxidative process.

The tale of the various functions of thiamin in Nature, its need for the growth of micro-organisms, and of the work which has led to the present ideas of the intimate connexion with carbohydrate metabolism is well told, with due caution and criticism and not without pointers for the future. It is a safe generalization, to which there is not much exception, that wherever there is life some form of this vitamin is a necessity. To this extent the original idea implied by Funk in the term 'vitamin' is now justified. Upon nomenclature

there is still some controversy, perhaps not very important. To many it will be difficult to dissociate their minds from the term 'vitamin B₁'. Others think with justification that the name 'aneurin' should be used as it was proposed by Jansen, the first to isolate crystals of the vitamin. Dr. Williams adheres throughout to the sombre 'thiamin', used by the American Medical Association.

The reviewer has nothing but praise for this work as a whole, for the knowledge which it displays, for its fair judicial outlook, and for its production. He has not detected many errors. One might be mentioned: the work of Carter and Drury, mentioned on p. 211, actually preceded that of Drury, Harris and Maudslayi. The publishers also deserve congratulations upon a high standard of production. R. A. PETERS.

Brighter Optics

(1) Introduction to Physiological Optics

By Prof. James P. O. Southall. Pp. x + 426 + 3 plates. (London, New York and Toronto: Oxford University Press, 1937.) 21s. net.

(2) The Science of Seeing

By Dr. Matthew Luckiesh and Frank K. Moss. Pp. viii + 548 + 1 plate. (London: Macmillan and Co., Ltd., 1937.) 25s. net.

(1) **E**NGLISH-SPEAKING scientific workers already owe much to Prof. Southall, since it was he who edited the English translation of Helmholtz's great work on physiological optics. Prof. Southall's aim in the present volume is to give his readers a general introduction to the broad science of light and vision which, without being too prosaic, would be accurate and trustworthy so far as it goes. Every observation dealing either with the physiology of the eye or with its optical properties found a place in Helmholtz's "Physiological Optics". It was, in fact, a text-book describing the normal working of the organ of sight. Only a rare genius like Helmholtz could make himself a master of both aspects of the subject, and since his time there has been a widening gap between them. It is doubtful whether the term 'physiological optics' is to-day a sufficiently descriptive title for a book on vision.

The chapters on the optical system of the eye, correction eyeglasses, and the movements of the eyeball are of a high quality. The author is here on firm ground and his literary style is quite crisp, but his treatment of the subject, although

comprehensive, is not elementary. The first chapter to deal with optical questions ignores thin lenses, and plunges almost immediately into a formal statement of the geometrical optics of thick lenses—a very specialized subject.

The treatment of the biological aspects of vision is far less satisfactory. Workers on the physiology of the eye have tried hard during the last ten years to free the subject from the dogmas which in the past have brought on it such discredit. Relics of the past persist, however, for, in answer to an examination question, "State the main facts of colour vision", nine out of ten students will begin their answers, "There are two rival theories of colour vision . . ." Much has been done to improve this state of affairs, and it is a great pity that Prof. Southall has not referred to the works of Adrian, Ames, Granit, Hartline, Hartridge, Stiles and others; Fincham is classed as an "also ran".

In parts the author is grimly determined not to be dull:

"a sprightly disposition is mirrored in an active pair of eyes that are incessantly darting this way and that. . . . Such eyes can speak all languages and need no interpreters. A downcast look, a scornful glance, a soulful gaze, these and many similar expressions are in common use to describe this interplay of the eyes which conveys so much meaning not only in the intercourse of human beings with each other but also between man and beast. What can be more beautiful and expressive than the eyes of a dog watching intently his master's slightest gesture."

(2) Prof. Southall has covered a very wide field dealing with visual problems, and it is surprising that so much is left over that Dr. Luckiesh and Mr. Moss can still find enough material to fill another large book about the eye, this time dealing with the practical aspects of vision and illumination. It is a great pity that there is such a sharp distinction between two aspects of the same subject as exemplified by these two books, for the problems are basically the same. "The Science of Seeing" is much the most serious book to be written by Dr. Luckiesh and his collaborator. Dr. Luckiesh is the director of the lighting research laboratory, General Electric Company, Cleveland. For many years he has been urging us to raise the level of artificial illumination. He does not believe in half measures. The existing level of domestic artificial illumination lies between 1 and 10 foot-candles. Dr. Luckiesh says:

"Similar measurements applied to various visual tasks in homes, schools, offices and factories indicate that hundreds and even thousands of foot candles are necessary even to reach the conservative standard of visibility adopted for the present purpose of demonstrating the use of the visibility method of prescribing foot candles on a rational basis. Engraving and sewing require 500 to 3,000 foot candles" (p. 343).

Illuminations of this order would render rooms so

hot that they would be uninhabitable unless a special cooling plant were installed. One is always a little surprised when those interested in high illuminations advocate their use for the good it does our eyes, whilst at the same time disclaiming all responsibility for the harm the resulting high temperatures would do to the rest of the body. It is to be hoped that interested parties will not wreck an admirable campaign for better artificial illumination by attempting to advance too quickly.

Illuminating engineers have received little support from biologists interested in vision, and one cannot blame Dr. Luckiesh and Mr. Moss for attempting to fill some of the gaps in our knowledge. They claim, for example, that the heart-rate is reduced to its resting level more rapidly when reading under an illumination of 1 ft. c. than when reading under 100 ft. c. Since the authors claim that the speed of reading was much the same under the two illuminations, most people might be forgiven for wishing to perform a given task under the lower illuminations, thereby saving some unnecessary heart-beats. For restful conditions in the home it would seem necessary to have low illuminations.

It is clear that the 'science of seeing' has not advanced far: 'physiological optics', although growing fast, appears to be not yet strong enough to give a helping hand.

R. J. L.

An Encyclopædia of Music

The Oxford Companion to Music

By Dr. Percy A. Scholes. Pp. lv+1091+179 plates. (London, New York and Toronto: Oxford University Press, 1938.) 21s. net.

MR. WELLS'S "World Encyclopædia" has not, as yet, materialized, but encyclopædias and dictionaries are now appearing which, if they do not show that unity of plan which should dominate the work that Mr. Wells has in mind, may yet be regarded as its precursors. The "Oxford Companion to Music" conceals, under its modest title, a vast amount of learning, set out in orderly and scholarly fashion, and designed to provide clear and exact answers to the thousand-and-one questions raised by any inquiring and intelligent amateur of the art. It would be idle to expect to find, even within the compass of nearly eleven hundred large octavo pages of small print, detailed treatises on harmony, counterpoint, singing, the pianoforte, the organ, and so forth. But Dr. Scholes does better. He gives succinct accounts of the fundamentals

of the technical side of the art, sufficiently detailed to give the reader a firm grasp of the elements of the subject, and in many instances provides pointers which show where further information may be obtained.

It is difficult, within the compass of a short notice, to indicate adequately the scope of the information given in this truly encyclopædic work. As was to be expected, nothing of importance on the technical side has been omitted. Over and above this, one finds scholarly articles on such diverse topics as music-halls, hymns and hymn tunes, mis-attributed compositions, "God Save the King", concerts and concert halls, the printing of music, the profession of music, and the like. Analyses of the plots of the classic operas are provided, and the work abounds in biographical details. The scientific articles are brief but adequate—the article on acoustics being a model of its kind. Wherever possible, the treatment lays stress on the evolutionary aspect of the subject, and Spencer's definition of evolution as a change from

"an indefinite incoherent homogeneity to a definite, coherent heterogeneity" receives more than one illustration.

The author has a light touch, and his handling of some topics (see the article on absolute pitch) becomes easily conversational without in any way becoming discursive. It must not be assumed that the author has been unmindful of Lealie Stephens's warning—"No flowers, by request"—to contributors to the "Dictionary of National Biography", but the fact remains that his treatment of many topics is so thoroughly absorbing, so admirable an example of the art that conceals art, that there is a danger of the book's becoming a pleasant fireside

companion rather than a volume for the reference shelves.

The author has consulted experts in many friends, and has done so in the true spirit of Boswell, receiving the corrections with deference, but not always agreeing with them. He is to be warmly congratulated on the completion of a single-handed effort the magnitude of which cannot often have been equalled or exceeded.

The book is admirably produced, is profusely illustrated, and should indeed prove to be a Good Companion to all lovers of the art of music. But why omit all mention of Sims Reeves?

A. F.

Plant-Life of the French Mediterranean Region

La distribution géographique des végétaux dans la région méditerranéenne française
Par Ch. Flahault. Œuvre posthume publiée par H. Gausson. (Encyclopédie biologique, Vol. 18.) Pp. xi+180+4 plates. (Paris: Paul Lechevalier, 1937.) 100 francs.

BOTANICALLY the Mediterranean region is one of the best defined of the larger floristic and ecological divisions of the earth's surface. This is because of the high constancy of the seasonal distribution of temperature and rainfall maxima and minima. Data are not yet sufficient for an adequate survey of the whole region, which includes considerable parts of southern Europe, northern Africa, and western Asia, but the work here noticed is a valuable contribution to such a survey, in that it brings together especially the results of the author's numerous studies of the plant-life of a very typical and well-worked area of the western Mediterranean Basin. The work is published posthumously, since Flahault died in 1935, and was awarded the Gay Prize in 1937 by the Paris Academy of Sciences.

Much of the book is naturally concerned with details of the distribution of species and vegetation in the south of France, but many broader discussions and comparisons are included. The flora of the French Mediterranean basin is said to include about four thousand species of vascular plants; but a considerable number of these have a wide distribution extending far beyond the limits of the Mediterranean region. The interesting question of 'characteristic' species is discussed at some length. The high value which has been assigned to the olive as the sole or main indicator of the limits of the Mediterranean region (in France) is disputed on strong grounds. It is concluded that "le Chêne vert"

(*Quercus Ilex*) "est partout, dans le bassin française de la Méditerranée, où règne le climat méditerranéen; il est partout où se développe la flore méditerranéenne dans les limites du bassin. Il est le terme principal d'une association de végétaux qui caractérise la région méditerranéenne, mieux que tout autre caractère."

The limitrophic regions (of the halophytes, mountains, etc.) are briefly considered, and the French Mediterranean region proper is divided into three sectors as the result of a very full analysis of environmental conditions and their correlation with characteristic species and types of plant communities. Four maps form a valuable aid to a clear understanding of the text. One of the maps, particularly well printed in a wide range of colours and coloured patterns, shows the distribution of the main communities.

The influence of man on the existing flora and vegetation of the area is considered to be limited. The conclusions reached are exceedingly interesting, partly because they differ in some respects from those of other workers in other parts of the Mediterranean region. Thus Flahault definitely says that man has not profoundly modified the flora, even with reference to forest species; that man has unintentionally caused the extinction of relatively few species; and that man has introduced very few species which have become naturalized to the extent that they would survive in competition with the native plants were the human 'protecting' conditions removed. Naturally occurring species survive destruction, for at least very long periods, by a kind of passive resistance. Man's 'troubling of nature' is ephemeral, even in a country of ancient civilization, and Nature necessarily regains her rights as soon as the modifying agent is removed.

W. B. T.

Social Ecology:

a Critical Analysis. By Milla Alasa Alihan. Pp. xiii+267. (New York: Columbia University Press; London: Oxford University Press, 1938.) 14s. net.

THE author discusses theoretically the use of the concepts of plant biology in considering human phenomena. The advances made by the human sciences in recent years may be attributed largely to the introduction of biological methods and ideas into these studies. Human ecology is an extension of this principle. It has been defined as "the study of the spatial and temporal relations of human beings as affected by the selective, distributive and accommodative forces of the environment".

The so-called ecological school in the United States is still, apparently, in the stage of clarifying its fundamental concepts and has, so far, little experimental work to show.

The present work is largely a commentary and exposition of the principles laid down by the pioneers of human ecology in the United States such as Park, Burgess, McKenzie and others. The author's discussion might well have been more critical.

Writers in Great Britain like Hogben frequently stress the need for a planned ecology of human life, while Pearl, Charles and others have discussed population problems in the light of animal and plant ecology.

There is no doubt, as the author shows, that a great deal of light can be thrown upon human life by the use of ecological concepts such as concentration, centralization, segregation, invasion, zonation and so on, which also enable us to study social phenomena of a new type. Psychologists may, however, query the validity of postulating fundamental principles such as competition as the motive force in the formation of a community or natural order. Perhaps the rather novel way in which competition is defined, namely, in the sense of mobility, freedom of movement or independence of locomotion, makes the idea more acceptable, though it might be equally appropriate to identify 'freedom of movement' with a co-operative community instead of with a competitive one as the ecologists do. J. I. COHEN.

The Hills of Lakeland *

By W. Heaton Cooper. Pp. xviii+126+52 plates. (London and New York: Frederick Warne and Co., Ltd., 1938.) 15s. net.

THOSE who know and love the Lake District will like this book: those who do not know the former can learn to love it through the latter. The text is obviously from the pen of one who has learned to love his native Lakeland. He describes the past and the present of a gam of English scenery in a style so facile and clear that the reader is transported as in a dream through crags and fells that alas have never been seen by many. He pays justifiable tribute to a region of great natural beauty and leaves the reader with a longing to down tools and indulge in the dream he has created. The dream, too, often amounts almost to reality through the beautiful illustrations which adorn the text. There are sixteen plates in

colour and thirty-six plates in monochrome which have been executed by the author. These pictures make the book.

To realize and appreciate the majesty of Lakeland it is essential to know its past history. Therefore, the author describes well its geology, with the aid of maps.

Well-produced and beautifully illustrated books of this kind can do as much as, if not more than, any other form of propaganda to encourage appreciation and preservation of our natural heritage—the countryside.

Newer Methods of Volumetric Chemical Analysis

By Erna Brennecke, N. Howell Furman, Hellmuth Stamm, Rudolf Lang and Kasimir Fajans. Wilhelm Böttger, Editor. Translated by Prof. Ralph E. Oesper. Pp. xiii+268. (London: Chapman and Hall, Ltd., 1938.) 18s. 6d. net.

ALL who make any considerable use of volumetric analysis will find this monograph of great value, for not only does it treat of the most recent advances but also, in addition, the editor has secured the co-operation of a number of recognized experts to deal with the various sections of this symposium. The topics discussed are: (1) The elimination of the titration error in acidimetry and alkalimetry; (2) ceric sulphate and (3) alkaline permanganate as volumetric oxidizing agents; (4) iodate and bromate methods; (5) chromous solutions as volumetric reducing agents; (6) oxidation-reduction indicators and (7) adsorption indicators.

In each section there is an excellent blend of theoretical and practical exposition, while to each chapter there is appended a selected bibliography which includes papers up to the end of 1936. The monograph has been excellently translated from the second German edition and is well printed and produced.

The Lyre-Bird:

Australia's Wonder-Songster. By R. T. Littlejohns. Pp. 12+30 plates. (Sydney and London: Angus and Robertson, Ltd., 1938.) 4s. 6d.

TO take motion photographs in heavy forest successfully is no easy matter, and Mr. Littlejohns and his collaborator, Mr. A. H. Chisholm, would have had to give up the attempt if they had not received assistance from the Federal Government. The final result was an excellent sound film which the Government now uses for propaganda purposes.

Mr. Littlejohns has written an interesting account of the lyre-bird and has supplied to the different 'cuts' from the film appropriate letterpress. From these serial pictures we see that the tail, when in full display, is spread forward over the back in the shape of a fan, with the two lateral feathers at right angles.

The lyre-bird is also a fine songster, and in its mimicry is unsurpassed. It has been known to copy the notes and calls of no fewer than seventeen different species, and other sounds as well, such as the tearing of bark by black cockatoos.

Science in Industry*

THE twenty-third report of the Department of Scientific and Industrial Research, which covers the period October 1, 1937–September 30, 1938, includes the report of the Committee of the Privy Council signed by Lord Runciman, and the longer report of the Advisory Council over Lord Riverdale's signature, together with summaries of the work of the National Physical Laboratory and other research stations and research boards and brief accounts of the work of the various research associations. Like previous reports of the Department, the present one gives a most impressive picture of the immense contribution which the work of the Department is making not only to almost every type of industry but also in all aspects of national life.

The expenditure of the Department in 1937–38 was £872,127 gross or £637,200 net as against £583,230 net in 1936–37. As usual, the largest single item of expenditure was £110,907 on the National Physical Laboratory, compared with £105,589 in 1936–37, the gross expenditure of £252,209 including the cost of work at the Laboratory for the Food Investigation Board, the Radio Research Board, the Road Research Board and other research boards of the Department. Against this gross total, receipts amounted to £141,802, of which £69,822 represents fees from industry for paid work. The total receipts from industry, including contributions to co-operative research, amounted to £98,452 as against £106,250 in 1936–37, while a further £81,923 was received from other Government Departments for services rendered, £33,337 from the Road Fund for the road research and £6,282 from the Empire over-seas for food investigation. Expenditure on fuel research was £103,240 gross or £94,782 net, on building and road research £97,382 gross or £40,626 net, on the Chemical Research Laboratory £23,340 net, on food investigation £54,709 gross or £45,307 net, on forest products research £38,841 net, on water pollution research £9,134 gross or £5,421 net and on the Geological Survey and Museum, £71,472 net. Grants to research associations, etc., amounted to £148,282, as against £120,510 in 1936–37 and £108,951 in 1935–36, and the report notes the formation of a new research association, the British Coal Utilization Research Association, bringing the number of such associations to twenty-three.

The report refers to the dissolution of the

Radium Beam Therapy Research Board, but the investigation for which it was responsible will be continued under the general control of the Committee of the Privy Council for Medical Research, and the Department will continue to keep in touch with the physical investigations included in the general programme of research. The Welding Panel of the Steel Structures Research Committee has also been discharged during the year upon the completion of some outstanding work, as well as the Standing Conference on Timber Utilization.

Food

A large part of the report of the Advisory Council is devoted to a review of progress in food investigation in recent years. The food investigation organization of the Department has now completed twenty years of work, and under present conditions the work that was begun in the face of a serious shortage of food has lost nothing of the national importance which was attached to it in 1937. Indeed, questions of storage no less than of transport of food are now regarded as an essential, if not a decisive, element in a national policy of defence, and the importance of this phase of the Department's work to the whole community need not be further stressed. From the start, this work has been concerned to avoid loss and wastage, during handling and storage, in the supply of foodstuffs and to ensure that this supply is made available in the best condition. Throughout the period, the need of the consumer has been the governing consideration, and the Food Investigation Board has found solutions for all three of the great problems which confronted it at the start.

The problem of the preservation of fruit, much of which responds badly to ordinary cold storage, has been solved by the development of 'gas-storage', a new method in which the ventilation of cooled stores is adjusted so that their atmosphere contains just the right amount of carbon dioxide. Ten years ago there were no gas-stores. To-day they provide three million cubic feet of storage, and this is only a beginning. Again, up to 1933, Australia and New Zealand still had to send their beef to Great Britain in the frozen state, when it is not a satisfactory product. Now it has been shown that chilled beef can be preserved for long periods in special chambers enriched with carbon dioxide, and in 1937 Australia and New Zealand sent us some three quarters of a million hundred-weight of chilled beef carried in this way.

* Department of Scientific and Industrial Research. Report for the year 1937–38. (Cmd. 5937.) Pp. iv+203. (London: H.M. Stationery Office, 1939.) 3s. net.

The third problem, that of handling and preserving fish, which is highly perishable, and as ordinarily handled and stowed cannot be kept really fresh for more than ten to twelve days, has also been solved by the development at the Torrey Research Station of brine freezing and cold storage at a low temperature. By the new methods lemon soles have been stored for two years and were in excellent condition at the end of that period. Success in these fields has been achieved, as the Advisory Council's report insists, by building up, however slowly, a science of the storage and transport of food, and the achievements of the Department in regard to food investigation are a remarkable tribute to the service which science can render in everyday life.

The present report refers to other work in progress, including investigations of the changes in muscle post mortem, the rancidity of edible fats, the causes of rotting of eggs, the factors which affect the composition and structure of the fatty and muscular tissues of the pig and the quality of the bacon which depends upon them, the distribution of vitamin A in fish, the cold storage of herrings, the spoilage of haddock in crushed ice and chemical indexes of freshness. The work on gas-storage has covered the storage of Cox's Orange Pippin apples and English-grown William pears, and studies in the resistance of apples to fungal invasion have also been continued, as well as on the experimental storage of broccoli, the freezing of vegetables for preservation, the thermal properties of butter, and on the relation between the rate of formation of hydrogen swells in cans filled with various fruits and the rate of corrosion by acid of the steel base of the tin-plate used in their manufacture. The Advisory Council has now further invited the Board to review the whole field of research into the processing of foodstuffs and to submit proposals for embracing under its scientific supervision work in this field which is desirable in the national interest.

A further special aspect of food research is stressed in the report of the Advisory Council—that of preventing the loss of stored foodstuffs by attack. The destruction of grain by weevil and other pests is estimated to cause a loss in Great Britain of £500,000 annually, a figure which might easily be exceeded if the problem is left unsolved while the plans for storing grain in the national defence policy are developed. The Department has now accepted the responsibility for a survey of the infestation of grain and grain products in this country, covering all stages in the handling of the grain, from harvesting or arrival at the port to delivery to the consumer. A standing conference, representing all the industrial interests desiring to co-operate, has been established as a consultative

body, on which brewers, corn merchants, flour millers, railway companies, cattle food trades, wharfingers, maltsters, lightermen, farmers and port authorities are represented, and the work was commenced in May by the staff of the Stored Products Laboratory at the Imperial College of Science and Technology, London, under Prof. J. W. Munro.

Besides the work of the Food Investigation Board, several of the research associations have made important contributions to our knowledge of foodstuffs and dietary problems. The Research Association of British Flour Millers, for example, has been responsible for important investigations into the nutritive value of bread which have emphasized the importance of bread and lard, or bread and butter in the dietary, and other work has been concerned with developing the instrument for measuring and recording graphically the baking quality of flour and the conditioning of wheat prior to milling.

Investigations carried out by the Research Association for the Cocoa, Chocolate, Sugar Confectionery and Jam Trades, on the properties of different white sugars used for certain confectionery processes, have indicated that the differences in behaviour were due to differences in minute quantities of impurities in the sugars. This discovery has led to new operating methods and also substantial savings of sugar, and further investigations of the same type have shown that complaints by employees that certain brands of sugar were unsatisfactory for a specific purpose were justified. Other investigations of the Association have advanced our knowledge of the properties of pectin compounds and afforded a new explanation of the phenomena of jelly formation. The Food Manufacturers' Research Association has obtained important results in bacteriological investigations on the curing of bacon and hams, as well as on the canning of meat and on the corrosion and perforation of the cans and the methods of lacquering the cans to prevent corrosion.

LIGHT INDUSTRIES

Other research associations are making equally important contributions in the field of clothing. The Boot, Shoe and Allied Trades' Research Association, continuing its work on occupational footwear, has made good progress in research to discover the best styles of footwear for various kinds of employment, and other investigations commenced during the year deal with the influence of heel height upon poise. The results obtained in this intrusion on the thorny problem of the effect of high-heeled shoes on health suggested that the best height is governed by a woman's occupation

and the customary poise which her occupation may impose.

The Wool Industries Research Association has continued its investigation on shrinkage-resistant wool, including an entirely new type of reaction, which consists in the use of proteolytic enzymes of the type of papain whose activity can be controlled chemically and which appear to have specific action on certain regions of the wool fibre. Other work has been concerned with the rubberization process, the measurement of shrinkage in fabrics due to milling and laundering, and the fastness of dyed materials to washing. The Linen Industry Research Association has continued its work in relating yarn and fabric properties, and on degradation and fading of fabrics used for casements and awnings; it is now possible to select vat dyes which decrease the chances of premature deterioration. Similarly the British Launderers Research Association's investigations have thrown much light on the mechanics of the first part of the washing process, and its bacteriological investigations have shown that goods washed and finished in the laundry are much more nearly sterile than goods washed and dried in the home.

The British Leather Manufacturers' Research Association has continued its investigations on the chemical basis of the finishing process, and an X-ray plant has been installed for studying the effect of the various tanning processes on the internal structure of the fibres. The physical and microscopical characteristics of chrome calf and of glacé kid have been examined with the object of obtaining better quality leather for boot and shoe uppers. The Research Association of British Rubber Manufacturers has devised a method by which the ordinary dry raw rubber of commerce can be reduced to a fine granular condition by a simple process requiring no special machinery beyond that ordinarily used in rubber manufacture, while its investigations on ebonite have aimed at obtaining a material better suited to modern needs.

The Printing and Allied Trades Research Association has now passed a year in its new laboratories, and has completed an investigation into the causes of the tarnishing of bronze printing used in the decoration of goods for confectionery and cigarette wrappers, which has traced the tarnishing to minute quantities of compounds containing sulphur in the paper, ink or adhesives used. A method of determining these small quantities of sulphur has been devised which enables the materials to be tested as to their suitability. The Research Association of British Paint, Colour and Varnish Manufacturers has completed investigations on the surface characteristics of pigment particles and

their physical form in relation to their behaviour in paint, as well as on the role of oxygen in the formation of films by drying oils and varnishes.

HEAVY INDUSTRIES

It is impossible in the space at our disposal to refer to the work of all the research associations even, but three more examples can be given to illustrate how their activities contribute to almost every side of the amenities no less than of the necessities of society. The Electrical and Allied Industries Research Association has been giving attention to problems arising in making electricity supply more readily available to farms and in its more efficient application to agriculture and horticulture, as well as to the prevention of interference with broadcasting, the study of surge phenomena with the view of minimizing damage and inconvenience due to lightning, and the design of flame-proof mining switchgear. The British Non-Ferrous Metals Research Association has investigated the behaviour of copper pipes and galvanized tanks in the domestic water system, while the work of the Cast Iron Research Association has led to the development of cast iron with a tensile strength of more than sixty tons per square inch, although a few years ago a strength of more than about twelve tons per square inch could not be obtained.

FUEL

Investigations carried out by the Automobile Research Committee on the factors which affect the starting of automobile engines in the cold have shown that by an apparently minor modification in engine design the power of the engine to overcome its own internal friction can, under certain conditions, be doubled. Further investigations under this Committee have dealt with the tendency of piston rings to stick in their grooves, due to the formation of gum in the lubricating oil under the high-temperature conditions, and a comparatively simple test has been developed for measuring the gum-forming propensities of lubricants. Besides its chemical and physical survey of the national coal resources, the Fuel Research Board has dealt with the preparation of coal for the market and has continued its work on the hydrogenation of coal and tars to oils and motor-spirits and on the synthesis of hydrocarbons and the production of lubricating oils.

NATIONAL PHYSICAL LABORATORY

Turning now to the activities of the National Physical Laboratory, special stress is laid on the work carried out in regard to the testing of the electrical switch gear. The development of the

grid has entailed transmission of large amounts of power at high voltages and has called for much patient research into means for its control. An important problem is the provision of switchgear designed to ensure the safety of operators and to protect electrical equipment against accident. No public station is available for examining the behaviour of new designs and circuits reproducing serious conditions of overload which sometimes occur in service.

While the Department was considering the possibility of erecting such a station, a proposal for co-operation was made by the association of manufacturers owning the existing stations. It offered to open its stations to tests for any British manufacturer, with a guarantee that testing-time would be available at the stations as a whole equivalent to the full time of a Government station of the type contemplated. Moreover, it agreed to accept a measure of supervision of the tests by the Department which would make possible the issue of a National Physical Laboratory certificate for switchgear which passed agreed standards of performance. Such standards have already been drawn up by the British Standards Institution to cover circuit breakers of medium and high capacity. The negotiations necessary to accept this offer have been completed and the National Physical Laboratory is now prepared to accept orders for testing electrical switchgear designed to operate at voltages between 3,300 and 11,000 volts and up to capacities not exceeding 250,000 kva. for compliance with the provisions laid down in the appropriate British Standards specification.

Much important work has also been carried out at the Laboratory on the reduction of noise, including an investigation into the noise of motor-horns, while investigations are in progress for the Institution of Automobile Engineers on the silencing of motor-cycles and the reduction of drumming in motor-car panels, as well as on the lessening of noise in tube trains. Other work has been carried out in association with the Building Research Station on the transmission of sound through walls, floors and building materials, while in another department problems of illumination involving street lighting and the effect of illumination by the headlights of a motor-car under both dry and wet conditions have been investigated. An interesting side investigation has been that of the possibility of controlling the movement of eels in water by electrical fields, undertaken by the Laboratory at the request of the Ministry of Finance for Northern Ireland, instigated by the necessity of devising some alternative form of fishing owing to the obstruction to the discharge of water by an existing eel weir in a large drainage scheme on the lower

Bann River. In this investigation the possibility of diverting eels electrically on a small scale appears to have been established.

BUILDING AND ROAD RESEARCH

The Building Research Board, with its research station at Watford, has continued its work on the efficiency of buildings from the point of view of the user, and has been associated with the investigation on the strength of existing road bridges being undertaken for the Ministry of Transport.

The Road Research Board has continued its studies on the problem of skidding and on bituminous surfacings, in which the behaviour of the surfacings on a public highway is being compared directly with their behaviour on one of the road machines at the laboratory. It has also been associated with the Timber Development Association in investigations of the properties of wood block paving. A special investigation is being carried out for the British Rubber Producers Research Association on the effect of incorporating chlorinated rubber with tar.

MISCELLANEOUS

The Forest Products Research Board has been responsible for investigations ranging over the fire resistance of timber, the control of the death watch beetle or the lytus powder post beetle, glues and adhesives and the chemistry of wood. The Water Pollution Research Board has covered the base exchange process of water softening, the exchange properties of synthetic resins, the contamination of water by lead and the problems arising in the treatment and disposal of dairy waste water. Attention has also been given to the physical, chemical and biological changes which occur in the purification of domestic sewage by the active sludge process, while under the Chemical Research Board investigations have ranged over the preparation of new chemotherapeutic products; the evaluation of antiseptics, the tanning of tarred cordage, immersed corrosion and chemical reactions at high pressure. The cause of persistent contamination of beer by a sulphurous odour has also been investigated and the trouble removed. The variety of bacteria which are responsible for the trouble has been isolated, and the infection has been traced to the cellar floors of the brewery.

The Radio Research Board has completed its studies of the ionosphere and of the propagation of waves along the ground and through the atmosphere, which have become of direct practical importance with the increased use of ultra-short rays for communication purposes. Other work has dealt with problems of direction finding.

The Department has also been responsible for illumination research, including the daylight problems involved in illumination conditions in deep rooms and the standardization of lamps and fittings. Lubrication research carried out by the Department has included measurements of static friction, as well as work with the four-ball high-pressure testing apparatus and on the physical properties of surfaces. Atmospheric pollution, the detection of toxic gases in industry, the development of a respirator for use in dust-laden atmospheres, X-ray methods and measures conducive to greater

safety in handling gas cylinders and containers have all come within the orbit of the Department.

The present report gives a most impressive picture not only of the way in which the work of the Department of Scientific and Industrial Research serves almost every aspect of everyday life no less than the needs of industry, but also of the admirable way in which its organization is adapted for co-operative work on the many problems that are brought before it by industry or by national needs.

Marine Biology in South Africa

By Prof. R. S. Adamson and Prof. T. A. Stephenson,
University of Cape Town

SINCE 1932, an ecological survey of the South African coast has been in progress, carried out from the Departments of Botany and Zoology of the University of Cape Town. The survey is necessarily expensive, since it extends from Durban in the east to Port Nolloth in the west, covering a coastline between one and two thousand miles in length, parts of which are almost inaccessible. The expenses were defrayed, in the early stages, by the University of Cape Town and the South African Research Grant Board, with some private contributions; and assistance has also been received from the Royal Society of London. At the present time, expenses are being met from a generous grant made to the University by the Carnegie Corporation of New York.

The survey has been carried out by more than a dozen persons, but the principal contributions have been made by T. A. and Anne Stephenson, E. J. Eyre, G. F. Papenfuss and K. M. F. Bright. At present, thanks to the Carnegie grant, the survey employs three salaried research assistants and has been able to purchase a Chevrolet van for field-work.

The ecological results of the survey, up to the present, are being published in three periodicals. Accounts of specific areas on the coast have appeared during 1937-38 in the *Transactions of the Royal Society of South Africa* (24 and 25) and in the *Annals of the Natal Museum* (9). The first part of a general account of the results, as they affect the whole coast, is being published in the *Journal of the Linnean Society of London* (40). In addition to these papers by field-workers on the survey, systematic accounts have been published by specialists to whom collections, made in the course of the field-work, have been sent for identification. Altogether the survey has so far

been responsible for the appearance of thirty-two papers, references to which will be found in the publications just mentioned.

Material collected during the survey and belonging to certain animal groups is identified by specialists on the staffs of the South African and Natal Museums, and many of the algae are identified by Dr. Papenfuss, who is engaged upon a revision of the whole of the South African algae; but the greater part of the material has to be sent to specialists at various European or American centres, notably the British Museum. Throughout the survey, steady support has been received from this circle of systematic workers, invaluable assistance without which the continuation of the investigation would have been impossible. Sincere thanks are offered not only to these systematists, but also to those who have assisted the survey by publishing results, and particularly to Dr. R. F. Lawrence of the Natal Museum. Duplicates of all collected material are retained at the University of Cape Town for future reference.

The survey has hitherto been confined to a study of the rocky parts of the intertidal belt. The scope and aims of the investigation are detailed in the first paper¹ of the series mentioned above, but briefly it may be said to consist of three parts: (1) a general study of eight districts situated at intervals along the coast, from Port Nolloth in the west to Durban in the east; (2) a further study, at as many stations as possible, between the eight already mentioned; this section of the work to deal mainly with a selection of common organisms which have been shown by the eight primary surveys to be of particular importance; and (3) a series of experimental studies designed to explain the observed distribution in the field of ecologically important

organisms, in terms of their reactions to carefully controlled conditions in the laboratory; special attention being paid to temperature.

The reason why a survey of this nature is of particular interest in South Africa is found in the local arrangement of oceanic currents. The coast of Natal is markedly influenced by the southward-flowing warm Mozambique-Agulhas current, which renders the inshore water sub-tropical in temperature, although Durban is far south of the Tropic of Capricorn. The inshore water along the west coast of the Union, on the other hand, is almost sub-antarctic in temperature (particularly in its northern part), as the result of an upwelling of antarctic intermediate water. The tropical regions of the coast are therefore, as it were, displaced southward on the east coast and northward on the west. The south coast (Cape Point to Cape Padrone) is a region where the inshore water is of an intermediate average temperature, the influence of neither the coldest nor the warmest water of the other coasts being paramount. The situation is particularly interesting in the vicinity of the Cape Peninsula, on which Cape Town is situated, since here a narrow tongue of land, on the average about five miles wide, separates water-masses which, in summer, may differ from each other in temperature by as much as 8° C. The arrangement of currents is in fact more complex than this paragraph would suggest, but cannot be described in detail in an article of this nature.

The results of the initial phase of the survey show clearly that the South African intertidal belt has three principal populations of animals and algae, distributed in accordance with the arrange-

ment of currents described, and apparently controlled primarily by temperature. In Natal, the population consists partly of 'Cape' species, but a high percentage of the biota belongs to the great tropical Indo-West-Pacific group, and includes reef corals and many species which characteristically inhabit coral reefs. On the south coast (and indeed on the southern part of the east coast also), the bulk of the conspicuous tropical species has disappeared, and the population is a typical 'South African' one, with many endemic species. In the cold water of the west coast a third population holds the field. It should be understood that although these three series of organisms are undoubtedly distinct, if regarded as wholes, there is much overlapping, and although each group includes species which are confined to, and extend little beyond, their own optimal area, other species are common to two, or even all three, of the main geographical regions.

Although the survey has hitherto been primarily concerned with zoogeographical considerations, several specific side-lines have been followed up, and these include detailed studies of the bionomics of the South African Patellidæ¹, and of the intertidal snail-like gastropods², together with investigations of the oxygen conditions in rock-pools³ and of the recolonization of denuded intertidal areas⁴.

¹ *Trans. Roy. Soc. S. Africa*, 34, 342-4.

² Stephenson, T. A., *Proc. Linn. Soc. Lond.*, 148, 74 (1936).

³ Bokenham, N. A. H., Neugebauer, F. L. M., and Stephenson, T. A., *Ann. Natal Mus.*, 9, 115 (1938).

⁴ Stephenson, T. A., Zond, A., and Eyre, J., *J. Exp. Biol.*, 11, 102 (1934).

⁵ Bokenham, N. A. H., and Stephenson, T. A., *Ann. Natal Mus.*, 9, 47 (1938).

Epicentres of Earthquakes, 1913-1932*

By Ethel F. Bellamy, University Observatory, Oxford

THE Seismological Committee of the British Association has since 1911 made itself responsible, in a greater or less measure, for collating the records of earthquakes made by seismological stations all over the world. The work of computing the epicentres was first undertaken by Prof. John Milne at Shide, and on his death was taken over by Prof. H. H. Turner, who gave the *International Seismological Summary*† (formerly the *Bulletin of the B.A. Seismological Committee*) the form it now bears.

* Based on a communication at the Cambridge meeting of the British Association.

† Since the 1922 meeting of the International Union for Geodesy and Geophysics, the cost of preparation and publication has been met jointly by the International Seismological Association, the British Association, and the University Observatory, Oxford.

Such determination of epicentres, based on least squares solutions of the recorded times of arrival of *P* waves at the various stations, now covers both accurately and completely all the medium and large earthquakes recorded in the period 1913-1932 inclusive. It is the purpose of the present note to direct attention to the geographical distribution of these epicentres.

During this period, 7,940 shocks have been recorded, and these have originated in 2,865 separate and distinct epicentres. The positions of these epicentres are plotted in Fig. 1, an equal area projection centred on longitude zero, latitude zero. Attention may be directed to the density

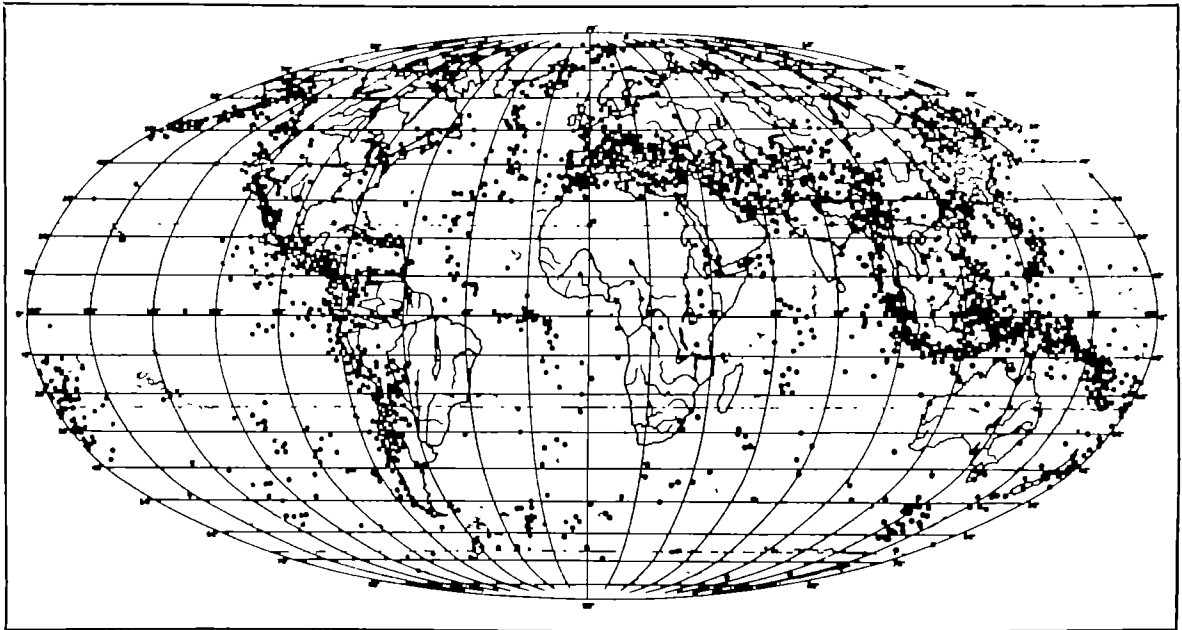


Fig. 1.

POSITIONS OF 2,865 EPICENTRES AS DETERMINED IN THE INTERNATIONAL SEISMOLOGICAL SUMMARY, 1913-1932, INCLUSIVE. (Map reproduced by permission of Messrs. Stanford, Ltd.)

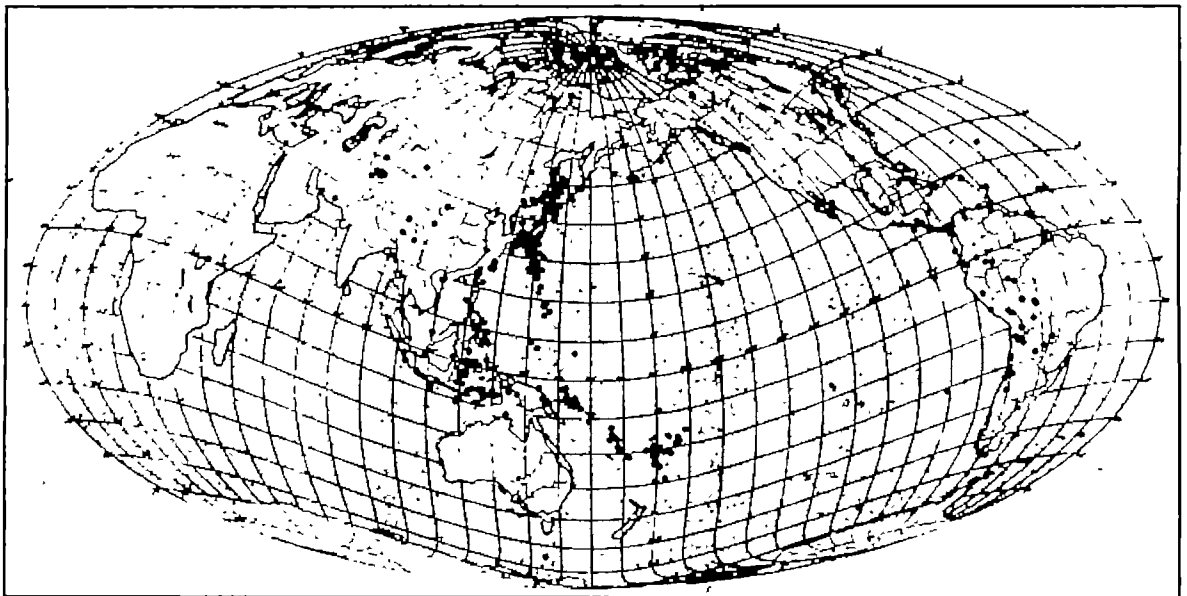


Fig. 2.

DISTRIBUTION OF 350 DEEP-FOCUS AND 30 SHALLOW-FOCUS EPICENTRES (1913-32).

On the original drawing the depth of focus is indicated by the nature of the circle, half-filled and filled, depending upon the depth, for deep foci, and with a central cross for shallow foci. Owing to difficulties of reproduction these distinctions will scarcely be discernible in the above figure.

(Map reproduced by permission of the American Museum of Natural History, New York.)

of epicentres in the Mediterranean zone, and along the east and west boundaries of the Pacific. Interesting, too, is the line of epicentres in mid-Atlantic, which follows so accurately the continental boundaries on either side, though whether this is due to a line of weakness or to a mere accident of distribution, the material available is still too small to settle.

Particularly interesting among these epicentres are those, to which Prof. Turner first directed attention¹, where the focus occurs at depths greater or less than normal. In the period concerned, there have been found 350 deep-focus and 30 shallow-focus epicentres; the positions of these are shown in Fig. 2, which is another equal area projection, centred on longitude 160° E. and latitude 20° N. It will be noted, as pointed out by Prof. Turner², on the basis of much less complete material, that the deep-focus epicentres appear to define the "boundary of an oval region about 180° long., centred with fair accuracy on

the Equator, and enclosing a considerable part of the Pacific Ocean, though its eastern boundary intrudes into S. America".

Maps such as these, which are a by-product of the work of preparation of the *Summary*, are not only of interest in themselves, but also serve to emphasize the need for a more uniform distribution of seismological stations. While approximately one third of the recorded earthquakes in the period under review occurred in the southern hemisphere, not one eighth of the existing five hundred seismological stations are located in that hemisphere. It is clear that such a one-sided distribution of stations cannot fail to affect the distribution of recorded epicentres, and it is greatly to be desired that new stations, with the accurate timing now made possible by the wireless broadcast of time signals, should be established in South America and South Africa.

¹ *Geophys. Supp. Mon. Not. Roy. Ast. Soc.*, 1, 1 (1932).

² *Inter. Scis. Summ.*, 1927, 1, 108 (1930).

Obituary Notices

Dr. L. H. Dudley Buxton

BY the death of Dr. L. H. Dudley Buxton, which took place at Oxford on March 5, at the early age of forty-nine years, the University of Oxford, Exeter College, and the study of anthropology alike suffer great loss.

Leonard Halford Dudley Buxton, the son of Dr. Dudley Wilmot Buxton, a well-known London medical man, was educated at Radley College, where he was senior scholar, and at Exeter College, Oxford, which he entered with an open classical scholarship in 1908. In addition to Honour Moderations and *Literae Humaniores*, he read for the diploma in anthropology, which he gained with distinction. Being more attracted by his scientific than his literary and philosophical studies, Buxton's interests turned to anthropology, and more especially, under the influence of the late Arthur Thomson, then professor of anatomy, to the study of physical anthropology. After a period of field work in the Sudan, he accepted a demonstratorship in physical anthropology in his University. Shortly afterwards the outbreak of War interrupted his work, and for four years he served in France in the Cameron Highlanders and in Intelligence—the latter a duty for which his facility in languages peculiarly fitted him. At the close of the War he returned to Oxford to carry on his work as demonstrator in the anatomical department of the University Museum, performing a highly useful service in arranging, classifying and cataloguing the osteological material, much of it, in some instances almost or quite forgotten, of no little value and interest in the annals of physical anthropology.

Not long after his return to Oxford, Buxton was awarded the Albert Kahn travelling fellowship, with which he travelled for a year in the United States, India and China, staying for some little time in the last-named country in order to travel inland. The opportunity thus afforded him of obtaining a first-hand acquaintance with a people still living in a condition of relatively primitive nomadism was one which his quick powers of perception could readily turn to account in its bearing on general theories of cultural development. How deeply he had been influenced by his contacts in China is apparent in the books, more especially the second, which he wrote on his return, "The Eastern Road" and "Primitive Labour", both published in 1924. In a further publication, "The Peoples of Asia" (1925), also, the quickness of his perception in marking racial character, and aptitude in ethnological analysis are readily to be noted.

This power of analysis was not confined to investigation of living peoples. Buxton had already excavated prehistoric osteological material on Cretan sites, and a visit to Mesopotamia, as well as the examination of the material which came from the excavations at Kish and elsewhere, led to an account of the basic types of the early peoples of the region, which is perhaps, in the technical sense, Buxton's best piece of work. No less valuable in a different context was the survey, anthropological in the broadest sense, which Buxton initiated of the peoples of the remoter districts of Oxfordshire, in which folk-lore, social history and custom, and anthropometric observation combined to produce studies of lasting interest.

In recognition of his discovery among family papers of the lost correspondence of Descartes with Huygens Buxton was awarded the *Légion d'Honneur*.

In due course, Buxton was elected to a fellowship on the foundation of his College, of which later he became bursar. The business ability which he showed revealed capacities of which the University also readily took advantage. In carrying out these duties, his success was at least in some measure due to a geniality which had won him the affection of his pupils, his colleagues and his contemporaries.

Mr. Howard Carter

It is with regret that we have to record the death, on March 2, of Mr. Howard Carter, the painter and archaeologist, whose name will always be remembered as the discoverer of the tomb of Tutankhamen.

Born at Swaffham in Norfolk in 1873, Carter was the youngest son of Samuel Carter, the animal painter. Owing to delicate health he never went to a public school but as a lad worked at painting with his father. At the age of eighteen years he first went to Egypt as a draughtsman on the staff of the Archaeological Survey of Egypt, then being carried out under the auspices of the Egypt Exploration Fund. His earliest line-drawings were published in the present writer's "El Bersah I" (1893), and many of his water-colour drawings of the animals and birds figured in the tombs at Beni Hasan, and executed in 1892, are reproduced in colour in "Beni Hasan IV" (1900). In 1892 he was for three months assistant to Mr. (now Sir) Flinders Petrie in the excavations that were then being carried out at El Amarna, Lord Amherst of Hackney defraying all Carter's expenses.

In the autumn of 1893 Carter was again in Egypt, this time as draughtsman to M. Naville at Deir el Bahari, and with Naville he worked for six years; the greater number of the plates of the six folio volumes of Naville's "Deir el Bahari" (1895-1903) were printed from Carter's drawings. In 1900 he was appointed inspector-general of the monuments of Upper Egypt under the Egyptian Government and during the four years that he held this post he did much restoration work in the temples of Western Thebes, Edfu, and Kom Ombo. In the Valley of the Tombs of the Kings he installed electric light in six of the more important tombs, and the electric light installation in the Temple at Abu Simbel in Nubia was also carried out by him.

In January 1902, at Carter's instigation, Theodore M. Davis, an American, undertook to finance a systematic exploration of the Valley of the Tombs of the Kings at Thebes for the benefit of the *Services des Antiquités*, and this work was entrusted to Carter. Among the discoveries he then made were the royal tombs of Tuthmosis IV (Carter-Newberry, "The Tomb of Thoutmôsis IV", 1904), and Hatshepsût (Neville-Carter, "The Tomb of Hatshepsûtu", 1906). When Lord Carnarvon began excavating at Thebes in 1908, Carter, at the express desire of Sir

Gaston Maspero, then director-general of the *Service des Antiquités*, was appointed to supervise the excavations and record all 'finds'. After five years work, there appeared the handsome volume "Five Years Explorations at Thebes" by Carnarvon, Carter and others. In 1914 Carter by a lucky chance found the long-sought-for tomb of Amenhotep I (*J. Egyptian Archaeology*, 3, 147; 1916), and soon afterwards he located a tomb of Princess Hatshepsût, which the Arabs had recently found and plundered (*ibid.*, 4, 107; 1917).

At the conclusion of the Great War, Carter persuaded Carnarvon to let him once again explore in the Valley of the Tombs of the Kings, and in 1922 he was rewarded by the discovery of the tomb of Tutankhamen with its extraordinary wealth of jewels and tomb furniture. Carter at once realized that only with the help of a large staff of expert workers could he attempt to clear the tomb of all the treasures it contained. Fortunately, this problem was quickly solved through the generosity of the Egyptian Expedition of the Metropolitan Museum of Art, New York. In answer to Carter's appeal, Mr. A. M. Lythgoe, the curator of the Egyptian Department of the Museum, placed at his disposal Mr. A. C. Mace, one of the associate curators, Mr. Harry Burton, their expert photographic recorder, and Messrs. Hall and Hauser, draughtsmen to their expedition. At the same time, Mr. Lucas, director of the Chemical Department of the Egyptian Government, offered his aid, and all were soon at work. During the years that followed other workers were enrolled, including Dr. Alexander Scott and Dr. Derry. Altogether it took ten years to record the contents of the tomb and to preserve the objects so that they might be safely packed for transport to the National Museum at Cairo. Carter and his staff published three popular volumes on the tomb and its contents between 1923 and 1933; but much remains still to be published and this it is hoped will soon be done by the Cairo Museum authorities. Only a few weeks ago Prof. Georg Steindorff published, in the *Annales des Services des Antiquités de l'Égypte*, 38, 641-667, a full account of the paintings on the walls of the tomb.

PERCY E. NEWBERRY.

Mr. E. R. Bolton

EDWARD RICHARDS BOLTON, who died on February 10, was born in Dublin in 1878, and was the only son of J. A. Bolton of Blackrock, Co. Dublin, of long Irish ancestry. He was at school at Bedford (Elstow) and studied chemistry at King's College, London, and in Fresenius's laboratory, Wiesbaden. On his return to England he was engaged for a short period in heavy chemical industry in Newcastle and in 1902 became chemist to the East India Products Oil Mills, Hammersmith, later Loders and Nucoline, Ltd. At these mills, Bolton carried out the first caustic refining of coco-nut oil in Great Britain. He became a director of the firm, having in the meantime started in analytical and consulting practice in Hammersmith.

Bolton quickly established a commanding position as analyst, consultant and technical adviser in the oil and fat and many food industries. In 1920, Technical Research Works Ltd. was founded, with premises in Milner Street, Sloane Square, Bolton being managing director, and transferring his analytical and consulting practice to the same address. 1920 is notable, too, in that it is the date of Bolton's patent for the continuous hydrogenation of unsaturated oils, fats and the like.

Much original work came from Bolton's fertile mind and clever hands: it was published mostly in the *Analyst*, from the year 1910, his last two papers (with K. A. Williams) being in 1938, both dealing with whale oil: his aptitude in devising apparatus and instruments is exemplified in the Bolton and Williams colorimeter. He also served on a number of research committees, particularly on analytical methods; at the time of his death he had just begun work with the "S.P.A." Sub-Committee on the determination of unpolymerisable matter in oils. Outstanding among his publications, there appeared in 1911 his book "Fatty Foods" (Bolton and Revis) a second edition of which, with the title "Oils, Fats and Fatty Foods" (Bolton) came in 1928.

Bolton was a well-known member of many societies; particular mention should be made of his services to the Society of Public Analysts and Other Analytical Chemists, of which he was honorary secretary from 1915 until 1925 and president during 1926-1927. For a period he was honorary treasurer of the Federal Council for Chemistry, and later was a member of the British Council for Chemistry of the Royal Society, a member of the delegacy of King's College, London, and a Royal Institution Visitor.

Seemingly in the full vigour of life, Bolton died, suddenly, after an illness from which he was thought to be recovering, leaving a widow and a host of friends to lament his loss. He was a remarkable and much-loved man, held in universal regard and affection alike by his staff, his colleagues and a wide circle of professional and business friends. His death is a serious loss to the profession of chemistry; yet throughout his life he did much to minimize this loss, for generosity in giving to others the fruits of his own gifted mind and of his wide experience was a notable characteristic of his ever-generous nature.

E. HINKS.

Prof. C. C. Okell

PROF. CHARLES CYRIL OKELL, who died on February 9, was educated at Douglas Grammar School, St. John's College, Cambridge, and St. Bartholomew's Hospital, and distinguished himself as a student. He became medically qualified during the Great War and served in the R.A.M.C. as lieutenant and captain in France, Palestine and Egypt, and was awarded the Military Cross when a regimental medical officer. Soon after the War he became bacteriologist to the Wellcome Physiological Research Laboratories at Beckenham, and left that institution to become professor of bacteriology at

University College Hospital Medical School, London. He was for some time assistant editor of the *Journal of Pathology and Bacteriology* and at the time of his death was editor of the *Journal of Hygiene*.

Okell's active scientific life began at Beckenham. He was soon engaged in what has since become one of the main labours of the laboratory—the investigation of the problem of human immunization against diphtheria. He collaborated with Glenny in an important paper on the meaning of the Ramor flocculation test for diphtheria antitoxin. This was followed by a large volume of work on the problem of immunization against scarlet fever and a number of papers on the hæmolytic streptococcus and its toxin. He was also concerned in a comprehensive examination of the sugar reactions of the diphtheria bacillus and the development of an intracutaneous test for the virulence of diphtheria bacilli which made the routine testing of virulence much cheaper and more practical. He also published papers on the standardization of dysentery antitoxin, scarlet fever antitoxin and tuberculin, and was among the first to realize the importance of the application of statistical methods to biological assay.

Okell was part author of a paper which was perhaps the first to establish with statistical rigour the fact that 'B.C.G.' had some immunizing power against virulent tubercle bacilli. One of his last efforts at Beckenham was his attempt with Hindle to establish the possibility of vaccination against yellow fever, an exciting and dangerous piece of work, which he approached in the same spirit of detachment which characterized all his efforts.

On his appointment to the chair at University College Hospital Medical School, Okell delivered the Milroy Lectures in 1932, in which he summarized the fruit of his labours for many years on the hæmolytic streptococcus. He also made the discovery that simple operations such as tooth extractions are followed in a large number of cases by the appearance of streptococci in the blood of the patients, a most important observation which he would have followed up but for the rapid onset of the ailment which led to his retirement to Cambridge.

All Okell's work was done in collaboration with others. He loved the company of his fellows both in work and in leisure. He did not like working alone, and always discussed what he was doing with all and sundry. He was a great conversationalist, and was always worth listening to, not only when talking of his special subject, but also when ranging at large over literature, art and ethics. In none of the work in which he collaborated was his contribution the least important factor and he was generally the moving spirit. His work was never far removed from practical application. Interested though he was in fundamental problems, it could be seen that the motive of his work was primarily the benefit of the sick, particularly in the prevention of disease.

Okell was universally popular, and the gradual restriction of the field of his labours by his illness was a grief to all of his friends. He leaves a memory of care for others and single-hearted devotion to medicine which will endure.

J. W. TREVAN.

News and Views

New Fellows of the Royal Society

At the meeting of the Royal Society, held on March 16, the following were elected fellows of the Society:

G. S. ADAIR, assistant director of research in physiology, Cambridge, distinguished for his researches on the physical chemistry of proteins, particularly in connexion with haemoglobin.

C. H. ANDREWS, pathologist, National Institute for Medical Research, distinguished for his work on filtrable viruses and the bacteriophage, particularly in relation to the neutralization of viruses by antisera, and his studies on filtrable tumours.

M. BORN, Tait professor of natural philosophy, University of Edinburgh, distinguished for his work in many branches of mathematical physics, and particularly for his contributions to quantum theory and its applications to physics and chemical physics.

A. J. BRADLEY, assistant director of research in crystallography, Cavendish Laboratory, Cambridge, distinguished for his methods of applying X-ray crystallography to elucidate the structure of metals, and particularly the gamma phase and order and disorder in alloys.

D. BRUNT, professor of meteorology, Imperial College, London, distinguished for his contributions to analytical and dynamical meteorology, and particularly to the theory of the transfer of heat in the atmosphere.

F. A. E. CREW, Buchanan professor of animal genetics, University of Edinburgh, distinguished for his work on sex reversal in frogs and birds and on the genetics of many animals, especially *Drosophila* and budgerigars.

F. W. EDWARDS, Department of Entomology, British Museum, distinguished for his extensive researches on the order Diptera and for his studies on larval characters in relation to classification.

B. M. JONES, Mond professor of aeronautical engineering, Cambridge, distinguished for his researches in aeronautical science and for the elucidation of problems of design, such as the control at slow speeds and the determination of drag on full-scale structures.

G. W. C. KAYE, superintendent, Physics Department, National Physical Laboratory, distinguished for his pioneer work in X-ray measurements and for his studies on acoustics and physical constants: has rendered valuable service to the Radium Protection Committee and the National Radium Commission.

E. G. T. LIDDELL, fellow of Trinity College, Oxford, distinguished for his researches upon the physiology of muscle movement and posture in mammals, and upon their control during the normal and abnormal functioning of central nervous mechanisms.

E. J. MASKELL, lecturer in plant physiology, Cambridge, distinguished for his work in the realm of plant physiology, especially in relation to problems of translocation.

I. MARSON, vice-chancellor of the University of Sheffield, formerly professor of chemistry, University of Durham, distinguished for his researches in physical chemistry, particularly on the physical interaction of mixed gases and on new aspects of the chemistry of iodine.

O. E. K. MEES, vice-president of the Eastman Kodak Company, Rochester, N.Y., distinguished for his influence on the technology of photography, thereby assisting advance in many branches of science.

M. H. A. NEWMAN, lecturer in mathematics, Cambridge, distinguished for his contributions to pure mathematics, particularly in the field of topology and group theory.

H. H. READ, professor of geology, Imperial College, London, distinguished for original work especially in connexion with the tectonic and petrological problems of the igneous and metamorphic rocks of northern Scotland.

SIR R. G. STAPLEDON, professor of agricultural botany and director of the Welsh Plant Breeding Station, Aberystwyth, distinguished as the founder of the Welsh Plant Breeding Station where, with a team of workers, he has undertaken studies of far-reaching importance on the improvement of pastures.

H. M. TURNBULL, professor of morbid anatomy and director of the Bernhard Baron Institute of Pathology, London Hospital, distinguished for his work on morbid histology, particularly in relation to vascular disease, encephalitis, toxic hepatitis, diseases of bone, and normal and abnormal haemopoiesis.

E. E. TURNER, head of the Department of Organic Chemistry, Bedford College, London, distinguished for his contributions to the stereochemistry of organic compounds, especially in connexion with asymmetry in derivatives of diphenyl and with dissymmetry in the phenoxarsines.

V. B. WIGGLESWORTH, reader in medical entomology, London School of Hygiene and Tropical Medicine, distinguished for his researches on insect physiology, especially in relation to digestion, tracheal respiration, excretion and possible endocrine secretion.

E. J. WILLIAMS, professor of physics, University of Wales, Aberystwyth, distinguished for his researches on the passage of electric particles through matter, and on individual collision processes, which have provided evidence for the existence of the heavy electron.

Dr. C. H. O'Donoghue

DR. C. H. O'DONOGHUE has been appointed to the chair of zoology in the University of Reading in succession to Prof. F. J. Cole (see *NATURE* of March 4, p. 368). After graduating with first-class honours in zoology and physiology from King's College, London, he was appointed lecturer in zoology at University College. He obtained the D.Sc. degree in 1912, was awarded a Beit Memorial Scholarship for research and spent six months studying at Freiburg under Prof. F. Doflein. In 1918 he went to Canada as professor of zoology in the University of Manitoba, and in 1923 acted as director of the Marine Biological Station at Nanaimo, Vancouver Island. For two terms he was visiting professor at Stanford University, California. He was also appointed by the Canadian Government for two years as head of a scientific expedition to Jasper Park in the Rocky Mountains. As a member of the Research Committee of the Biological Board of Canada, he helped to establish the Prince Rupert and Cultus Lake Stations. In 1927 he returned to Great Britain at the invitation of the late Prof. J. H. Ashworth, to become senior lecturer and later reader in zoology in the University of Edinburgh. In 1932 he was awarded the Neill Prize of the Royal Society of Edinburgh, and he was president of the Royal Physical Society of Edinburgh in 1933. His research covers a wide field, but is chiefly concerned with the taxonomy of the Bryozoa and Nudibranchia, and with vertebrate anatomy, physiology and embryology.

Prof. M. Leclerc du Sablon

CONGRATULATIONS are to be extended to Prof. Mathieu Leclerc du Sablon, who attains his eightieth birthday on March 25. Prof. Leclerc du Sablon is probably the last living member of the famous group of French botanists who at the end of the nineteenth century made very important contributions to the study of plant anatomy. From 1883 until 1890 he was working in Paris at the École Normale Supérieure, and later at the Natural History Museum under Van Tieghem, his father-in-law and teacher. During this period he produced a series of important papers on various subjects in some of which are facts now taught to every student of elementary botany. His studies on the dehiscence mechanisms of anthers in the flowering plants and of the sporangia in the Archegoniatae are especially noteworthy; he was the first to discover the mechanism of the annulus in the fern sporangium. Other important contributions were papers on the structure and physiology of tendrils, on the haustoria of parasitic flowering plants, on the development and comparative structure of the sporophytes of Liverworts, and on the development of the vascular system in young fern plants. In 1890 he was appointed professor of botany in the University of Toulouse, a post which he held for thirty years. His extensive knowledge of plants found expression in the "Cours de Botanique", a large text-book written in collaboration with Gaston Bonnier, his brother-in-law and former colleague. The first part of this work appeared in 1901; but it

was not completed until 1938 when, after the death of Bonnier, the last part dealing with plant physiology was published. His activities have covered an exceptionally wide field, and his influence on the development of botany, especially in France, has been very considerable.

Archaeological Studies in France

PROF. H. V. VALLOIS, professor in the Faculty of Medicine of the University of Toulouse, has been appointed professor of prehistoric anthropology in the Institut de Paléontologie humaine of the University of Paris. Prof. Vallois, who has long been recognized as standing in the front rank of authorities in France on human palaeontology, has been in charge of the anthropological laboratory for practical studies of the École des Hautes Études in Paris since 1937, and is senior editor of the periodical *L'Anthropologie*. He took up his duties at the Institut at the beginning of the current semester, and is delivering a course of lectures on the general principles of human palaeontology and the prehumanids. A course of lectures on prehistoric ethnography is also being delivered concurrently by the Abbé Breuil. A new department has been formed in the École des Hautes Études for the study of geology with special reference to the origin of man. The first director of the department will be P. Teilhard de Chardin, who during his prolonged residence in the Far East has made numerous and important contributions to the study of the palaeontology and pre-history of China and south-eastern Asia. It will be remembered that the first discovery of palaeolithic implements in China was due to Teilhard de Chardin, while his studies of the fossil fauna of Choukoutien is the basis for the dating of Peking man. He contributes to the current issue of *L'Anthropologie* (48, 5-6; 1938) notes on the human palaeontology of southern Asia, summarizing the results of his observations in Burma, Malaya, Java and Indo-China, when accompanying Dr. Hellmut de Terra on his recent geological and archaeological survey in the Far East, supplementary to his investigations in India (see *NATURE*, 143, 275; 1938).

German Activities in Central Europe

DURING the past fortnight, the State of Czechoslovakia has been forcibly broken up and a large part absorbed into the "Great German Reich" as the "Protectorate of Bohemia and Moravia". In the account of Czechoslovakia's contributions to science which appeared in *NATURE* of November 26, 1938, pp. 942-44, the hope was expressed that the scientific and cultural development of the Czechs would still be possible after their territory had been drastically curtailed by the Munich Agreement, and that they would continue to make contributions to the advancement of scientific knowledge and take a share in its application to the welfare of mankind. This hope was qualified by the anxiety then felt for those men of science and learning whom the impoverished State might not be able to support, and it is gratifying to know that, until recently, indeed

until the very end, the educational authorities succeeded in maintaining practically all the important research institutions and cultural associations remaining within the country. Scientific publications also continued to appear, and there was every reason to believe that the nation would, by hard labour, maintain its vigour and prosperity, and its men of science would be able to continue to achieve distinction and add to the sum of human knowledge by meritorious work in their respective fields. It is, perhaps, too early to foresee the consequences of the latest events in Central Europe. The new Protectorate is avowedly to have a measure of autonomy, though this is scarcely likely to go so far as to permit the free and open interchange of thought which has been banned in Germany for the past few years.

Tuberculosis in Wales

THE report is published of a Committee, consisting of Mr. Clement Davies and Dr. F. J. H. Coutts, appointed by Sir Kingsley Wood, when Minister of Health, in response to a request of the King Edward VII Welsh National Memorial Association for an inquiry into the anti-tuberculosis service in Wales and Monmouthshire (London: H.M. Stationery Office. 4s. 6d. net). The problem of tuberculosis is relatively more serious in Wales than in England, for the mortality rate has not declined so rapidly as, and exceeds, that of England. Excessive mortality in Wales occurs among young adults aged fifteen to twenty-five years and in the age group twenty-five to forty-five. In contrast with England, the rates at fifteen to twenty-five show little change since 1921 and the rate for females is distressingly high. Certain areas, notably Anglesey, Caernarvon and Merioneth, are especially afflicted with the disease. The report states, that for practical purposes, racial susceptibility as a factor in causing the high mortality may be ignored. Segregation in tuberculosis is one of the most effectual preventive measures against the spread of the disease, the need for additional bed accommodation if tuberculosis is to be adequately dealt with is stressed, and it is suggested that, with a widely scattered population in some Welsh areas, small local institutions of a simpler type might be a valuable adjunct to the more fully equipped hospitals. The Committee recommends the provision of additional laboratory accommodation, and suggest that the proposal to establish a village settlement in Wales should be explored.

It is pointed out that after-care work has made little headway in Wales, and although the Committee does not recommend that the Association should undertake this work, the hope is expressed that local authorities will realize the importance of setting up effective care organizations. Treatment is only one aspect of tuberculosis work, and the importance of preventive work should be realized. Unfortunately, over large areas in Wales, preventive duties are neglected or are carried out imperfectly by local

authorities, who do not appear fully to realize their responsibilities. In regard to housing, the report states that in rural areas, villages and small towns there are hundreds of houses that are unfit for habitation. The Committee also points out that there is scope for much improvement in the provision of milk and meals in schools, and authorities in Wales as a whole, with few exceptions, make little or no provision for midday meals. The Committee concludes by directing attention to the great disparity among local authorities in the standard of performance of public health services, and remarks that many of the authorities, owing to small population and inadequate resources of their area, are incapable of carrying out their public health duties properly. The Committee was impressed with the general efficiency of the Welsh National Memorial Association's work for the treatment of tuberculosis.

Launch of the R.R.S. *Research*

THE launching of the Admiralty non-magnetic ship, the R.R.S. *Research*, will take place at 6 p.m. on April 4 at the Noes Works, Dartmouth, of the builders Messrs. Philip and Son, Limited. The launching ceremony will be performed by Mrs. Spencer Jones, wife of the Astronomer Royal. The day and time of the launching have been chosen to coincide with the highest spring tides, as investigations proved that the *Research*, which is a 770-ton ship, would need all the water possible. The construction of a special vessel such as this, which is to be so far as possible non-magnetic, raises many problems. The question of the best substitutes for iron or steel in various components and fittings has required a good deal of investigation and experiment. The builders have shown a great interest in the work and have co-operated with the Admiralty to obtain the most satisfactory results. Lieut.-Commander D. H. Fryer, who has been appointed captain of the *Research*, was given special leave by the Admiralty to make a voyage to Australia in one of the grain ships in order to gain experience of sailing ships. He has recently completed the rigging of a scale water-line model of the *Research*, which will be on view at the reception to be given by Messrs. Philip and Son after the launching.

Recent Researches in Steel Metallurgy

IN a Friday evening discourse at the Royal Institution on March 17, Dr. W. H. Hatfield discussed what he described as the three principal aspects of steel research: (a) elucidation and improvement of the process of steel manufacture and manipulation; (b) the investigation of the properties of steel under variable conditions approximating to those of service; and (c) the exploration of the influence of added elements and of the effect of heat-treatment. Dr. Hatfield showed a colour film illustrating the electric and open-hearth steel processes, the casting of ingots and forging operations. Dr. Hatfield said that one of the most complex studies is that of the changing properties of steels with varying temperature, this

study not only including the properties of the steel at a particular temperature but also the degree of persistence of these properties at that temperature over long periods of time. In this connexion, details were given of a creep test carried out on a heat-resisting steel maintained under a load of 280 lb. per sq. inch for a period of 10,000 hours at 900° C. With reference to the production of permanent strain at normal temperatures, Dr. Hatfield instanced a test now in progress at the Brown-Firth Research Laboratories. The experiment consists of a strip of cold-worked austenitic steel placed in tension under a stress of 25 tons per square inch. The test was commenced in June 1929, and since that date the extension has been nil within the accuracy of measurement applied, that is, a sensitivity of 1/40,000 of an inch and a gauge length of 8 inches. In discussing the results achieved by the addition of alloying elements, Dr. Hatfield stated that, experimenting upon the basis of the rustless steel composition by modifying the chromium and nickel, and by adding other elements such as tungsten, molybdenum, cobalt or titanium, steels have been produced which maintain a reasonably protective film at temperatures even in excess of 1000° C., besides possessing a useful strength.

Palaeolithic Man in Northern England

ALTHOUGH it is more than sixty years since the late Sir William Boyd Dawkins brought to light evidence of the presence of man during the Upper Palaeolithic period in the north Midland region of England, it was not until Mr. A. Lealie Armstrong's investigations in the cave and other deposits of the area in a series of systematic researches, which began in 1921, that it became possible to establish a chronological succession in human occupation here in the course of the palaeolithic age, and its relation to phases of the Ice Age. The results of these investigations were surveyed by Mr. Armstrong in his Wildé Lecture before the Manchester Literary and Philosophical Society on March 14. In dealing with the earlier evidence of occupation, he pointed out that until three years ago it had not been known that the range of Lower Palaeolithic man extended to the northern Midlands, but intensive research directed to the contents of the glacial drift and old river terrace gravels of the Trent and its tributaries had provided evidence of his presence there in the form of hand-axes of flint and other artefacts, representing all the Lower Palaeolithic cultures. Excavations in the Pin Hole Cave, Creswell, revealed three zones of occupation in Mousterian times, including two cold periods. Mr. Armstrong's Trent Valley researches indicate that the lower terrace gravels of the river approximate in time to the second Mousterian occupation of the cave, and that they were laid down during one, or possibly both, of the cold periods recorded in the cave. Rock shelters in the Creswell gorge and neighbouring valleys and habitation sites on the Lincolnshire cliff, covered by solifluxion deposits, indicate that man lived in these regions while events which mark the final glaciation

of England were active in the east, west and north of the region; therefore human occupation of the north Midland area throughout palaeolithic times can now be demonstrated.

Archaeological Finds in the Nile Delta

AN archaeological discovery described as "exceptionally important" is reported from the ancient city of Tanis in the Sharkia Province of the Nile Delta (*The Times*, March 20). Prof. Montet of Strasbourg, who has been engaged for some years in excavating on the site, on which both Mariette Pasha and Sir Flinders Petrie carried out archaeological investigations, has discovered the first gold coffin to be found in Egypt since that of Tutankhamen, and a silver sarcophagus, the first example in that metal from Egypt. Tanis was the capital of Egypt between the Thirteenth and Eighteenth Dynasties; but the present find was made in excavating a series of funerary chambers of the tombs of kings of the Twenty-first and Twenty-second Dynasties (1100-950 B.C.), the capital of which was Tell Basta, the site of the modern Zagazig. Hitherto there has been no certain knowledge of the residence of these kings. The funerary chambers were empty, but a few days ago a narrow corridor was found leading to a wall which, when pierced, gave entry to an intact chamber of medium size, built of white limestone, and containing a gold sarcophagus. Within this sarcophagus was a second of silver, in which was a mummy. Inscriptions show that it is that of King Shishak. Two human skeletons still wearing ornaments were found on either side of the sarcophagus; and there were many jewels among the remains. In one corner of the tomb were funerary statuettes representing King Cumin, and in another corner a large vase, which has yet to be opened.

Libraries in Technical Institutions

A REPORT on libraries in technical institutions, which has been issued by a joint committee of the Association of Technical Institutions, the Association of Principals of Technical Institutions and the Association of Teachers in Technical Institutions, should be of considerable service to those responsible for providing and maintaining library services in technical colleges (Loughborough: Loughborough College, 1939). In addition to a clear analysis of the aims of such a library service, which should assist in the formulation of sound policy based on well-defined principles, it gives sufficient detail in regard to such matters as accommodation and planning to be of real service in the design of a new library or expansion of existing services. A feature of the report is the inclusion of plans and details not only of three distinct types of library design but also of a number of representative libraries. The basic recommendation of the report is that in every technical institution there should be at least one room of adequate size reserved solely as a library, containing an ample supply of books and periodicals kept thoroughly up to date and covering all departments of work carried out in the institution, and including also a good

collection of books of general interest. Wherever possible there should be a separate reading room, and in institutions doing advanced work small rooms should be provided for individual study and research. To secure full value from the library service, the library should be under the supervision of someone who has had a measure of special training and experience in library work. Alternative methods of recruitment to this end are discussed in the report. It is further recommended that properly qualified librarians employed in technical institutions should always be regarded as equal in status to members of the teaching staff and be paid on the Burnham Technical Scale—graduate or non-graduate—according to qualifications. An annual allocation for the provision of books, periodicals and binding of 3s. per student for the first 2,000 students and 2s. per student for each subsequent student is recommended.

Uniformity of Mycological Terms

THE Plant Pathology Committee of the British Mycological Society has addressed a circular letter to organizations in the British Isles which use the scientific names of fungi causing plant diseases. It is suggested that an agreement to use the names from a standard list of plant pathogens would be of great convenience, and would strengthen attempts to secure international uniformity. The proposed standard names are those included in the "List of Common Names of British Plant Diseases" (published for the Plant Pathology Committee of the British Mycological Society by the Cambridge University Press, 1934). Mycological nomenclature is greatly in need of any authoritative lead such as the one now proposed. It would, in fact, be very gratifying if the present modest suggestions should not only find immediate acceptance, but would also be extended later. A universally acceptable standard of naming for all fungi is urgently needed. The British Mycological Society has, moreover, always maintained a proper balance between all the branches of its study. It should, therefore, be accorded the full support of all mycologists of Great Britain. The Society has accepted its Committee's suggestions on nomenclature for all papers on pathogenic fungi, which will be published in its volumes of *Transactions*. Provision has been made for any desirable criticisms to be advanced against the actual list of names, and it is proposed to issue periodical revisions. Further particulars of the scheme may be obtained from the Secretary of the Plant Pathology Committee, Dr. G. C. Ainsworth, Experimental and Research Station, Cheshunt, Herts.

Horticulture of the Amaryllidaceæ

"HERBERTIA", the fifth year-book of the American Amaryllis Society (From the Editor, Mira Flores, Orlando, Florida, U.S.A., 1938) maintains a proper balance between needs of the grower, the scientific worker and the teacher, and attains a human interest in addition. The present volume is dedicated to Ernst H. Krelage (Holland), about whom an

interesting autobiography appears. Classification of the Amaryllidaceæ is somewhat difficult, but a series of papers by Dr. H. P. Traub and J. C. Th. Uphof clarifies some obscurities and makes possible a tentative revision of the genus *Amaryllis*. Cytological studies have also been used by Walter S. Flory to re-establish the genus *Habranthus*. Experiments by W. M. James upon vernalizing seed of *Leuocoryne Ixioides* indicate the possibility of much faster production of flowering-size plants. I. W. Heaton reviews the possibilities of growing hybrid amaryllids with culture solutions instead of compost, and preliminary experiments suggest a useful and extremely economic method of culture. The section on harvesting, storage and forcing contains two mutually complementary papers by Dr. John Grainger (England), who describes the scientific principles underlying the production of early bloom, and by Prof. E. van Slogteren (Holland), who considers the practices for early forcing. "Herbertia" has also the usual descriptions of regional activities and garden culture. It is comprehensive, and succinct yet adequate. The policy of Dr. Hamilton P. Traub, its editor, presents the requisite blend of new and established knowledge which is essential for progress in modern horticulture.

A Doctors' Peace Manifesto

THE Balkan Medical Union (Athens, Belgrade, Bucarest and Istanbul) has addressed an appeal to medical men of all nations to take active measures to awaken public opinion on the horrors of war, and the terrible sufferings it inflicts upon the civil population of open towns. The Union believes that "only enlightened international opinion can make plain the imminence of the danger, and the uselessness, even for the victor, of war-time atrocities. The immutable truth that hate breeds only hate, and atrocity breeds vengeance, must be impressed on everyone". The Balkan Medical Union, founded in 1931, is essentially a scientific organization; but it also aims at bringing together the intellectuals of different countries so that they may know one another, and come to a mutual respect and understanding, whereby the misunderstandings that engender hate and disastrous struggles between nations may be dispelled.

The League of Nations

A REVISED edition of the "Aims, Methods and Activities of the League of Nations", which first appeared in 1935, has now been published (Geneva: League of Nations; London: George Allen and Unwin, Ltd., 1938. 2s.). Like the first edition it consists of four parts, the first including a historical account of international organization followed by a description of the nature, aims and methods of the League. The second part attempts to describe and assess impartially the achievements of the League, and although eminently readable and not overburdened with detail, gives a good comprehensive account of its work, which at the same time indicates some of the causes of its success and failure. The chief criticism that can be advanced of this section,

which occupies the greater part of the book, is that in attempting to be comprehensive it fails to evaluate sufficiently—the highly significant work of the League in the field of nutrition, for example, receives the barest mention. The work of the Permanent Court of International Justice and of the International Labour Organisation are dealt with in the third part; the final section of the book containing the text of the Covenant and extracts from the Statute of the Permanent Court and from the Constitution of the International Labour Organisation.

Hospitals in War Time

THE Minister of Health has issued to all hospital authorities and voluntary hospitals a memorandum explaining the main lines on which a scheme for a war-time hospital organization is being worked out for England and Wales (Emergency Medical Services Memorandum 2. H.M. Stationery Office. 6d. net). The basis of the emergency scheme is the division of hospitals into different classes according to the use which it is intended that they should serve, and almost all hospitals are included in some way. Room is to be made for the reception of casualties in one wing or block of most of the mental hospitals in the country, and a few mental hospitals are to be cleared of their ordinary patients. It is proposed to link up casualty hospitals to each other in the more vulnerable areas and to selected hospitals farther away. In order to increase the hospital accommodation, all hospitals would be asked to discharge all patients for whom institutional treatment is not essential, which it is estimated would probably free from 30 to 50 per cent of the existing hospital beds, and additional beds would be introduced into selected hospitals and institutions. Proposals for the organization of the medical and nursing staffs are also outlined.

Physical and Mental Welfare

THE Physical and Mental Welfare Society of New Zealand, Onehunga, N.Z., suggests that the centenary of New Zealand might be celebrated by the foundation of a memorial, and that this might take the form of an endowed scheme whereby the 'masses' might be kept in touch with scientific truths and views bearing upon the physical and mental welfare of the race. New Zealand was recognized as an independent Colony in 1841. Bearing on this subject, the Health Organisation of the League of Nations has issued reports on physical education and on nutrition (*Bull. Health Organisation*, 7, No. 4, 1938. Allen and Unwin, Museum Street, W.C.1. 2s. 6d.). The first report suggests a programme of laboratory research upon the effects of physical exercise, and on the relation between intellectual and physical development. The other report deals with principles to be observed in the study of diets and of the nutrition of a population, particularly as regards nutrition in the tropics.

Disposal of Offal

IN the Benjamin Ward Richardson Lecture recently delivered at the Royal Sanitary Institute, Mr. John Austin dealt with the hygienic treatment

and disposal of offal and by-products in abattoirs. He said that two most important considerations govern the treatment of animal offal, namely, (1) the hygienic disposal of animal waste matter, and (2) its economic utilization. Suitable premises are needed to which all raw material can be brought from the slaughter-hall with the minimum amount of handling; they should be well lighted and ventilated and provided with an abundant supply of steam and hot and cold water. Mr. Austin then considered by-product work under the headings of blood, hides and skins, tripe, casings, edible fat and inedible offal, all of which require immediate treatment owing to the rapidity of decomposition after slaughter.

British Chemical Industry

A SURVEY of the achievements of British chemical industry in the last twenty-five years was given by Sir Gilbert T. Morgan in three Cantor Lectures to the Royal Society of Arts which have just been published. The field covered included inorganic chemicals, gases, nitrogen products, pigments, electro-chemistry, metals, the utilization of coal, explosives, dyes, fermentation, plastics and drugs, and the lectures give a valuable survey of modern processes and the progress made in the period considered.

Centro Volpi Di Elettrologia

THE second number of this journal (English edition) mentions that amongst the first of its activities will be a convention for the development of 'experimentations' in view of industrial autarchy. In order to develop research work, which is the basis of industrial emancipation, Italian industrialists and the 'most competent scientific workers and technicians of the country will meet in Venice during October 26-28. They will examine the many sides of the problem of the improvement of existing laboratories, the creation of new ones and the co-operative work between them. The centre extends its welcome to all those who wish to attend the conventions. In the field of international relations the Centre is endeavouring to establish collaboration.

Safeguarding of Unpublished Research

SUCH attempts as were made by individuals or institutions to remove important papers to places of greater safety during the September crisis merely served to emphasize the impossibility of handling at short notice the quantity of material involved. The Research Co-ordination Committee accordingly decided to continue its investigation of the possibilities of micro-film technique. In view of recent international developments, the steps taken by the Research Co-ordination Committee to facilitate the reproduction and storage of documents are particularly timely. The process was described in *NATURE* of March 11, p. 393. Briefly, it consists in photographing documents of any kind, such as charts, pages of books, loose sheets, maps, etc., on to standard 35 mm. cine-film. Documents up to 17 in. x 24 in. can be dealt with (or larger ones in two or

more sections). The photographs are preserved in negative form on acetate safety film, which when tightly rolled is far more resistant to fire than any paper record. Working with quarto papers (10 in. $\times$ 8 in.), 1600 facsimiles can be obtained on 100 ft. of film. This micro-record occupies only one twentieth of the volume of the original. Full-size prints can be made from it at any time, or it can be read in a special projector, or thrown on a wall-screen for lectures. Preliminary arrangements are in hand for making micro-film records at the cost of one half-penny per quarto document, possibly less if a sufficient volume of material is handled. Further information may be obtained from the Hon. Secretary, Research Co-ordination Committee, 35 Gordon Square, London, W.C.2.

Old Science and Medicine

E. P. GOLDSCHMIDT AND CO., LTD., of 45 Old Bond Street, have recently issued three catalogues entitled respectively "Science and Medicine", "English Science and Medicine" and "Old Medical Books". The first catalogue contains entries of a complete set in thirteen volumes of Johann Peter Frank's "Complete System of Medical Polity", the first edition of De Kampelen's works on the talking machine, the first German edition of Kepler's "Steriometria" and numerous original papers by Pasteur, Scheel and others. In the catalogue on "English Science and Medicine" we note the rare third edition of Harvey's "De Motu Cordis", Gilbert's "De Magnete", several works by Robert Boyle, including that on "The Mechanical Origine of Production of divers particular Qualities . . . of Magnetical Qualities", the first work on electricity in English, the first edition of Sir Robert Dudley's "Arcano del Mare", one of the foremost English works on navigation and several modern works by Huxley, Galton, Rutherford, Banting and Best, among others. Among the most notable works in the catalogue of "Old Medical Books" are the first edition of John Vigo's treatise on surgery in black letter (1543), the first illustrated edition of Dioscorides (1543), Sir Theodore Turquet de Mayerne's work on arthritis (1676), and the first editions of Laennec's book on auscultation (1819) and Semmelweis's on puerperal fever (1861).

Eclipse of the Sun on April 19

AN annular eclipse of the sun, partly visible as a partial eclipse from the British Isles, occurs on April 19 next. The annular phase is visible in Alaska and the Arctic Ocean. At Greenwich, the eclipse begins at 17^h 29^m, the greatest phase (0.36) being reached at 18^h 18^m; sunset is at 19^h 2^m, just before the eclipse ends. The position angle of first contact is 298° from the north point of the sun's image or 258° from the vertex. At Edinburgh the corresponding times are: beginning 17^h 17^m; greatest phase (0.44) at 18^h 12^m; ending at 19^h 3^m. The above times are in Universal Time; add 1 h. to convert to Summer Time.

The Night Sky in April

THE moon is full on April 4 at 4.3^h and new on April 19 at 16.6^h. The altitude of the full moon at transit at Greenwich on April 5^d 0^h 43^m is 27½°. Lunar conjunctions with the planets occur as follows: on April 10 with Mars; on April 16 with Venus; on April 17 with Jupiter; and on April 18 with Mercury. On April 22, Venus is in conjunction with Jupiter, the geocentric separation of the planets being only 0.4°. The two planets rise, however, less than one hour before the sun. Mercury is at inferior conjunction with the sun on April 3 and is therefore not visible. Saturn is in conjunction on April 11 and likewise rises and sets with the sun. Mars still remains a morning star, rising about 1½^h in mid-April. The only bright stars occulted during the month are ϕ Ophiuchi (mag. 4.6) on April 8 at 2^h 2.9^m (reappearance) as seen from Greenwich, and 26 Geminorum (mag. 5.1) on April 24 at 22^h 12.1^m (disappearance). The Lyrid meteors, the radiant of which is near 104 Heroulis, are due at their maximum between April 19 and 22, but in some years they are nearly absent. All the above times are given in universal time (U.T.). Summer Time begins on April 16.

Announcements

MR. J. E. MONTGOMERY has been appointed secretary of the Institution of Mechanical Engineers in succession to Brigadier-General Magnus Mowat, who has retired on account of ill-health. Mr. Montgomery has been assistant secretary of the Institution since 1920.

THE Rockefeller Foundation has announced that during the next seven years it will grant a sum not exceeding £12,000 to the Imperial College of Science and Technology, South Kensington, for research on vitamins, sterols and related compounds under the direction of Prof. I. M. Heilbron.

AN Institute for Research in Aeronautical Medicine has recently been founded at Mount Fuji, Japan.

IN 1938 the number of deaths in France was 40,000 higher than the number of births, while in Italy the births exceeded the deaths by 424,000 and in Germany by 500,000.

THE University of Peiping, which was closed at an earlier stage of the Sino-Japanese War, has recently been reopened under the direction of Prof. Hisomu Nagat, formerly of the University of Formosa.

WE have received a part of the *Collection Scientifique* issued by the Institut Internationale de Coopération Intellectuelle (1938), entitled "Les déterminations physico-chimiques des poids moléculaires et atomiques des gaz", price 45 francs. The volume contains papers by Moles, Whytlaw-Gray, Cawood, Keesom and others, a long discussion and addenda.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 524.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Atomic Numbers of the So-called Transuranic Elements

We have recently had the opportunity of obtaining a very strong preparation of the so-called transuranic elements, which are precipitated with platinum as sulphide in acid solution, from roughly 100 grams of uranium, after an irradiation with the neutrons of ($^7\text{Li} + ^2\text{H}$) carried out for us in the Cavendish High-Voltage Laboratory. A deuteron current of 100 $\mu\text{a.}$ at 900 kv. was employed over a period of several hours, and the source of neutrons and the uranium were surrounded with a large amount of paraffin so that 'thermal' as well as fast neutrons were effective in the transformation.

The platinum precipitate, weighing less than 20 mgm., separated four days after the irradiation, was examined in a tube counter filled with xenon and alcohol vapour. The counter was fitted with a thin mica window at one end, and roughly 20,000 impulses per minute were recorded with the bare source 2 cm. from this window. When the β -particles were absorbed in graphite, roughly 425 impulses per minute remained. Absorption measurements using aluminium, copper and lead showed that, of these, more than a hundred impulses per minute were to be attributed to a quantum radiation in the ordinary X-ray region.

Further measurements were then made with thin foils of molybdenum (42), palladium (46), silver (47), cadmium (48), indium (49) and tin (50). In this range of elements, a large increase in transparency was observed between indium and tin; 30 mgm./cm.² of tin reduced the counting rate by 36 per minute, whereas the same mass per square centimetre of any of the other elements produced a diminution which was almost twice as great. The simplest interpretation of this result is that a quantum radiation of wave-length between 0.443 Å. and 0.424 Å., the wave-lengths corresponding to the K absorption energies of indium and tin, is emitted by the source. According to the tables of natural X-radiations, the $K\alpha$ -radiations of iodine alone lie in this interval of wave-length. Again, then, the simplest supposition to make is that the element iodine is, in fact, one of the bodies present in the platinum precipitate, being formed from tellurium by β -transformation.

According to previous results¹, our precipitate contained only the radioactive bodies of half-value periods 66 hr. and 2½ hr. respectively. We therefore investigated chemically the suggestion that these bodies are in reality isotopes of tellurium and iodine. Strong confirmation was obtained from the fact that we were able to concentrate the activity of shorter period in a precipitate of silver iodide. On the basis of these results, it is very unlikely that any of the active products hitherto separated with platinum from irradiated uranium is a true transuranic element;

rather must they all be regarded as originating in a similar process of nuclear fission to that in which the barium and lanthanum bodies have recently been shown to arise.

These results had been obtained when the *Physical Review* of February 15 was received in the laboratory. It is of interest to remark that Abelson² there records similar observations, made some time earlier than ours, and draws similar conclusions from his observations.

Cavendish Laboratory,
Cambridge.
March 9.

N. FEATHER.
E. BRETSCHER.

¹ Meitner, Hahn and Straßmann, *Z. Phys.*, 106, 210 (1937).

² Abelson, *Phys. Rev.*, 55, 418 (1939).

Transmutation of Uranium and Thorium by Neutrons

It has been shown by Hahn and Straßmann¹ that uranium bombarded by slow neutrons forms a radioactive noble gas. We repeated their experiments, using the very strong neutron source of the Philips X-Ray Laboratory. About 500 cm.³ of a saturated solution of uranyl nitrate was irradiated. Air was bubbled through the liquid at a rate of 600 cm.³ per minute, then it passed through a tube filled with cotton-wool (length 15 cm.) and through a wash-bottle containing 40 cm.³ of water with a small amount of nitric acid and one drop of ammonia. After adding caesium, rubidium, barium, strontium and lanthanum salts we obtained from the contents of this wash-bottle radioactive substances which could be precipitated together with caesium, rubidium and barium.

Caesium, precipitated after 15 minutes with antimony chloride dissolved in hydrochloric acid, showed periods of 10 minutes, 30 minutes and a longer period. Precipitating the caesium from the solution 45 minutes after the irradiation had been finished, we obtained the 30-minute period only.

Rubidium was obtained by precipitation with a saturated solution of sodium bitartrate, dissolving the precipitate in dilute hydrochloric acid and adding perchloric acid. Occasionally the precipitation of the bitartrate was repeated in order to remove traces of caesium. A period of 16 ± 2 minutes was found. As the decay curve has a shape quite different from that of the caesium precipitate (neither a shorter nor a longer period was observed), this activity cannot be ascribed to small amounts of caesium.

We looked for a short period in precipitates of the mixed alkali perchlorates prepared in a very short time. A period of 1-2 minutes was observed. We could not determine whether this activity is due to caesium or rubidium.

Barium, precipitated as a sulphate or as a chromate, showed a period of 87 ± 1 minutes. After prolonged irradiation a much longer period was also observed. No short period was found when the isolation was carried out within a few minutes. By varying the time of irradiation it was shown that the 87-minute period is not produced by the alkali with a period of 1-2 minutes. From the fact mentioned above that the 30-minute period in caesium is not accompanied by a longer period, it follows that the 87-minute activity does not arise from this caesium either. Therefore we conclude that the 87-minute period is produced by the 10-minute activity of caesium, which is in good agreement with the fact that in the caesium precipitate a period of approximately this half-value was observed.

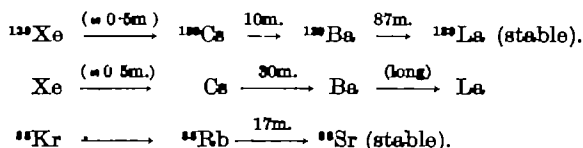
Strontium, which we freed from barium by treatment with chromate and precipitated as strontium sulphate, was found to be inactive after an irradiation of 100 minutes. Precipitates of mixed strontium and barium sulphates prepared in a very short time did not show any short-period activity.

In order to obtain a rough value for the half-life of xenon, we passed the air at a measured rate through two wash-bottles in succession. From the velocity of the air and a comparison of the activities of the caesium obtained from the two bottles, we calculated the average period of xenon effective in producing radio-caesium to be of the order of half a minute. From this experiment we were able to deduce the optimum air-flow.

From the presence of both caesium and rubidium in the wash-bottle, it follows that xenon as well as krypton escape from the uranium solution bombarded with slow neutrons. This indicates that the uranium nucleus may break up in different ways. Radio-xenon gives rise to at least two kinds of active caesium with periods of 10 minutes and 30 minutes. The caesium with the 10-minute period forms radio-barium with a half-life of 87 minutes. The longer barium period is probably produced from the caesium with a half-life of 30 minutes. We carefully compared the barium period of 87 minutes with that produced in barium by neutron capture and found them to be identical. Moreover, we compared the absorption curves of the beta-rays in aluminium as measured with two Geiger counters in coincidence arrangement. We found a perfect agreement.

Active krypton forms radio-rubidium with a period of 16 ± 2 minutes. Probably this period is due to the known radioactive rubidium isotope obtained from rubidium by neutron-capture. The half-life of the latter we found to be 17 ± 2 minutes. In this connexion, it may be mentioned that from uranium bombarded with neutrons Curie and Savitch¹ obtained precipitates of alkali salts showing a period of 18 minutes.

Based on the experiments described we suggest the following processes:



Corresponding experiments with a concentrated solution of thorium nitrate irradiated with the fast neutrons from a (Li + D) source also resulted in the production of a radioactive gas. Preliminary measure-

ments showed that at least three periods occur in the alkali precipitate. The precipitate of strontium and barium sulphates was found to be radioactive too.

In order to check our observations, we collected the radioactive atoms from uranium on filter-paper in a way analogous to that described by Joliot². The irradiations ranged from 15 minutes to 20 minutes. The filter was boiled in a solution containing caesium, rubidium, barium, strontium and lanthanum salts. The alkali perchlorates precipitated from this solution showed a short period of 1-2 minutes and at least one longer period. Barium chromate obtained from the solution showed periods of 12 ± 2 minutes and 87 minutes. The strontium proved to be active too.

We succeeded in measuring the 1-2 minute period more easily without a chemical separation by covering the filter paper with a layer of 4 mm. of aluminium.

It is interesting to observe that the 12 ± 2 minute period in barium was not obtained from the gas. This suggests that it may be formed together with krypton, unless it arises from a very short-lived xenon period or from caesium formed directly from uranium.

An attempt to activate uranium with the gamma-rays from lithium bombarded by protons gave no result. A search for electrons having an energy exceeding 10 Mev. during the irradiation of uranium with slow neutrons using two Geiger counters in coincidence arrangement was unsuccessful.

F. A. HEYN.

A. H. W. ATEN, JUN.

C. J. BAKKER.

Natuurkundig Laboratorium,
N. V. Philips' Gloeilampenfabrieken,
Eindhoven.
March 10.

¹ Hahn and Strassmann, *Nachrichten*, **37**, 80 (1939).

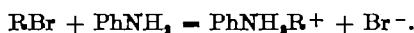
² Curie and Savitch, *C.R.*, **208**, 343 (1939).

³ Joliot, *C.R.*, **208**, 341 (1939).

Chemical Separation of Isomeric ⁸⁰Br Atoms

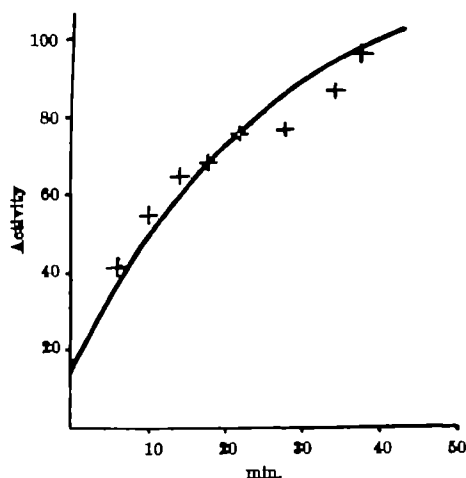
FOR rather more than a year, we have been studying the concentration of radiobromine by modifications of the method of Seillard and Chalmers¹, and have been using concentrates to follow the kinetics of exchange reactions between radiobromine ions and alkyl bromides. In the course of this work, we have encountered a number of puzzling phenomena which are now completely explained by the remarkable discovery made by Segrè, Halford and Seaborg² and DeVault and Libby³ that the isomer of ⁸⁰Br with a half-life of 4.5 hours decays by a γ -ray change to an isomeric ⁸⁰Br which emits β -rays with a half-life of 18 minutes. The recoil from the soft γ -ray emitted by the parent nucleus (and its internal conversion) has been found sufficient to break a chemical bond in the BrO_3^- anion or to activate the C-Br bond in *tert*-butyl bromide and facilitate the hydrolysis of this compound. These reactions have been used to separate the isobaric 18-min. product from its parent 4.5-hour isomer with which it was previously in radioactive equilibrium. The β -ray activity of the daughter isotope in the reaction product was found to decay with a half-life of 18 min., whilst the activity of the residual bromine in the original reaction increased with time as the equilibrium concentration of the 18-min. isomer was restored by decay of the parent.

The purpose of this note is to record some of our observations which confirm the results of the workers at Berkeley. We have found that the addition of a few per cent of aniline (other nitrogenous organic bases behave in a similar manner) to an organic bromide before irradiation with slow neutrons gives a large increase in the amount of radiobromine which can be extracted afterwards by water or aqueous acids. In this case it is the capture γ -rays which disrupt or activate the C-Br bond and facilitate the reaction



This reaction can also give a large separation of the ^{82}Br isomers, as the following experiment shows.

Pure ethylene dibromide was irradiated with slow neutrons (from 200 mgm. radium sulphate plus beryllium) for 15 hours. Five per cent of aniline was then added and the mixture shaken with water at intervals until five hours had elapsed. By this time all the 18 min. isomer originally present would have decayed. After a final wash, the β -ray activity of the specimen was followed for 45 min., with the result shown in the accompanying graph. The initial



activity found was largely due to ^{82}Br with a half-life of 36 hours; this was measured after the shorter lived products had completely decayed, and the data in the graph are corrected for this activity. If the separation of the ^{82}Br isomers were complete, the initial activity would be zero. The full line in the figure represents the calculated curve for 90 per cent separation: it will be seen that the reaction of salt formation with aniline gives a separation of this order of magnitude. The activity in the aqueous extract was found to decay with a half-life of 18 min.

In our kinetic studies alkyl bromides, notably *n*-butyl bromide, were allowed to interact with radioactive bromine ions in a solvent consisting of 90 per cent acetone and 10 per cent water. At the end of the reaction the alkyl bromide was separated by dropping a portion of the mixture into water and extracting with benzene. When working with bromine of which the activity was mainly that due to the 4.5 hour period, we have repeatedly found that the β -ray activity of the benzene solution increased 20 per cent or more during the first hour after washing with water, whilst a reference specimen of the acetone solution decayed normally. This effect was not observed during the study of slow reactions in which

the activity was measured after two to three days and was entirely due to ^{82}Br (36 hours). Hence the hydrolysis of *n*-butyl bromide under the conditions of our experiments also gives a considerable separation of the isomeric ^{82}Br atoms.

L. J. LE ROUX.
C. S. LU.
S. SUGDEN.

Sir William Ramsay and
Ralph Forster Laboratories,
University College,
London, W.C.1.

¹ Ballard and Chalmers, *NATURE*, **134**, 402 (1934).

² Segré, Halford and Seaborg, *Phys. Rev.*, **55**, 331 (1939)

³ DeVault and Libby, *Phys. Rev.*, **54**, 322 (1939).

Structure of Meteorites

Prof. E. A. Owen and R. W. Williams¹ have recently advanced a theory in which they account for the Widmanstätten figures in meteorites on the basis of their X-ray studies of iron-nickel alloys, natural and artificial. Their conclusions have been criticized by Prof. S. W. J. Smith and J. Young² on the grounds that only the surface of the meteorites is heated by passage through the earth's atmosphere. This criticism must not be allowed to detract from the merits of the experimental evidence given by Owen and Williams, which to a large extent receives confirmation from an investigation I have recently carried out with Mr. Goldschmidt.

X-ray powder photographs show that the iron-rich end of the nickel-iron equilibrium diagram must be completely redrawn. The areas of single phase and two-phase equilibria shown in the figure are based on the results of long periods of heat-treatment, and cannot be attained by cooling at the usual rates. Some idea of the times required even under the most favourable conditions is given by the time-scale attached to the diagram. Shorter times of annealing give entirely different results. There is not space here to give the evidence on which this diagram is based, or to explain its details. The purpose of this communication is to show how it affects the problem of the meteorites.

The new diagram confirms Owen's conclusion that suitable heat-treatment leads to the production of a two-phase structure in certain alloys. A typical meteoritic structure, which consists of a mixture of kamacite (body-centred cubic with 8 per cent of nickel) and taenite (face-centred cubic with about 26 per cent of nickel), is the equilibrium state at temperatures between 350° and 580° C. The existence of pleonite in some meteorites may perhaps be explained as due to sudden cooling from above 580° C., leading to a deformed body-centred cubic structure produced by a sudden breakdown of the face-centred cubic form, though other explanations are possible.

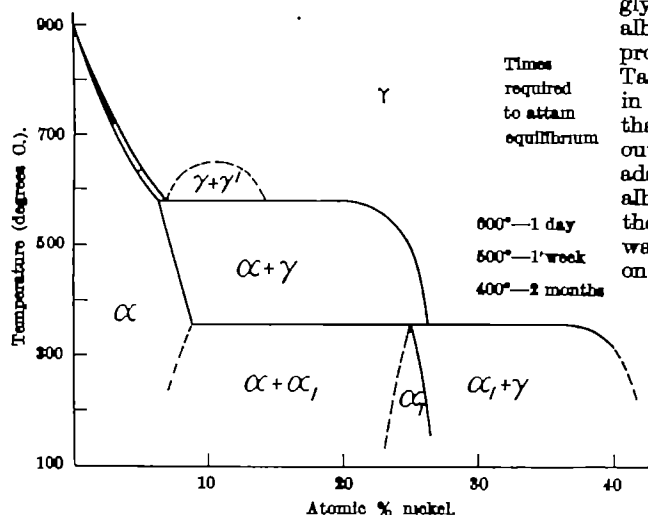
Up to this point Owen's results are confirmed. There are, however, two important features of his theory which require modification.

(1) It must be concluded from the criticisms advanced by Smith and Young that the heat-treatment by which the meteorites received their characteristic structure occurred before they reached the earth and was not substantially modified by passage through the earth's atmosphere.

(2) Our diagram indicates that a further transformation not mentioned by Owen occurs at 350° C. or thereabouts. The typical meteoritic structure is

only in equilibrium between 350° and 580° C., and not below 350° C. Such meteorites must therefore have received their heat-treatment above 350° C. They must have cooled too quickly for equilibrium conditions to be followed down to terrestrial temperatures; at such temperatures they are too sluggish for further changes to take place.

The $\alpha + \gamma$ structure formed in the temperature range between 350° and 580° C. requires a time of the order of months to break down when the temperature drops below 350° C. Breakdown takes place, for example, when the cooling rate is about 1° C. per day, not for more rapid rates. The transformation to $\alpha + \gamma$ at 580° C. is also slow, but not so slow as the lower transformation. At a cooling rate of 100° C. per day this reaction is just beginning to go. The conclusion seems to be that the meteorites have cooled at some intermediate rate, slow enough to permit the 580° C. change to take place, but too fast for the 350° C. transformation.



Before deciding when and where this cooling took place, it is important to consider another fact. A single cooling, though satisfactory for the production of small submicroscopic crystals such as are found in our experiments, would be totally inadequate to give the large crystals found in meteorites. It must be concluded that the process has been repeated thousands if not millions of times.

Is it possible that some meteorites were bodies in cometary orbits, and they have been heat-treated by approaching the sun and cooled by moving into the outer parts of the solar system? The cooling rate seems quite reasonable, the short time in which the meteor is near the sun being quite inadequate for the attainment of equilibrium below 350° C., though it may well be sufficient to promote crystal growth at higher temperatures. The meteorite is subjected to fresh heat-treatment every time it reaches the neighbourhood of the sun, but the most effective part of this treatment is that which takes place in the $\alpha + \gamma$ range; as the crystals grow, it becomes increasingly difficult for the 350° C. transformation to take effect.

This explanation is applicable to meteorites in which the tenite phase has a composition of about 26 per cent nickel. For example, the San Cristobal meteorite with 26.3 per cent of nickel is mostly

tenite with patches of plessite. The structure of other meteorites in which the tenite contains more nickel must have been produced in other ways. Prof. S. W. J. Smith and J. Young have recently described such a case¹.

A. J. BRADLEY.

Cavendish Laboratory,
Cambridge. Feb. 7.

¹ NATURE, 142, 909 (1938).

² NATURE, 142, 1102 (1938).

³ NATURE, 143, 334 (1939).

'Intraglobular' Reactions and the Cyclol Structure of Proteins

In order to explain the effect of a protein on a certain condensation reaction, Talmud¹ has proposed a hypothesis for 'intraglobular' reactions, based upon Wrinch's well-known theory² of protein structure. As an example, he showed that a considerable portion of 2-5-dioxopiperazin formed by condensation of glycine ethyl ester³ in an aqueous solution of egg albumin remains in solution associated with the protein, in excess of the normal solubility limit. Talmud suggests that the reaction has taken place in large part within the hollow cyclol globules, and that the reaction product is prevented from diffusing out owing to its molecular size. By independent adsorption experiments (on heat-denatured egg albumin at 0°) Talmud believes he has shown that the amount of dioxopiperazin remaining in solution was in excess of the amounts that could be adsorbed on the surfaces of the globular protein molecules.

We have measured the sedimentation constant and the diffusion constant of the egg albumin-dioxopiperazin complex in order to get an estimate of its size and shape. The sedimentation constant was measured both in the water-alcohol-dioxopiperazin medium formed by the reaction, and in a solution dialysed against 0.2 M sodium chloride. Within experimental errors, we always obtained the same value. The average was 3.62 (sedimentation constants are given in units of 10^{-13} ; diffusion constants in units of 10^{-7} throughout), which is a little higher than for ordinary egg albumin⁴ (3.55). This fact possibly indicates that the glycine ethyl ester has replaced some of the water bound to the molecule. The diffusion constant was found to be 6.6, as an average of three experiments. For ordinary egg albumin the value⁴ is 7.76. The reduction of the diffusion constant indicates an increase of the volume of the particle, probably by interaction between the glycine ester and the free amino or carboxyl groups on the surface of the protein molecule. According to Talmud's theory, there should be no change in the volume of the complex particle, because the dioxopiperazin molecules are retained inside the globule after the 'intraglobular' reaction.

Talmud found precipitation on prolonged dialysis against pure water, probably due to denaturation. We found no difficulty in dialysing against salt solutions. When dialysing against water, a small precipitate formed, but most of the complex remained in solution and showed the same sedimentation constant as before dialysis.

Our experiments seem to show that the egg albumin-dioxopiperazin complex can be considered as a chemical compound, in which glycine residues, $-\text{HN} \cdot \text{CH}_2 \cdot \text{COOH}$ or $-\text{CO} \cdot \text{CH}_2 \cdot \text{NH}_2$, are bound to the hydroxyl groups or the free amino groups of the

protein. One might also suppose that one glyceme molecule might be bound to another one already combined with the protein. It is not clear why such reactions should be slower than the formation of dioxopiperazin from glycine ethyl ester. The 'intra-globular' accumulation of dioxopiperazin molecules should have given a higher sedimentation constant (calculated from Talmud's figures, $s = 4.02$) than we found. Talmud assumed that the whole volume of the egg albumin molecule could be filled with dioxopiperazin molecules. This disregards the volume taken up by the protein itself. The space available for non-protein materials inside the presumed globule must be much less than the total volume of the protein globule. The low value found for the diffusion constant probably must be explained by outside bound groups. If one presumes the egg albumin molecule to be spherical (which is very nearly true) and the bound groups to be placed symmetrically around it, the reduction of the diffusion constant from 7.76 to 6.6 means an increase of about 60 per cent in the volume.

It is therefore obvious that Talmud's experiments cannot be taken as an experimental proof of Wrinn's hypothesis, although they may be of interest for the understanding of protein structure and protein synthesis.

NILS GRALÉN.

Institute of Physical Chemistry, THE SVEDBERG.
University, Uppsala.
Mar. 2.

¹ Talmud, D. L., *Compt. rend. Acad. Sci. U.R.S.S.*, **20**, 163 (1938). *Brit. Chem. and Physiol. Abstr.*, A, II, 42 (1939), and private communications.

² Wrinn, D. M., *Proc. Roy. Soc. A*, **100**, 50; A, **161**, 505 (1937); *Trans. Far. Soc.*, **33**, 1308 (1937); and several communications in NATURE.

³ Fischer, R., *Ber.*, **84**, 433, 2306 (1901).

⁴ Svedberg, T., *NATURE*, **130**, 1051 (1937); *Ind. and Eng. Chem., Anal. Ed.*, **10**, 113 (1938).

Spontaneous Coagulation of Rubber Latex

So early as 1913, Whitby advanced the view that spontaneous coagulation in rubber latex takes place before decomposition processes begin¹. Arguments against this view have since been advanced by several investigators, and the opinion at present generally held is that the coagulation of fresh latex is caused by formation of acid from the bacterial decomposition of the serum constituents.

Recent investigations made on latex of *Hevea brasiliensis* have provided confirmation of the view held by Whitby. Experiments were conducted throughout on latex obtained immediately after collection from the trees, which had been tapped three or four hours previously. The formation of ions from decomposition of latex was followed by conductivity measurements. The conductivity of latex did not change until coagulation was complete. This occurred 6–11 hours after collection of the latex, varying from sample to sample. The resistance of the conductivity cell increased after gel formation due to contact resistance on the electrodes.

The pH after coagulation (measured by Lyphan indicator strip) was only 0.2 lower than the average original figure of about 6.4. Decreasing the pH below 6 by the addition of phthalate-KOH buffer solutions had no effect on the rate of coagulation of the samples. After coagulation decomposition of latex constituents proceeds; but this bears no relation to the process of coagulation which is already complete.

Further support of Whitby's view was provided when strong antiseptics preventing bacterial decomposition were added to fresh latex without preventing spontaneous coagulation. The addition of 0.3 and 0.4 per cent sodium pentachlorophenate had no influence on the behaviour of latex as described. No decomposition nor any change in the pH value of 7 could be found in coagulated samples which were measured over a period of 3–8 weeks.

The exact nature of this process of coagulation is not known; enzymatic action on proteins may, however, be put forward as an explanation.

PAUL STAMBERGER.

Malaya:

Jan. 19.

¹ *Koll. Z.*, **12**, 151 (1913).

Demonstration of the Participation of Free Radicals in the Rearrangement of Benzyl Phenyl Ether

It has been shown previously¹ that when benzyl phenyl ether is heated in quinoline at about 250°, the normal rearrangement of the ether to *o*- and *p*-benzyl phenols is accompanied by the formation of benzylquinolines and of toluene. It is now found that hydroxyphenyl quinolines are also products of this reaction, and that it is possible, by a careful control of the experimental conditions, to increase very considerably the yields of benzylquinolines and hydroxyphenyl quinolines at the expense of the normal products of the rearrangement.

This new evidence strongly supports the contention that the preliminary phase of the reaction is a dissociation of benzyl phenyl ether into benzyl and phenoxy groups. As both these groupings are found to attack the same positions in the quinoline nucleus, it seems unlikely that they react as ions having opposite charges. This result is consistent only with the view that the reactive centres of both groups are in the same electronic state². This can only occur if the ether dissociates into free radicals.

This conclusion does not require the assumption of any special reaction of free radicals, except their ability to replace the hydrogen of the aromatic nucleus; it is based on experimental evidence which is considered to afford an independent and reasonably satisfactory demonstration of the existence of free radicals of short life in solution.

An extension of this investigation to other rearrangements is now in progress.

W. J. HICKINBOTTOM.

Department of Chemistry,
University,
Birmingham.

¹ Hickinbottom, *NATURE*, **142**, 830 (1938).

² Bradley and Robinson, *J. Chem. Soc.*, 1254 (1932).

A Fluoride with Pyrochlore Structure

THE formula of the rare mineral rastonite is usually written $(\text{Na}, \text{Mg})\text{F}_3 \cdot 3\text{Al}(\text{F}, \text{OH}) \cdot 2\text{H}_2\text{O}$. This implies a replacement of Na by Mg . X-ray investigation of this mineral shows that it belongs to the space-group $\text{O}_h^1 - \text{Fd}3m$ and that the edge of the unit cube has a length of 9.87 Å. By recalculation from the best available analysis (Penfield and Harper, 1886), it can be shown that a unit cube contains on the average 48 (F, OH), 16 (Al, Mg), 2.7 Na and 7 H_2O . The structure is similar to that

of the pyrochlore group (type $E 8_1$) for which the formula $X_2Z_2(O,OH,F)$, has been written. In the case of ralstonite the X position (16c) is only partly filled by 2.7 Na. Water partly fills the 8b position which is occupied by O, OH or F in minerals of the pyrochlore group.

Ralstonite may be dehydrated without destruction of the crystal lattice.

A. PABST

(Fellow of the John Simon
Guggenheim Memorial Foundation,
University of California, Berkeley).

Mineralogisches Institut,
Tübingen.
Feb. 12.

A Visual Phenomenon

MR. DARTNALL¹ has recently described an interesting visual phenomenon which, as has been pointed out by Mr. Wright², is connected with the after-images of different colours possessing different rates of development. A visual phenomenon possibly connected with this differential rate of development came to my notice some time ago, and no doubt must have been observed by others as well. A stroboscopic disk painted in black and white sectors is run under illumination from an (ordinary) Osram neon lamp connected to a.c. supply (80 cycles). At speeds such that the pattern is not stationary but somewhat shifting, the white sectors appear to be distinctly coloured (rainbow type)—one edge pink and the other green. The same effect is seen, though not so clearly, when the neon lamp is replaced by an ordinary incandescent lamp, provided the illumination is not high.

THAKUR SINGH.

Physics Department,
University,
Delhi.
Feb. 2.

¹ NATURE, 142, 1000 (1938).

² NATURE, 142, 1136 (1938).

Changes in the Water-Content of Organs and Tissues as a Result of Stimulation by Oestradiol

APART from its specific property of stimulating proliferation in the reproductive tract and in certain other tissues of the body, oestrogenic hormone has the more general effect of causing water and salt retention. This was clearly demonstrated in the follicular phase of the menstrual cycle in the pig-tailed monkey¹ and baboons², and in rhesus monkeys which had been injected with oestrogenic hormone^{3,4}. In these animals, water-retention is most obviously related to swelling of the sexual skin, and it may be associated with a marked shift of body water (as shown, for example, by changes in erythrocyte concentration)^{3,4}. Study of the renal excretion of electrolytes has shown that water-retention also occurs in male dogs after treatment with oestrogenic substances⁵, while more recently Astwood⁶ has reported that the water-content of the uterus of the rat undergoes a transient rise which reaches its peak six hours after a single injection of oestrogenic hormone, returning to normal about twelve hours after the injection.

A further study of immature rats shows that

oestrogenic stimulation causes a rapid change in water-content not only in the reproductive tract but also in most organs and tissues.

Estimations of the water-content of nine selected tissues were made at six-hourly intervals after the subcutaneous injection of 0.1 γ of oestradiol in 0.1 c.c. of oil. Water-content was determined by comparing the weight of the fresh tissues with their weight after desiccation in an oven at 110° C. Ten rats were used for each six-hourly reading.

The tissues were divided by their responses into two clearly defined groups, the first being made up of the skin, uterus and vagina, and the second of striated muscle, heart, pancreas, brain and gut.

Water-content in the first group of tissues reached a high level by the end of the first six hours. It then fell (in the case of the skin and vagina to a lower level than normal) and remained down until the twenty-fourth hour, when it rose again to remain at a high level until the sixty-sixth hour. By the seventy-second hour, it had either resumed its normal level or fallen below it.

The changes in the second group of tissues (striated muscle, heart, brain, pancreas, gut) were in a sense reciprocal to those in the first. In the first twelve hours after injection, water-content either fell or remained unaffected. It rose to a level above normal during the period (twelfth to thirtieth hours) in which the water-content of the first group of tissues was low. It then decreased and reached a minimum about the middle of the second and more prolonged period in which the water-content of the reproductive tissues and skin was high. At the end of this period it underwent a sharp transient rise, before reaching its normal level, or a lower level than normal, at the seventy-second hour. Corresponding observations have been made on normal and castrated male rats injected with oestradiol, as well as on normal mice in oestrus and in dioestrus, the latter observations showing that cyclical changes normally occur in the water-content of the tissues referred to above.

These findings show that oestrogenic stimulation causes a much more widely spread change in the body than has been suspected hitherto. In the case of the skin, the total amount of water-shift amounts to almost one per cent of the total body-weight (estimation based on tables provided by Donaldson⁷). A change of this kind and magnitude cannot be regarded as secondary to changes in water-concentration occurring primarily in the reproductive tract, and presumably, therefore, oestrogenic stimulation has a direct effect on the water-content of many, if not of all, tissues.

In so far as oestrogenic substances lead to water- and salt-retention, they behave like the chemically related substances progesterone and testosterone, as well as like desoxycorticosterone. This general property of the sterol hormones does not, however, imply a similarity of action. Thus nitrogen-retention is associated with the water- and salt-retention stimulated by oestrogenic and androgenic substances, whereas it does not occur as a result of the action of progesterone and desoxycorticosterone⁸. Furthermore, it has been shown that the excretion of water which has accumulated in the sexual skin of monkeys under the influence of oestrogenic stimulation cannot be prevented by the administration of progesterone, testosterone, or cortin⁹. Preliminary observations on the effect of these substances on female and male rats, made in the course of the present study, suggest

that, while changes in water-content occur in all the tissues studied (the changes being especially pronounced in the skin), their character and time-relations are not the same as those which occur after oestrogenic stimulation.

S. ZUCKERMAN.

A. PALMER.

(Rockefeller Research Fellow.)

G. BOURNE.

(Beit Memorial Research Fellow.)

Department of Human Anatomy,
Oxford.

March 2.

¹ Krohn, P. L., and Zuckerman, S., *J. Physiol.*, **86**, 269 (1937).

² Fisher, R. B., and Zuckerman, S., *J. Physiol.*, **89**, 15P. (*Proc.*, Dec. 12, 1936).

³ Guthkelch, A. N., and Zuckerman, S., *J. Physiol.*, **81**, 200 (1937).

⁴ Clarke, R. W., *Amer. J. Physiol.*, **133**, 39 (1938).

⁵ Thorne, G. W., and Engel, L. L., *J. Exp. Med.*, **68**, 299 (1938).

⁶ Astwood, H. B., *Endocrinology*, **23**, 25 (1938).

⁷ Donaldson, H. H., "The Bat" (Philadelphia, 1924).

⁸ Zuckerman, S., *J. Physiol.*, **94**, 5P. (1938).

A Humoral Transmission of Muscular Contraction in the Presence of Veratrine

THE hind limbs of a Hungarian frog are perfused with veratrine 1/50,000 in Ringer's solution. The liquid collected from the vein perfuses a second, similar Trendelenburg's preparation. Direct tetanic stimulation of the hind limbs of the first frog is followed, after a latent period of about 10 minutes, by an irregular contraction of the perfused muscles of the second frog. It is thus possible to demonstrate a humoral transmission of the contraction in the presence of veratrine.

This effect is not due to acetylcholine, because (1) veratrine has no anticholinesterase action (Bacq and Brown), and (2) the transmission is still demonstrable in the presence of curare.

We think that the substance responsible for the effect is the K ion, because (1) veratrine, even in 1×10^{-6} solution, greatly sensitizes frog's muscle to the action of K^+ , and (2) the addition of a small amount of potassium chloride (0.5 mgm.) to an inactive perfusate (2.5 c.c.), collected in absence of stimulation, reproduces perfectly the action of a 'stimulation' perfusate. This quantity of potassium can actually be liberated during a tetanic contraction.

A. SZENT-GYÖRGYI.

Z. M. BACQ.

M. GOFFART.

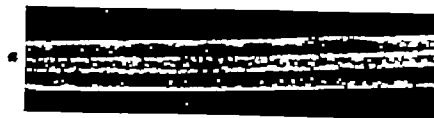
Chaire Francqui,
Institut L. Fredericq,
Liège.

Role of Fungi and Actinomycetes in the Decomposition of Cellulose

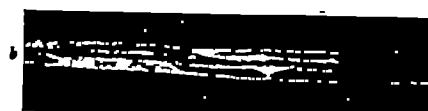
WAXSMAN¹ has recently demonstrated, by cultural methods, the important role of fungi and actinomycetes in the breakdown of plant tissues in composts and dunghills. The details of the process, however, were not directly observed. I have previously^{2,3} described methods, involving the use of polarized light, for the direct microscopical observation of the cytolastic process in the caecum and rumen of herbivora. These methods have since been applied to the study of the decomposition of vegetable materials in animal faeces, composts and dunghills. The role of Fungi and Actinomycetes in the breakdown of cellulose thereby immediately became conspicuous. Disintegration of the cell-wall constituents was directly evidenced by loss of double-refraction and by

disappearance of microchemical reaction in the affected structures.

The characteristic features which attend the excision of enzymatic cavities by fungi have been described by Bailey⁴; so that it is possible readily to distinguish the changes taking place from those produced by bacteria.



(a) Prosenchymatous fibre invaded by mycelium. Note destruction of secondary and persistence of primary and tertiary layers of wall. Polarized light. Crossed Nicols. $\times 400$. Composted material.



(b) Plant hair, late phase of attack. Note formation of conical and bloom-like enzymatic cavities (cf. Bailey⁵). On right, complete dissolution of secondary wall. Primary wall still intact. Tertiary wall in process of disintegration. Crossed Nicols. $\times 400$. Horse faeces *in vitro*. 2 months.

(c) Another portion of same hair. Earlier phase of attack. Breakdown of channels by fungus filaments. The advancing tip of a hypha can be clearly seen slightly right of centre. Crossed Nicols. $\times 400$. Horse faeces *in vitro*. 2 months.



(d) Enzymatic cavity in hair. Polarized light. Note entire loss of double-refraction $\times 600$.

(e) Identical specimen plus chloroform. Note absence of microchemical reaction in the enzymatic cavity. In both d and e the relative immunity of primary and tertiary layers can again be observed.

DISINTEGRATION OF CELLULOSE IN ANIMAL FAECES AND COMPOSTS.

Details of the process of infection and attack are now under investigation. Abundant infection of the lumen can commonly be demonstrated in prosenchymatous tissues. Rigid unbranched and extremely attenuated hyphae are there formed which from point-to-point penetrate the tertiary layer of the wall through fine rectilinear channels. In the secondary layer these hyphae expand and branch repeatedly; their proliferation being accompanied by an active excision of enzymatic cavities. The disorganization of the tertiary layer, on the contrary, is delayed until a later phase in the process; whilst the primary layer may in some cases entirely resist destruction. This resistance is due to the impregnation of the cellulose substratum by encrusting

substances the presence of which can be demonstrated by extraction with solvents and by microchemical reactions. In this way it can be shown that the cytotoxic process may be highly selective; and that the changes occurring, for example in composts, may bear reference to the balance of cell-wall constituents in the materials employed.

The accompanying photomicrographs illustrate some of the salient features in the changes described above.

14 Applegarth Road,
Brook Green, W.14.
Jan. 30.

FRANK BAKER.

¹ Wakeman, S. A., Umbreit, W. W., and Gordon, T. C., "Thermophilic Actinomyces and Fungi in Soils and Composts", *Soil Science*, 47, 37 (1939).

² Baker, F., and Martin, R., "Disintegration of Cell-Wall Substances in the Gastro-Intestinal Tract of Herbivora" (with references to previous publications, 1931-1937), *NATURE*, 141, 877 (1938).

³ Baker, F., and Martin, R., "Studies in the Microbiology of the Caecum of the Horse", *J. Bakt.*, Abt. II, 99 (1939).

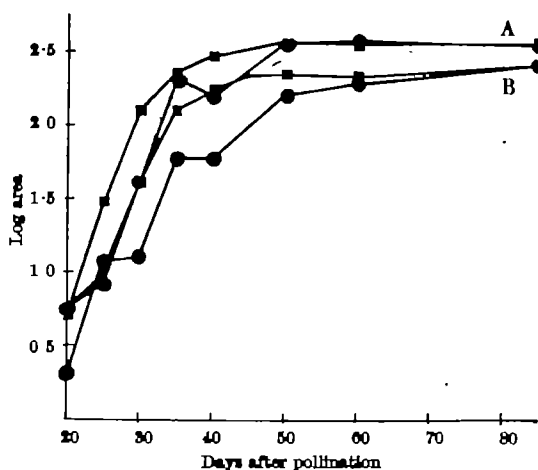
⁴ Bailey, I. W., and Vestal, M. R., "The Significance of Certain Wood-destroying Fungi in the Barymatic Hydrolysis of Cellulose", *J. Arnold Arboretum*, 18, 196 (1937).

Hybrid Vigour in the Tomato

THE vigorous growth of hybrids between closely related varieties has been widely observed, and for several years the phenomenon has received the attention of geneticists. Investigations have also been made on the physiology of hybrid vigour (heterosis). Ashby¹ and Luckwill² have shown that in the tomato heterosis is manifested at an early stage in the life-history, between fertilization and seed ripening, so that the ripe hybrid seed, resulting from cross-pollination, is larger and heavier than that of the parent strain. In a recent experiment a different result has been obtained, and the causes of this contradiction have been investigated.

Two lines of tomato (105 and 107) were crossed in both directions and also *artificially* self-pollinated. Fruits were killed and fixed at different times after pollination and the seeds and embryos measured. If the development of the hybrid embryo is compared with that of the selfed maternal parent, it is found that in each case the hybrid embryo is significantly larger in the earlier stages of development, but that this initial advantage is not maintained. In the ripe fruit the hybrid embryo is the same size as the embryo of the selfed maternal parent. This is illustrated in the accompanying graph. The final size of the reciprocal hybrid embryos, which are of identical genetic constitution, is significantly different, and is evidently determined by the maternal parent. The final size of a hybrid embryo is thus no criterion of the degree of heterosis. The results for the size of the whole seed were exactly similar, and this agrees with the fact that, in the tomato, seed size and embryo size are highly correlated.

The relation of the embryo to the fruit is a double one. Development of fruit and size attained depend on the presence of growing embryos: but the size of seeds is also determined or limited by the nutritive supplies from the fruit. In this investigation of the tomato it was found that 'fruit weight' was highly correlated with 'seed number' (0.735 ± 0.041) and this confirms the first relation. Also 'mean seed weight' was directly correlated with 'fruit weight/seed number', that is, 'fruit weight per seed' (0.580 ± 0.061). This illustrates the second. It may be said, therefore, that the 'mean seed weight'



MATERNAL INFLUENCE ON EMBRYO DEVELOPMENT.

A. 107 and (107 × 105). B. 105 and (105 × 107).

● Parent embryos; ■ hybrid embryos.

is determined primarily by the number of seeds which chance to develop in a fruit.

In a further experiment with the tomato, the seeds of hybrids were compared with those of the selfed parent, the more usual technique of allowing self-pollination to take place *naturally* being employed. In the hybrids (*artificially* pollinated) the seed number was lower and the value of fruit weight/seed number much higher. The mean seed weight of the hybrid was greater than that of the selfed parent. Data are given in the following table.

	Parent 107 Natural pollination	Hybrid 107 × 105 Artificial pollination	Ratio hybrid parent
Mean seed No.	207	143	
Mean fruit wt. per seed	0.564	0.702	1.27
Mean seed wt. (mgm.)	3.065	3.866	1.27

This is the result obtained by Ashby and Luckwill. It is clear, however, that the greater seed size is not due to heterosis, but to the fact that fewer seeds developed in the hybrid than in the naturally selfed—and therefore more efficiently pollinated—parent. In the embryo development experiment first quoted, where all the progeny were the result of artificial—less efficient—pollination, there is no difference between the seed size of the hybrid and that of the maternal parent.

EDWIN S. J. HATCHER.

Department of Botany,
The University,
Bristol, 8. Feb. 8.

¹ Ashby, *Ann. Bot.*, n.s., 1 (1937).

² Luckwill, *Ann. Bot.*, n.s., 1 (1937).

A Gold Sol Test for Bovine Mastitis

ERADICATION of bovine mastitis is one of the major problems confronting dairy research, and the solution of the problem depends to a large extent on trustworthy methods for detecting udder infections, particularly of the sub-clinical type. Many tests have been proposed, but none appears to compare in reliability with the method of isolating the causative micro-organisms by plating on selected media.

A promising chemical test was recently put forward by Rowland¹ in which the characteristic changes in the percentage distribution of the milk proteins are utilized. Rowland showed that even in sub-clinical mastitis the percentage of casein-nitrogen falls below the normal level. This loss in casein is primarily out-balanced by a rise in globulin, and this suggested the possibilities of working out a method similar to Lange's gold test for cerebrospinal fluid, a test which is largely bound up with pathological changes in the globulin content of this body liquid. Owing to the predominance of casein, no characteristic results could be obtained with whole milk, but a sensitive test was procured with casein-free milk serum prepared in the manner described by Rowland and titrated back with sodium hydroxide, using methyl red as indicator, to a pH in the region of 6.0-6.5. When 5 ml. of a red gold sol prepared in accordance with Lange's directions are mixed with 1 ml. of this serum, the colour of the gold sol remains unaffected by sera from milk of healthy individual cows or quarters,

but turns instantaneously to violet or blue in the case of even slight infection of the udder.

The results so far of this simple and rapid test seem to correlate particularly closely with the bacteriological findings regarding the presence or absence of mastitis-producing organisms in the milk. Experiments with dilution series suggest that the correlation between globulin content or globulin/albumin ratio and the intensity of the colour changes is not of a simple nature, and preliminary investigations indicate that the proteose-peptone fraction of nitrogenous compounds of the milk also participates in the reaction.

A detailed study of all the factors involved is now in progress.

R. ASCHAFFENBURG.

National Institute for Research
in Dairying,
University of Reading.
Feb. 28.

¹ *J. Dairy Res.*, 9, 47, 174 (1938).

Points from Foregoing Letters

By isolation of the natural *K* X-radiation, and also by chemical tests, it has been shown by N. Feather and E. Bretscher that an isotope of iodine is one of the active products formed by the action of neutrons on uranium, and previously regarded as belonging to a series of transuranic elements.

The formation of radioactive noble gases during the irradiation of uranium with slow neutrons has been studied by F. A. Heyn, A. H. W. Aten jun., and C. J. Bakker. It is shown that the nucleus can be split in different ways, giving rise to either krypton or xenon. Several decay products of these gases are observed. Bombarded with fast neutrons, thorium also is found to form noble gases too.

L. J. le Roux, C. S. Lu and S. Sugden record experiments in which two further reactions (the condensation of alkyl bromides with aniline and the hydrolysis of *n*-butyl bromide) have been used to separate the isomeric ⁸²Br nuclei. These results confirm the discovery of Segrè, Halford and Seaborg and of DeVault and Libby that the ⁸²Br nucleus of period 4.5 hour decays by a γ -ray change to give the isomeric ⁸²Br nucleus of period 18 minutes.

On the basis of X-ray experiments on iron-nickel alloys, A. J. Bradley offers a new explanation of the structure of some meteorites. These bodies may consist of a mixture of large α - and γ -crystals, corresponding to a state of equilibrium at some temperature between 360° and 580° C. It is suggested that they have gradually assumed this state while in the neighbourhood of the sun, which they encircle in a cometary orbit.

N. Gralén and The Svedberg state that sedimentation and diffusion experiments show that the hypothesis proposed by Talmud for 'intraglobular' reactions based upon Wrinch's theory of protein structure cannot explain the formation of a complex between egg albumin and glycine ethyl ester. It is suggested that the complex can be considered as a chemical compound, and with the glycine residues bound on the outside of the protein molecule.

P. Stamberger finds that the coagulation of rubber latex from *Hevea brasiliensis* takes place 6-11 hours

after collection, before decomposition processes have set in. No change in electrical conductivity could be observed during that period. The coagulation is apparently due to the action of enzymes on the protecting proteins.

W. J. Hickinbottom reports that a study of the isomerisation of benzyl phenyl ether in quinoline solution has yielded results which demonstrate that the isomerisation is preceded by an initial fission of the ether into free radicals.

X-ray investigation of the fluoride-containing mineral rastonite shows, according to A. Pabst, that it has a structure similar to that found in the pyrochlore group.

Oestradiol produces in immature rats changes in the water content of most organs and tissues, according to experiments by S. Zuckerman, A. Palmer and G. Bourne. The skin, uterus and vagina show an increase in the water content in the first six hours, then a fall until the 24th hour, and then again an increase until the 66th hour. The water content of the striated muscle, heart, pancreas, brain and gut, on the other hand, changes mainly in the opposite way from that described above.

The fungal disorganization of plant residues in dung and composts has been studied by F. Baker by direct microscopical observation in polarized light. Characteristic disintegration patterns are illustrated. Fungal attack originates in the lumen of fibres, fine hyphae penetrating the tertiary and proliferating in the secondary layer of the wall. The primary layer remains immune from attack.

Some experiments described by E. S. J. Hatcher show that the large hybrid seeds and embryos obtained by crossing two inbred strains of tomato are not the direct expression of hybrid vigour. They are the effect of reduced competition between fewer seeds which are produced by artificial and therefore less efficient pollination.

A new test for bovine mastitis based on a reaction between casein-free milk serum and solutions of colloidal gold is outlined by R. Aschaffenburg.

Research Items

Sarcee Indians of Alberta

As little has been published about the Sarcee Indians, the National Museum of Canada sent Diamond Jenness to a reserve near Calgary to study their old customs and beliefs. The material gathered has now been embodied in a report of the Canadian Department of Mines and Resources (*Bull.*, No. 90, *Anthropol. Ser.* 23, 1938). Though frequently mentioned by European explorers of the eighteenth century, the Sarcee did not become regular visitors to any trading post until the last decade of that century. In the inter-tribal warfare of the earlier nineteenth century, the Sarcee, being one of the weaker tribes, joined themselves to the Blackfoot Confederacy. Throughout the nineteenth century, they suffered much from the effects both of warfare and epidemics, so that by 1924 the number on the reserve had been reduced to 180 individuals only. In physique, mentality and customs they seem scarcely distinguishable from Blackfoot Indians; but they have retained an Athapascan tongue. They were a democratic people, who did not countenance hereditary distinctions of caste or rank. They were divided into bands containing a number of closely related families, that usually hunted together and always camped as a unit when the tribe was united. Girls belonged to their mother's bands; boys above the age of nine or ten years to that of the father, though still retaining close contact with their mother's band. The bands seem to have been very fluid, constant neither in number nor composition. Each band had its leader, who was not elected, but was recognized by common consent because of his prestige. Although he possessed no formal authority, his advice and instructions were rarely disobeyed. Separate from the bands and cutting across them were five societies or clubs, to one or more of which every male Sarcee belonged at some time or other. Each society held an annual four days' dance, being dormant for the rest of the year.

Androgens and the Ovary

M. Mazer and C. Mazer (*Endocrinology*, 24, 175; 1939) have found that, in the immature rat, prolonged administration of the androgen testosterone propionate caused a decrease in the weight of the pituitary, adrenals, ovaries and uterine horns and inhibition of oestrus with mucification of the vaginal epithelium. The degree of uterine atrophy was not in proportion to the ovarian atrophy, probably because the suppression of oestrogen production was partly counterbalanced by the direct stimulative effect of testosterone on the uterus. The adult rat reacted similarly except that the pituitary gland showed no significant decrease in weight. The deleterious effect of prolonged testosterone treatment on the ovaries was temporary. Restitution of structure and function occurred within 20 days. The literature and the authors' experiments showed that the duration of treatment was the determining factor in the effect of testosterone on the ovaries; short treatment produced stimulation and prolonged treatment depression. The ovarian atrophy, in the authors' opinion, was secondary to pituitary inhibition.

Glucose Excretion in Diabetic Dogs

P. Govaerts and P. Muller (*J. Clin. Invest.*, 18, 25; 1939) have investigated the excretion of glucose and creatinine in dogs made diabetic by pancreatectomy. The creatinine clearance being considered as a measure of the glomerular filtration and the glucose concentration of the arterial plasma as equal to the concentration of this substance in the glomerular filtrate, the quantity of glucose which the tubular cells reabsorbed from 1 c.c. of glomerular filtrate could be calculated. This figure was called the 'threshold'. When the blood-sugar concentration increased moderately, this threshold increased, and with further elevation soon reached a maximal value which remained constant for any higher level of glycaemia. In the diabetic dog at high levels of hyperglycaemia, a constant part of the filtered glucose saturated the reabsorptive power of the tubular cells, and the remainder was completely excreted as in a phlorizinized dog. These characteristics of the renal function did not change appreciably in the diabetic dogs during a period of observation lasting several months.

A Fossil Whale from Australia

In the older Tertiary rocks at Torquay, Victoria, B. G. Pritchard and his assistants discovered and collected from a cliff face the greater part of the skull of a zeuglodon whale, described as belonging to a new genus *Mammalodon* (*Victorian Nat.*, 55, 151; Jan. 1939). Various discoveries of fossil whale remains, consisting mostly of teeth, have been made in the Tertiary deposits of Australia since McCoy's first record of *Squalodon* or *Phocodon* from the Miocene of Cape Otway in 1864. But the present find differs from them in the small size and delicate build of the skull and of the teeth and their cusps. Dr. Pritchard considers it to be a very early type of Tertiary whale, "showing the closest approach to descent from a mammalian type of ancestor". The age of the rocks from which it was recovered is a matter of controversy, for they have been attributed to various periods ranging from Miocene to Eocene, but the author favours their Eocene origin.

Reproductive Organs of the Silk Worm Moth

SHINOSUKE ÔMURA has recently issued a notable paper on this subject (*J. Fac. Agric. Hokkaido Imp. Univ.*, 40, Pt. 3; 1938). In so far as the female organs are concerned, the work is directed to tracing the whole history of the spermatozoa from when they are discharged into the bursa copulatrix. It appears that the spermatophore, ejected by a male, occupies the greater part of the cavity of the bursa. Several hours after ejaculation, the spermatozoa fill the receptaculum seminis. They enter the ductus seminalis by their own motility, while their passage along this duct is aided by means of peristaltic movement of its muscular walls. About thirty minutes after mating, spermatozoa were appearing in the receptaculum seminis. The author claims that the sperms enter the receptaculum by its duct, the so-called ductus tortuosus. On the other hand, when they leave the receptaculum, to fertilize the eggs, he states that

they pass down the hitherto unrecognized canaliculus fecundans. Each egg, in its passage to the exterior, passes in such a manner that its micropyle is opposite the opening of the canaliculus into the vestibulum, and in this way becomes fertilized. The average time for laying each egg is only 6.7 sec. As regards the male organs, Omura points out that the ductus ejaculatorius of most authors is divided into three parts, namely, glandula spermatophora, glandula alba and glandula prostatica. The histology of the different parts of the male reproductive system is described and figured while the functions are discussed in some detail. The mechanism of ejaculation, and of spermatophore formation in the bursa of the female moth, is also described. The author claims that the secretion of the glandula prostatica is necessary for the proper functional activity of the sperms. The translocation of the spermatozoa from the testis into the post-testicular parts takes place, it appears, some four days before the moth emerges from the pupa.

Genetics in the U.S.S.R.

In February 1938, a conference on interspecific and intergeneric hybridization, arranged by the Institute of Genetics, was held at the U.S.S.R. Academy of Sciences at Moscow. A hundred and fifty scientific men took part, and more than forty papers were read. Profs. Vavilov, Kostoff and Lusa gave critical surveys of the present-day knowledge of distant hybridization and its importance in the improvement of plants and animals and to a better understanding of evolution. Reports were also made of work on hybridization in cereals, tobacco, fruits, forage crops and potatoes. Work on the crossing of various species of *Agropyron* with wheat, on the artificial induction of amphidiploidy (that is, of chromosome doubling in hybrids) and the genetics of animals was also considered. The proceedings of the conference have recently been published (*Bull. Acad. Sci. U.R.S.S., Ser. Biol., Nos. 3 and 4. Summaries in English*).

Organic Compounds Toxic to Fruit Pests

Two types of winter wash are necessary for fruit trees. Tar distillates are toxic to the eggs of aphides and apple sucker, but have little effect on those of capsid or red spider. Petroleum oils, on the other hand, are toxic to eggs of red spider and capsids, but not to those of aphides and apple sucker. H. Shaw and W. Steer (*J. Pom. and Hort. Sci., 16, 364; 1939*), in attempting to find a single substance toxic to both these groups, have investigated the ovicidal properties of 44 organic compounds consisting of di-nitrophenols, thiocyanates, naphthalene derivatives and organic bases. As a result of field and laboratory tests on eggs of the vapourer moth (*Orgyia antiqua*), the green apple aphid (*Aphis pomi*), the winter moth (*Operophtera brumata*), red spider (*Oligonychus ulmi*) and apple sucker (*Psyllia mali*), a large proportion of the materials tested was eliminated as showing little promise as winter ovicides. These included all but two of the thiocyanates, the naphthalene derivatives, and the bases other than nicotine and some of the quinoline and iso-quinoline compounds. The materials regarded as worthy of extended trial were 3:5 dinitro-cresol, *n*-dodecyl-thiocyanate (lauryl rhodanate), β -butoxy- β 'thiocyano-diethyl ether and nicotine. All these are suitable for use as supplements for winter petroleum washes. The authors discuss the mechanism of the

toxicity of nicotine in some detail, and favour the view that it penetrates the egg shell and interferes with the development of the embryo.

Soil Decomposition of a Plant Pathogen

SEVERAL fungi which attack plants from the soil disappear when the host is not grown for a certain period. S. D. Garrett, of Rothamsted Experimental Station, has made a study of this action with *Ophiobolus graminis*, the fungus causing 'take-all' disease of wheat (*Ann. App. Biol., 25, No. 4, 742; 1938*). The fungus apparently disappears as a result of natural decomposition by other micro-organisms of the soil. It will remain alive indefinitely in air-dry soil, at low temperatures of 2-3° C., and under sterile conditions. Decay of *Ophiobolus* mycelium is quickest when conditions are such that the normal micro-flora of the soil is greatest. Addition to the soil of energy materials lacking nitrogen, such as glucose or starch, hastens the destruction of mycelium, whilst dried blood, with readily available nitrogen, has the opposite effect. Soil conditions which are least favourable for the parasitism of *O. graminis* may, in fact, best preserve the organism during the non-pathogenic phase.

Proteins and Viruses

PROTEINS which possess the active principle of plant viruses have been isolated by W. M. Stanley and by F. O. Bawden and N. W. Pirie from diseased hosts. Hideo Moriyama and Shunkichi Ôhashi have studied the properties of certain proteins precipitated from healthy plants, and compared them with virus proteins (*J. Shanghai Sci. Inst. (Sect. 4), 4, 17; 1938*). Normal proteins which form minute masses visible under the microscope or ultra-microscope, were obtained without exception from healthy leaves of cucumber, kidney-bean, tomato, poplar, spindle-tree, dandelion, lettuce and egg-plant, and also from petals of bindweed flowers. They were precipitated with acetic acid at a certain hydrogen ion concentration, a method which Moriyama has also used for the isolation of vaccinia virus protein and ϕ phage protein. Some of the protein precipitates exhibited double refraction and all had a low content of nitrogen; they are lipo-proteins. It is suggested, from the general similarity of these preparations with virus proteins, that virus attack disintegrates the protein of the host, appropriates some of the decomposition products for its own formation, and leaves an unbalanced physiology which induces the observed pathological conditions.

Mechanical Properties of *Pinus radiata*

ONE of the exotics which has been most extensively planted in Australia and New Zealand is *Pinus radiata*. It grows comparatively fast and it is therefore not surprising that doubts should have been expressed as to the quality of timber that will result. In a previous pamphlet (No. 81), general information on the timber of the species was given. In the present pamphlet, No. 87 (Melbourne, 1938) "The Mechanical Properties of South Australian Plantation-grown *Pinus radiata*", by Ian Langlands, published by the Council for Scientific and Industrial Research, Australia, the results of the mechanical tests to which the timber has been subjected are given. This little brochure is divided into two parts. The first gives in non-technical language the chief results of

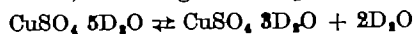
the tests; in the second the detailed results and the methods of analysis are given. The tests show that *Pinus radiata* ranks fairly high among other conifers in so far as its mechanical properties are concerned. A considerable variation in properties according to the position in the tree was found, the sapwood near the butt usually being the strongest portion. The direction of loading relative to the rings did not affect the static strength properties, with the exception of cleavage strength. The impact strength, however, was higher when the load was applied to the tangential surface. Statistical analysis showed that, although there is a correlation between mechanical properties and density, it is not sufficiently high to enable the properties of any particular piece to be estimated from its density. The pamphlet contains a discussion on the influence of rate of growth on the properties of the timber, and also gives a table of permissible working stresses.

The Illinois Basin Earthquake of November 17, 1937

THE Illinois Basin is now considered a seismic district, especially for small shocks. Earthquakes occurred there on January 30, 1907, April 30 and May 1, 1920, March 8, 1923, and November 17, 1937, and this latter has been studied by Ross R. Heinrich and Albert Frank (*Earthq. Notes*, Eastern Sec. Seis., Soc. Amer., 10, No. 3, Dec. 1938). Questionnaire cards were sent out, and, 160 being returned, much macroseismic evidence was available in order to draw a map showing the isoseists on the Wood-Neumann scale. In the centre shocks of intensity V are experienced, rolls of linoleum in the stores being toppled over and canned goods shaken off the shelves. The area covered was approximately 8,000 square miles. This macroseismic data agreed very well with the results obtained by reading the seismograms recorded at various towns. This latter evidence, using Joliet's tables for near earthquakes, gave T , 11h. 4m. 47.7s. C.S.T. and epicentre lat. $38^{\circ} 34' N.$, long. $89^{\circ} 5' W.$, about midway between Centralia and Odin. The epicentre was thus on the north-west limb of the Illinois Basin syncline and on the eastern flank of the Junction City dome. Faults exist near, but not at, the epicentre.

Copper Sulphate Pentahydrate

A SHORT announcement by F. Schacherl and O. Běhounek appeared a few years ago in *NATURE* (138, 406; 1936) describing the preliminary results of their investigation of copper sulphate crystals containing heavy water. These authors have now extended their observations (*Coll. Czechoslovak Chem. Commun.*, 11, 57; 1939). The pentahydrate is greenish in contrast with the blue pentahydrate, and its dissociation, according to the equation



has been studied over the range 20°C. to 60°C. The dissociation pressures of the two deuterates, measured tensimetrically, satisfy the equations

$$\log_{10} p = 11.176 - \frac{3086.98}{T} \quad \text{and}$$

$$\log_{10} p = 10.625 - \frac{2956.88}{T}.$$

The heat of 'hydration' of the pentadeuterate at 25°C. is 6.96 kcal.; that for the pentahydrate is 5.32 kcal., which suggests that D_2O is more firmly bound to the anhydrous salt than water is.

The Ionosphere

IN the issue of the *Journal of Research* of the U.S. Bureau of Standards of December 1938, N. Smith, T. R. Gilliland and S. S. Kirby give a summary of the results deduced from their observations of the heights of the various layers of the ionosphere and the critical frequencies at which reflection from them ceases, during the years 1933-38, in which sunspot frequency has increased. The daily and seasonal changes were regular over this period. The E layer had a minimum height of 110-120 kilometres, and its critical frequency varied as the fourth root of the zenith distance of the sun and as the intensity of solar radiation. At night the F layer had a minimum height of 300 kilometres; in the daytime it descended to 225 kilometres and in the summer had a second member at 350-400 kilometres. The critical frequencies for these layers were much higher than for the E layer and less regular. The long-period variations of critical frequencies for all the layers followed closely the variations of sunspot numbers. While the latter increased from 5 to 120, the critical frequencies increased for E by 25 per cent and for F by about 100 per cent, corresponding to increases of ionization of 55 per cent and 300 per cent respectively.

Total Solar Eclipse of June 8, 1937

O. B. MICHIE has recently published a report of the New Zealand Total Solar Eclipse Expedition to Canton Island on June 8, 1937 (*Mon. Not. Roy. Astro. Soc.*, 99, 2; 1938), in which he gives a brief description of some of the results obtained, more especially with the 19-ft. coronagraph and the 78-in. camera. It is interesting to notice that the two instruments gave very different results. The coronagraph showed a wonderful wealth of detail throughout the inner corona, and, in addition, the prominences were well defined. Nevertheless a 45-second exposure failed to reveal the corona beyond 1.5 diameters from the limb of the sun. By using the 78-in. camera it was possible in some cases to follow the streamers to distances of 3.5 or more diameters. The camera was provided with a rotating sector to enable photographs to be taken with the object of studying detail over a wide range of light intensity. The photographs obtained in this way and also the short exposure plates taken with the coronagraph showed several dark regions in the corona extending inwards to the rim of the eclipsed sun. From these and other details there is the suggestion of electromagnetic fields in action.

Radiants of the Orionid Meteor Shower

J. P. M. PRENTICE, director of the Meteor Section of the British Astronomical Association, has recently issued a paper with the above title (*J. Brit. Astro. Assoc.*, 46, 4; 1939) in which he gives an account of his work on the Orionids in 1936 and 1938. In previous papers he suggested that there is a 'radiant pattern' for this stream, and that the various centres of radiation are not stationary, as Denning believed. There was the further suggestion that each stream, as it moved eastward, came to a maximum on the same meridian of right ascension at about $\alpha = 96^{\circ}$. The paper gives very full details of the work which was carried out to investigate the last result, and Prentice is convinced that the Orionid streams have a standard meridian of maximum at $\alpha = 96^{\circ}$. This result is very interesting, but there seems to be no physical explanation for it.

The Indian Science Congress Association

Lahore Meeting

THE twenty-sixth meeting of the Indian Science Congress Association was held in Lahore in January, this being the third occasion upon which the Congress has met in the capital of the Punjab.

The president of the Association, Prof. J. C. Ghosh, professor of chemistry in the University of Dacca, devoted the first part of his address to a survey of the development in India of chemical research during the last decade. He showed that the appeal made by Prof. J. L. Simonsen in 1928 for a more intensive study of India's rich natural resources has met with a gratifying response, and, whilst deploring the lack of interest in inorganic chemistry, he was able to point to the valuable contributions made to physical chemistry. He directed particular attention to Prof. Bhatnagar's outstanding work in magneto-chemistry, to Prof. J. N. Mukherjee's elaborate investigations on the colloid chemical behaviour of soil constituents, and to the work of his own laboratory on the interplay of matter and radiation.

The second part of his address was an appeal for the formation in India of an All India Council of Scientific and Industrial Research. Research in agriculture has received generous support from public funds, but little or no attempt has been made to implement the recommendations of the Holland Industrial Commission. He suggested that there is little prospect of the schemes for industrial development, advocated at a recent conference of the Provincial Directors of Industry, meeting with success unless this development is supported by well-equipped and adequately staffed research organizations.

THE EARTH'S MAGNETISM AND THE UPPER ATMOSPHERE

The presidential address given by Dr. K. R. Ramanathan to the Section of Mathematics and Physics was devoted to geomagnetism; it was an extremely interesting, well-balanced and up-to-date survey of this subject, which after many decades of relative neglect has again begun to attract the attention of physicists. Apart from the standing challenge to theoretical physicists which is offered by the problem of the existence of the main magnetic field of the earth (and also of its secular variation), the subject has come into new prominence through its bearing on radio physics (the properties of the ionosphere) and on the entry of cosmic rays into the earth's atmosphere. Solar physicists are also concerned with the subject, because the time-pattern of geomagnetic disturbance, undoubtedly due to the sun, differs materially from that of the main changes hitherto observed on the sun's surface, and indicates that solar changes of much terrestrial significance are not yet properly distinguished by solar observers.

Dr. Ramanathan's address was mainly devoted to the transient changes of the earth's field, which are associated with the sun and the ionosphere, but he also dealt briefly, at the outset, with the main field, in connexion with which he made some interesting

quotations from the great memoir by Gauss on the spherical harmonic analysis of this field. In his survey of the transient variations, Dr. Ramanathan described the solar and lunar daily magnetic variations, magnetic storms, and—what is the most recently established type—the brief disturbances affecting only the day hemisphere, associated with radio fade-outs and solar eruptions. He rightly directed attention to the important contributions to geomagnetic science that have come from India, namely, the important work of Broun on the lunar daily magnetic variation, based on the data obtained at the Trivandrum magnetic observatory maintained for many years by the Maharajah of Travancore, and the truly monumental discussion of the Bombay magnetic data, by Moos. In recent years new Indian contributions to ionospheric studies have come from Profs. M. N. Saha and S. K. Mitra and their students.

In his survey of geomagnetic problems, Dr. Ramanathan provided an admirable brief outline of the present state of knowledge in this field, which should be of value to physicists everywhere who desire an introduction to the subject.

ANALOGY AMONG CHEMICAL ELEMENTS AND RADICALS

The first part of the presidential address to the Section of Chemistry, by Prof. P. B. Sarkar, included an account of the volumes and magnetic properties of ions and the relation between these properties and colour with the electronic structures of the rare earth ions. The effect of deformability was considered in its relation to isomorphism, where the influence of ionic radii was fully explained.

In this part of the address special emphasis was laid on the modern explanation of cases of isomorphism which cannot easily be understood or explained on the older views. As an example, it is stated that the ionic radii of Sr^{2+} and Be^{2+} are both 0.34 Å. The only difference between the two ions is in their polarizing power. A series of isomorphous simple and double sulphates and corresponding fluoberyllates have been prepared by Ray, and in almost all cases the fluoberyllates resemble the corresponding sulphates in both physical and chemical properties. The X-ray spectrum of barium fluoberyllate is practically indistinguishable from that of barium sulphate.

Although pure alkali aluminium fluoberyllates corresponding with alums have not been prepared, mixed crystals of alums containing both sulphates and fluoberyllates have been obtained. Prof. Sarkar directed attention to the analogy between the monofluophosphate ion PO_3F^- and the sulphate ion SO_4^{2-} . Several simple and double monofluophosphates as well as compounds of the alum type isomorphous with the corresponding sulphates have been prepared in his laboratory. Another case of isomorphism supported by mixed crystal formation is afforded by the formates and nitrites studied by Ray.

Prof. Sarkar concludes that three essential factors determining chemical similarity are (i) equality of ionic charge or valency, (ii) similarity of structure, and (iii) approximate equality of ionic radii. Of

these the first is the most important and demands complete equality, whereas the other two permit of slight deviation within a narrow range.

CONSERVATION OF INDIA'S MINERAL WEALTH

Dr. S. K. Roy, in his presidential address to the Section of Geology, chose as his theme the conservation of India's mineral wealth. Considering the vast size of the country, mineral occurrences are few and far between, and for this reason alone they should be stringently conserved to meet the growing demands of industry and national defence. India possesses deposits of both coal and petroleum, and attention should be directed towards their conservation.

Owing to the number of serious accidents which have occurred during recent years, researches on safety in mines have taken precedence over fuel research. Hydraulic packing, known as sand-stowing, has been found by the Coal Mining Committee to be an efficient method of preventing practically all major disasters, and there is no reason, therefore, why this should not be put into practice by law and the energies of experts now turned towards fuel research. There is ample scope for this, particularly in the Jharia coalfield, where about 30 million gallons of tar are wasted annually in production of soft coke. Of the 300 million gallons of petroleum consumed annually, only 76 millions are produced in India, and yet little is done to conserve the limited supply available.

Apart from coal and oil, there are a great many minerals which should be conserved. India is by far the largest producer of mica and could well command the world market were the industry efficiently organized. As things are, the mica deposits are for the most part exploited by unscrupulous small capitalists anxious only to fill their own pockets. Once they have recovered such mica as is easily available at the surface, they abandon the deposits. Thus in course of time valuable underground resources become overgrown and no one is aware of their existence. Another source of loss to the mineral wealth of India is the exceedingly low price at which minerals such as kyanite, magnesite, manganese, beryl, etc., are exported, simply because there is little demand for them within the country itself.

The history of India shows that years ago metals such as gold, silver and copper were available in large quantities. Diamonds also occur at three different geological horizons, and until the middle of the last century India supplied 98 per cent of the world's output. At the present time, however, diamond mining is extinct.

India cannot afford to ignore this wealth, which with the help of properly trained geologists, mining engineers and chemists, backed by local government departments, could be exploited to the advantage of the nation as a whole.

THE GEOGRAPHICAL PERSONALITY OF INDIA

The presidential address by Mr. N. Subrahmanyam to the Section of Geography and Geodesy covered widely, if superficially, almost every aspect of the life of India in an attempt to assess the present characteristics and the direction of change of Indian civilization to-day.

A review of physical factors, including climate and its effect on production, was comprised under the

heading of static geography. Then followed under the heading of dynamic geography an account of the more modern influences that are permeating India and an estimate of their effect. India has long been awakening into modernity through impact with Europe, and particularly through British permeation. Her isolation has gone: new forces permeate cities and towns and through the motor-car and radio are reaching the villages, where eighty per cent of the inhabitants dwell. Self-sufficiency is rudely shaken: even caste is adapting itself to new conditions. The old conditions and obstacles to progress such as pressure on the land, recurrent famines and appalling poverty are no longer accepted; their courses are recognized to be removable.

In short, man in India has fallen behind, but now he is catching up and bids fair to take full advantage of his opportunities. A new composite civilization should emerge as a synthesis of Eastern and Western cultures. From the medieval India there is emerging, though naturally not without discord in places, a modern India.

INDIAN FOREST MYCOLOGY

Dr. K. D. Bagehee's presidential address to the Section of Botany dealt with Indian forest mycology with special reference to forest pathology. It was in the early years of this century that Dr. E. J. Butler, at the time mycologist to the Agricultural Research Institute at Pusa inaugurated by Lord Curzon when Viceroy of India, wrote a paper or two on Indian forest fungi published in the *Indian Forester*. The subject, then almost a sealed book, has remained so until within the last few years. Dr. Bagehee's address shows that considerable progress is being made in a fascinating branch of forest studies, and one which will become of increasing importance in the years to come.

Dr. Bagehee stated that most of the forest diseases of India, including heart-rot, are indigenous. They seldom become epidemic, the organisms causing them being more or less in a biological balance with their hosts. When this balance is disturbed by unusual weather conditions or other factors, an indigenous disease temporarily becomes epidemic; when the disturbance ends, the disease resumes its former status, effecting cumulative damage through slow and constant action. But parasites coming into a new region often find some species particularly susceptible to their attack, because of the lack of any established balance between the parasite and the host, and thus an epidemic breaks out.

It may be pointed out that the balance mentioned above under which the primeval forest has maintained itself through the ages may be, and often is, interfered with by good forest management, the sylviculturist endeavouring to eliminate Nature's exuberant abundance in the production of material of little economic use and to increase the volume of the crop per unit of area whilst keeping it clear of dead and dying material. Whilst on one hand this should reduce the danger from insect or fungus pests, in epidemics the reverse may be the case. In plantations of one species, especially exotics, the forester has already realized the position.

Dr. Bagehee divided his subject into six main heads: (1) Coniferous rusts affecting conifers in the mountains; (2) root-and-stem-rotting fungi killing conifers in the mountains and hardwoods in the plains; (3) canker pathogens infesting native and

some introduced hardwood species; (4) nursery diseases; (5) timber diseases—timber-rotting fungi; (6) ecology and habits of the forest fungi of the forest floor or on the woody undergrowth or sub-aerial parts of the trees.

Dr. Bagchee discussed in some detail the diseases which he has studied, and dealt with certain possibilities of control measures. The address is a valuable contribution to the available knowledge on this subject.

BATRACHIANS AND THEIR ENVIRONMENT

The president of the Section of Zoology, Prof. C. R. Narayan Rao, directed attention in his address to changes induced in closely related frogs and toads by different influences of environment. The observations are of special interest because they are due to the author's own studies in an area of highly diverse physiographical conditions, and because they illustrate the possibilities that lie in ecological work of this kind. To select one or two of his points. We are accustomed to think of batrachians as limited to regions of great humidity, but some live continuously in "conditions of extreme dryness". These show distinctive adaptations: some inhabit deep burrows except during a short humid period; in *Uperodon* the skin is developed to absorb and retain water, which may thus be available during drought. Aquatic batrachians have large kidneys; those attuned to dry conditions possess relatively small kidneys, a correspondingly large bladder and a surprisingly small amount of excretory products in the urine. Lastly, the aquatic forms reduce the exposed area of moist skin by resting flat upon the ground, whereas the others sit with a half-perpendicular pose.

Another striking correlation, suggested tentatively by Prof. Narayan Rao, is that between the presence or absence of the tympanum and the temperature of the air or water in which the batrachians live, for he finds that higher temperature leads to conspicuous development of the tympanum, lower temperature to its reduction or absence. Temperature seems also to rule the shape of the body, cold temperatures inducing rather globular forms with reduction of surface area; whereas high temperatures are associated with extensive surfaces, and with the habit of aestivation, which sets in at 105° F.

Frogs typical of dense areas of jungle have elongated bodies and shortened hind limbs. Species represented both in forest and on high ground lay fewer eggs in hill streams and pools and, correlated with the smaller ovary, the fat-body also undergoes reduction. The studies made by Prof. Narayan Rao in South India offer many suggestions which workers in other parts of the world will be anxious to test upon their own amphibian population.

TRIBAL CULTURE CONTACTS AND ACCULTURATION

In India there are nearly thirty million primitive peoples, among whom tribal society in many areas is experiencing depopulation through changes in economic and social life. In certain groups, however, which have not lost their vitality and interest in life, cultural contacts bring about the selective adoption of alien traits, a cultural symbiosis or acculturation. This topic formed the subject of Dr. D. N. Majumdar's presidential address to the Section of Anthropology.

Nowhere in India is this cultural symbiosis or acculturation more patent than in Bastar, an

important feudatory State of the Central Provinces. Here the native population is Gond. Foreigners and immigrants, claiming Kahatriya origin, are believed to have mixed freely with the native population. Two groups, having social precedence, claim Kahatriya origin; the remaining groups are regarded as of indigenous origin, probably with good reason. The linguistic and ethnic frontiers in Bastar are very uncertain; and it has for long been a melting-pot of races and groups. The infiltration into an aboriginal area of caste peoples, who dominate the native population, has resulted in an interdependence of the two groups. The *Kabadi* custom is an example of this interdependence and co-operation. According to this custom, when a member of one of the inferior groups is in urgent need of money, for example, for the payment of a fine, or to meet the expense of a ceremonial wedding, he will borrow from the master for whom he works, repaying by agricultural service. Formerly, when tribal organization was strong, if such a sum of money was required, it was raised by group effort. Now that tribal and group solidarity is dissipated; the economic helplessness of the inferior groups is exploited by the caste people, the loans often entailing lifelong servitude, which may pass to his heir, if a man dies while still in debt.

Nevertheless, in some areas economic interdependence has led to a healthy reciprocity in cultural life, as, for example, in the Dusseerah religious festival, which has brought together the various cultural groups of Bastar as participants in a great cultural heritage. Further, many indigenous institutions survive to serve a useful purpose. Such, for example, is the dormitory institution, where unmarried youths and girls collect to dance and sing together at night. Originally, under tribal organization, this institution was intended to enable the warriors to lie in readiness to protect the women and property of the group from raids. It now serves as an educational institution, in which the young people learn the group standard of social life, discipline, the economic pursuits characteristic of the group, social and ceremonial duties relating to sex and associated matters. Thus the dormitory now fulfils an important role in the tribal life of the community.

INSECTS AND THEIR ROLE IN INDIAN AGRICULTURE

Under this title Dr. T. V. Ramakrishna Ayyar contributed an interesting presidential address to the Section of Agriculture. The substance of his discourse was a general survey of insects in relation to man and, in particular, in connexion with problems of Indian agriculture.

After discussing estimates of losses due to insect depredations in the United States, Dr. Ayyar compares similar losses in India. In so far as rice, wheat, cotton, sugarcane and oil-seed are concerned, he computes the annual losses of these crops, alone, at more than 200 million rupees. While the insect pest problems of the different areas of India differ considerably in geographical, climatic and other conditions, and according to the crops grown in each region, there are a few species of so wide a range as to affect India as a whole. Of these latter, locusts are of primary importance, and especially noteworthy was the large-scale infestation of the desert locust (*Schistocerca gregaria*) during 1926-31.

After reviewing various artificial methods of insect

control, the subject of natural or biological control was then considered. In South India, biological control has so far been tried on an organized scale against two species of insect pests. One, the fluted scale (*Icerya*), which was introduced into the Nilgiris about 1927-28, has been considerably checked but not completely exterminated by the beetle *Novius cardinalis*. The other pest, the coco-nut caterpillar (*Nephantis serinopa*), is indigenous and has a complex association of various insects living in relation to it. A biomimetic study of this association has been attempted, and some of the parasites have been found occasionally to exercise appreciable control over this caterpillar. In so far as pest plants are concerned, the cochineal (*Dactylopius*) has brought about a remarkable and spectacular result in the eradication of prickly pear.

In dealing with the organization of entomological work, Dr. Ayyar rightly stressed the importance of taxonomy and aptly remarked that discrimination between species is the starting-point of the majority of Indian biological problems. Other important aspects emphasized by him are the need for studies of ecology and of bioclimatics. He remarked that while pure science is often immensely practical and applied science is often very pure, between the two there is really no dividing line, both being necessary for the intellectual and material needs of man. In conclusion, he pleaded for the giving of greater encouragement in scientific institutions and universities to applied science, which is necessary to meet the many material needs of India.

PHYSIOLOGICAL RESEARCH IN INDIA

In his presidential address to the Section of Physiology, Prof. N. M. Basu made a plea for the establishment of physiological teaching and research in India, by the provision of better facilities for the holders of teaching posts, and the modification of existing degree courses to encourage the development of the student along the right lines. In spite of the many obstacles, much fruitful work has been carried out in India in recent times. The normal blood picture of the Indian has been established in many districts, and an extension of such work to other areas would be of the greatest value to the practitioner of medicine, as would an extension of the work on the standards of vital capacity and their relation to surface area and height.

Much time has been devoted to nutritional surveys and the investigation of the diets of various areas, and of the effect of supplementing those diets which were found to be deficient. Dietary surveys made in South Indian villages showed that not only are deficiency diseases common, but also the actual calorie intake is lower than the minimum. Addition of very small amounts of milk to such diets is very beneficial, chiefly through the calcium content of the supplement. The diet of middle-class Bengalee families has been found to be deficient in animal fat, animal protein and in calcium.

A considerable amount of work has been devoted to analyses of the composition of various foodstuffs, and to the determination of the biological values of the proteins of common Indian foods. Rice has a high biological value, and, together with pulses, forms a valuable addition to a diet. The vitamins have, naturally, attracted many workers. Vitamin C has been found to exist in large quantities in such

native fruits as litchi, mango and guava, and the importance of this vitamin in aiding resistance to infection has been established. The occurrence and stability of carotene and vitamin A in indigenous plants has received attention, and observations of interest have been made on the effect of diet on the absorption of this vitamin from the alimentary tract. An inquiry into the requirements and saturation of various groups in vitamins C and B₁ is now in progress, and promises to yield interesting results.

The preponderance of nutritional research is due to the fact that ample funds are available for it. If they were as well supported, other branches of physiology would advance as rapidly, and the subject would be able to take its full role in the development of biological science and medicine in India.

DYNAMIC STRUCTURE OF HUMAN PERSONALITY

In his presidential address to the Section of Psychology, H. P. Maiti pointed out that personality in its practical aspects meets us to-day wherever we have to deal with human nature, whether in hospitals, in clinics, in schools and colleges, or in industrial organizations.

There has always been a popular interest in personality, but until recently scientific psychology avoided it, probably because of its complexity. The work of the psychiatrists towards the end of the last century familiarized us with some of the problems of the abnormal personality, and Janet distinguished two main types of personality structure, namely, the 'psychasthenic' and the 'hysteric'. For psychiatric practice this work was fruitful, but it threw little light on the mechanism of personality integration. Nor in spite of the enormous amount of work devoted to their study have personality tests proved of reliable validity, probably because, if personality is a functional whole with interacting parts of which some are dominant over others, then no test or description can be adequate unless it can show the role of each part in the work of the whole. We need a dynamic theory of personality.

The most likely fields of study are (a) the clinical and psycho-analytic fields, where variations of function through pathological deviations can be observed, and (b) through observation of the normal changes attendant upon development.

The recent modification of the Freudian theory of the neuroses throws some light on a number of difficulties. The distinction of the Id, Ego, and Super-ego, roughly equivalent to the more popular distinction between passion, reason and conscience, shows the effect of the social influences of the early years on the rest of the personality. Genetically, the three are continuous one with the other, and can only be considered separate for functional purposes. The Id is undifferentiated instinct not yet organized under the unity of the Ego; the Ego gradually develops as the Id comes into contact with reality, and the Super-ego grows later out of the developing qualities of the Ego, thus helping the Ego to keep the Id in check.

These factors in their mutual interaction constitute the fundamental scheme of personality in an individual, and form a continuously active system, each part being in dynamic interaction with the other two. In the healthy mind the three structures harmonize, and retain their plasticity throughout life.

Science News a Century Ago

Pentland's Travels in Peru and Bolivia

At a meeting of the Royal Geographical Society on March 25, 1839, extracts were read from a paper by Dr. Bowring "On the Geography of the Country around Cuzco", and an account was given by Joseph Barclay Pentland (1797-1878), H.M. Consul-General in Bolivia, of his travels in Bolivia and Peru during the preceding two years. With the exception of General Miller, it was believed Dr. Bowring and Pentland were the only persons who had visited Cuzco with a scientific object. During his stay in the city—the ancient capital of the Incas—Pentland made plans of the ancient and modern city, and examined the remains of Peruvian architecture. In his paper, he dwelt upon the extraordinary style of cyclopean construction of the ancient Peruvians, which was no less remarkable for the care shown and the remarkable size of the stones, some of which exceeded 150 tons in weight. In the course of his journey, he determined by astronomical observation the position of nearly forty places and he determined their height by barometric measurements. He also referred to a canal cut across a pass of the Western Cordillera into the valley of the Tacna. This was planned by an Englishman named Scott and undertaken chiefly by British merchants. At one point it was 14,652 ft. above sea-level.

A Sawing Machine for Iron Rails

On March 26, 1839, Joseph Glynn, F.R.S. (1799-1863), described to the Institution of Civil Engineers a "Sawing Machine for Cutting off Railway Bars", which had been erected at the Butterley Iron Works, Derbyshire, for cutting rails for the Midland Counties Railway. The machine had two circular saws each of them being 3 ft. in diameter and $\frac{1}{4}$ in. thick. They were mounted in headstocks which could be moved at right angles to the rails. They revolved at 1000 revolutions per minute between two disks of cast-iron faced with copper, and dipped into water. The rails were sawn while hot, it taking 12 seconds to saw through the ends of a 78 lb. rail.

Audouin's Advice to a Naturalist

A FRENCH naval officer, M. Lefebvre, about to travel in countries bordering the Red Sea, solicited instructions as to what objects he should study. Among those he appealed to was the French entomologist Jean Victor Audouin (1797-1841). In the *Athenaeum* of March 30, 1839, appeared extracts from Audouin's remarks. "The Gulf of Suez", the article said, "is extremely rich in molluscs, zoophytes, crustaceans and annelids and it is very desirable that the fugitive colours of the Doris, Bursatella, Orchidia, and Tritonia, etc., should be delineated. The animals of several of the shells, also found in the Red Sea, are hitherto unknown; for instance the *Anatola*, and the same may be said of the zoophytes, concerning which it would be highly important to possess the particulars of form as well as colour, both of which alter so quickly; those of the polypi with flexible stems would be particularly interesting. . . . It is supposed that many new spiders may be found in Abyssinia, and the genus *Lycoea*, to which the *Tarantula* belongs, should be especially examined. It is, however, chiefly the class of insects which may be enriched by a journey to Abyssinia."

Societies and Academies

Paris

Academy of Sciences (C.R., 208, 545-608, Feb. 20, 1939).

H. COLIN and Mlle. M.-M. CHOULET: Formation of inulin in annual plants. Conditions for formation of inulin are more easily realized in the Campanulaceae than in the Compositae.

G. MALHOTRA: Correlations between related individuals, in the hypothesis of homogeneity.

V. A. KOSTITZIN: Compatibility of stable singular points of differential equations.

H. CARTAN and S. MANDELBOYT: Solutions of Carleman's problem for a finite interval.

D. BÉLOREZKY: Imaginary triple collisions in the plane problem of three bodies.

R. JAMIN: Theorem relating to the isentropic flow of perfect gases.

J. BETHENOD: Determination of the range in which an alternating current are functions.

F. CARBONAY: Propagation of high-frequency oscillations on networks for the transport of electrical energy.

T. KOFMAN: Action of visible and ultra-violet light on periodic reactions.

G. REBOUL and E. THIBAUD: Emission of ionizing radiations by salts of ordinary metals.

J. SOLOMON: Splitting of radioactive nuclei by neutrons. It is suggested that the action is analogous to 'predissociation' of molecules.

H. VON HALBAN, JUN., L. KOWARSKI and M. MAGAT: Intensity of the neutrons in cosmic radiation. Radio-element ^{86}Br was produced by cosmic ray neutrons, the intensity of which was much greater at a height of 9,500 metres in an aeroplane than on the ground in Paris.

Mlle. T. GUILLMART: Absorption in the ultra-violet of oximes in the solid state. The bodies exist in two forms with different spectra.

Y. DOUGET: Principles of cryoscopy and the construction of a cryoscopic apparatus.

C. DUVAL and G. MAKARS: Micro-estimation of halogen ions; acid-alkali test.

G. WETZBOFF: Reaction with chlorine of some derivatives of the phosphonitrile radical.

Mlle. M. MURGIER: Preparation of soluble molybdic acid.

Mlle. Z. SOUBAREW-CHATELAIN: Constitution of molybdic acid in dilute aqueous solution.

R. PAUL: Opening of hydrofuranic and hydro-pyranic cycles by acetic anhydride.

W. S. REICH: A new series of esters of the oces, the asoyl-esters.

J. LUGNON: Instantaneous determination, without calculation, of any altitude of a radio-sonde.

P. GAVAUDAN, Mlle. N. GAVAUDAN and J.-F. DURAND: Effect of some hydrocarbons and their derivatives on mitosis and on cytodiarrhesis.

A. TOURNADE and G. CHARDON: Mechanism of post-depressive hypertension observed after temporary insufflation of the lungs.

G. UNGAR and J.-L. PARROT: Influence of bleeding on the power of the plasma to destroy histamin.

H. MUNTZ: Fundamental laws of haemodynamics.

Mlle. V. DEUTSCH: Sedimentation constant and molecular weight of syphilitic reagent.

S. METALNIKOV, A. YAKIMACH and O. YADOFF: Action of radioactive radiations on microbes.

Dublin

Royal Irish Academy, Feb. 27.

J. M. O'CONNOR: The significance of monomolecular layers of fatty acids in the control of animal oxidation. The influence of temperature from 0° C. upwards on the oxygen consumption of the frog was examined. It is found to show sharp increases between 6° and 14° and between 21° and 30° and at 18°. These changes correspond in position and in extent to the expansion of a monomolecular layer of myristic and palmitic acid in the proportions in which they occur in the frog, and to the melting of palmitic acid.

A. AUSTIN MILLER: River development in South Ireland. The rivers of South Ireland originated as south-flowing consequent streams on a plane above the summits of the present mountains. Later, the rivers have, by repeated captures, extended along the east-west synclines of soft carboniferous rocks until many of them flow in this direction from source almost to mouth, turning south only in the last few miles of tidal estuary. For some time the sea-level stood 800 ft. above that of to-day and cut a broad beach, backed by a line of cliffs, at that height on the southern slopes of the Knockmealdowns and other mountain groups. The sea-level declined by stages to 400 ft., then to 200 ft., then to the level of the pre-glacial raised beach a few feet above Ordnance datum, then to about 100 ft. below present sea-level, returning only quite recently to the present position, drowning the estuaries.

Vienna

Academy of Sciences, January 12.

W. J. MÜLLER, E. LÖW and F. STEIGER: Difference in the rate of corrosion of pure and commercial aluminium in alkaline solutions. The E.M.F. of the local voltaic couples causing the corrosion is the same for both kinds of aluminium; the higher velocity of corrosion of commercial aluminium is due to the lower resistance of the surface film, brought about probably by the inclusion of metallic impurities.

J. LINDNER and B. ZAUNBAUER: Synthesis of quinoline by tetraethylamines. 7,8-tetramethylenequinoline.

J. LINDNER, F. SCHMITT and B. ZAUNBAUER: Hydrindene derivatives (2). Simple substitution products.

A. SKRABAL: Continuity of the kinetics of bleaching solution. The various kinetics of bleaching solution are all derived from a single law involving two velocity coefficients.

J. KISSER: Frequency of abnormalities of the leaves of *Juglans regia* due to a late frost.

January 19.

M. STARK: Stages in the development of crystalline schists of the Radstädter chalk beds in the Ahrtal and Gasteintal.

M. TOPPERGER: Theory of earthquake disturbances. The motion of the ground is assumed to be of the form $x = A e^{i\omega t} \sin \omega t$.

O. PAULEHN: Studies of the Raman effect (97). Poly-substituted benzols.

J. BRUNNER: New find of Hippurion fauna at Veles in Macedonia.

A. ERDELYI: Series involving products of Laguerre polynomials.

Washington, D.C.

National Academy of Sciences (Proc., 25, 1-54, Jan. 15, 1939).

W. J. ROBBINS and MARY B. SCHMIDT: Vitamin B₆, a growth substance for excised tomato roots. Slow growth has been maintained over a period of more than two years in a solution of mineral salts, pure cane sugar and thiamin. Growth is improved by substituting a light brown sugar for the pure cane sugar, due apparently to presence of vitamin B₆. Probably the roots synthesize sufficient vitamin B₆ for slow growth in solutions containing thiamin.

W. J. V. OSTERHOUT and S. E. HILL: Chemical restoration in *Nitella* (3). Effects of inorganic salts. Irritability disappeared after two to six days in distilled water but can be restored by 0.01 M. sodium chloride or sulphate in five minutes. This is considerably longer than is required with organic salts, suggesting a different mechanism.

E. DERSHEM: Photomicrographs of thin bone sections by the use of fluorescent X-radiation. A radiator containing an element the K emission lines of which are a little shorter in wave-length than the K absorption wave-length of the principal element of the specimen is used. This radiator (scandium oxide for photomicrographs of bone) is irradiated with an ordinary X-ray tube, and emits radiation heavily absorbed by the specimen. The 'camera' must be evacuated.

G. D. SNELL: Induction by irradiation with neutrons of hereditary changes in mice. Both X-rays and neutrons produce translocations and sterile F₁ males, but both fail to produce detectable numbers of recessive mutations.

D. BODENSTEIN: Imaginal differentiation inaugurated by oxygen in *Drosophila* pupae. The presence of oxygen, rather than a differentiation hormone in the anterior part, seems to be necessary for differentiation of the abdominal ectoderm.

H. C. SHERMAN, H. L. CAMPBELL and C. S. LANFORD: Experiments on the relation of nutrition to the composition of the body and the length of life. Contrary to the classical view that the chemical composition of an organism is rigidly specific, it is found that rate of calcification in the normally developing body can be varied by adjusting calcium intake within the normal range, without departure from full health. The higher intake seems to be permanently advantageous. High intake of vitamin A has improved length of life and vitality of offspring.

E. B. WILSON and JANE WORCESTER: Resolution of tests into two general factors.

W. R. MILES: Steady polarity potential of the human eye. Electrodes are placed on the skin near the eyes and the body potential balanced out. The potential of the eyeball is closely proportional to the sine of the angle of rotation of the eye.

O. STRUVE: Physical state of the interstellar gas clouds. A theoretical discussion leads to the view that there is a high abundance of hydrogen atoms in interstellar gas; roughly, hydrogen atoms to calcium atoms are as 10⁶ to 1.

G. A. MILLER: Groups of degree n in which the largest degree of a substitution is a minimum.

E. T. BULL: Euler's concordant forms.

S. LURSCHEITZ: Mapping of abstract spaces on polytopes.

J. W. TUCKER: Intrinsic metric of a polytope.

J. W. ALEXANDER: Concept of a topological space.

Forthcoming Events

CHEMICAL SOCIETY, March 29-31.—Anniversary Meetings. March 29, at 6.—Sir Henry Tizard, F.R.S. Rutherford Memorial Lecture to be delivered at the Royal Institution.

March 30, at 2.30.—Annual General Meeting. At 4.—Presidential Address.

BRITISH PSYCHOLOGICAL SOCIETY, March 30-April 3.—Extended General Meeting to be held at Reading.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned

SCIENTIFIC OFFICER (Physicist) to the Wool Industries Research Association—The Secretary, Torrington, Huddersley, Leeds, 6 (April 1).
DEMONSTRATOR IN INORGANIC AND PHYSICAL CHEMISTRY in Bedford College, Regent's Park, N.W.1—The Secretary (April 6).

INSPECTOR OF AVIATION FUELS AND LUBRICANTS in the Aeronautical Inspection Directorate—The Under-Secretary of State, Air Ministry (8.2.4), Berkeley House, W.1.

LECTURER (WOMAN) IN GEOGRAPHY in the Lincoln Diocesan Training College—The Principal.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

The One Hundred and Fifth Annual Report of the Royal Cornwall Polytechnic Society. New Series, Vol. 9, Part 2, 1938. Pp. 124 (Camborne: Camborne Printing and Stationery Co., Ltd.) 6s. [212]

Physical Society. Reports on Progress in Physics, Vol. 5. General Editor: Allan Ferguson. Pp. v+445. (London: Physical Society) 20s. net. [222]

Brompton Hospital Reports. A Collection of Papers recently published from the Hospital. Vol. 7, 1938. Pp. iv+207+39 plates. (London: Brompton Hospital.) 5s. [232]

Transactions of the Royal Society of Edinburgh. Vol. 59, Part 3, No. 23: The Structure and Function of the Alimentary Canal of some Tectibranch Molluscs, with a Note on Excretion. By Dr. Vera Freiler. Pp. 599-646. 6s. Vol. 59, Part 3, No. 23: The Cytology of the Thelytokously Parthenogenetic Saw-Fly *Thaumetoea maculosa* Kt. By Prof. A. D. Peacock and Dr. Ann R. Sanderson. Pp. 647-660+4 plates. 3s. 6d. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [232]

Check-Lists of the Forest Trees and Shrubs of the British Empire. No. 4: Draft of First Descriptive Check-List for Ceylon. Compiled by L. A. J. Abeyesundere and R. A. De Rosairo. Pp. iii+116. (Oxford: Imperial Forestry Institute.) [242]

Scientific Proceedings of the Royal Dublin Society. Vol. 22 (N 8), No. 7: A Study of the Seasonal Development of the Potato Plant in relation to Blight Attack and Spraying. By Paul A. Murphy. Pp. 60-82. (Dublin: Hodges, Figgis and Co., London: Hodges, Figgis and Co., Ltd.) 1s. [272]

Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the Year 1937-1938. (Cmd. 5939). Pp. 221. (London: H.M. Stationery Office.) 5s. 6d. net. [18]

Scientific Horticulture (formerly the H.N.A. Year Book) Vol. 7, 1939. (Published by the Horticultural Education Association.) Pp. 213+xxiii+12 plates. (Wye: South-Eastern Agricultural College) 4s. net. [18]

Emergency Medical Services. Memorandum No. 2. Emergency Hospital Organisation. Pp. 29. (London: H.M. Stationery Office.) 6d. net. [18]

The British Broadcasting Corporation. Twelfth Annual Report, 1938. (Cmd. 5951.) Pp. 36. (London: H.M. Stationery Office.) 6d. net. [23]

Department of Scientific and Industrial Research. Food Investigation. Leaflet No. 8. The Cold Storage and Gas-Storage of Eggs. By Dr. T. Moran. Pp. 9. (London: Department of Scientific and Industrial Research) Free. [63]

Publications of the International Tin Research and Development Council. No. 90: The Electrolytic Polishing of Tin and its Application to Micrographic Examination. By P. A. Jacquet. Pp. 12+12 plates. Free. No. 91. Anodic Films on Tin in Sodium Hydroxide Solutions. By Dr. B. Kerr. Pp. 14. Free. (Greenford: International Tin Research and Development Council) [63]

Department of Scientific and Industrial Research. Methods for the Detection of Toxic Gases in Industry. Leaflet No. 3. Sulphur Dioxide. Pp. iv+6. 2s. 6d. net. Leaflet No. 4: Benzene Vapour. Pp. iv+9. 3d. net. (London: H.M. Stationery Office) [63]

University College of Wales, Aberystwyth. Welsh Plant Breeding Station. The Temporary Ley. (Series H, No. 15, Seasons 1930-1937.) Pp. vi+150. Aberystwyth: Welsh Plant Breeding Station. 7s. 6d. [98]

Other Countries

Tanganyika Territory. Department of Agriculture. Annual Report, 1937, Part 2. Pp. 48. (Dar es Salaam: Government Printer.) 2s. 6d. [212]

The Hebrew University, Jerusalem. Its History and Development. Pp. xi+146. (Jerusalem: Hebrew University) [212]

Cawthron Institute, Nelson, New Zealand. Cawthron Lecture, 1938: Modern Advances in Medicine. By Dr. D. M. Carmalt Jones. Pp. 80. (Nelson: Cawthron Institute.) [222]

Imperial College of Tropical Agriculture. Reports of the Governing Body, the Principal's Report and the Accounts for the Year ended August 31, 1938. Pp. 40. (Trinidad and London: Imperial College of Tropical Agriculture.) [222]

Transactions of the American Philosophical Society. New Series, Vol. 31, Part 1. The Discovery of Antarctica within the American Sector, as revealed by Maps and Documents. By William Hebbert Hobbs. Pp. 71+31 plates. (Philadelphia: American Philosophical Society) 2.50 dollars. [223]

Aparato sexual femenino del *Bufo erasmii*: variaciones cíclicas y mecanismos reguladores de su actividad y estructura. Por la Dr. Inés López Colombo de Alienda. Pp. xii+166. (Córdoba: Instituto de fisiología.) [232]

Proceedings of the United States National Museum. Vol. 80, No. 3049: New Species of Polychaete Worms of the Genus *Euphrosyna*, with Notes on *Euphrosyna borealis* Grated. By Aaron L. Treadwell. Pp. 169-174. (Washington, D.C.: Government Printing Office.) [242]

U.S. Department of Agriculture. Technical Bulletin No. 656: Cost of Producing Extracted Honey in California. By B. L. Adams and Frank H. Todd. Pp. 36. (Washington, D.C.: Government Printing Office.) 10 cents. [242]

Geological Survey of British Guiana. Bulletin No. 12: 1. Exploratory Note on the Geological Map of the Groete Creek-Lower Ouyuni-Puruni Goldfield, by S. Brazevell; 2. Report on the Kartabo-Oko-Arenu Section of the Ouyuni District, by D. B. Grantham; 3. Report on the Wariri-Arenu-Quarantone Section of the Ouyuni District, by D. B. Grantham; 4. Report on the Area between Tinamu Fall and the Katanu River, by S. Brazevell. Pp. 49. (Georgetown: Geological Survey.) 24 cents. [242]

U.S. Department of the Interior: Office of Education. Monograph No. 19: Agricultural Education Programs. Pp. v+21. 10 cents. Vocational Division Bulletin No. 118 (Vocational Rehabilitation Series No. 12): Administration of Vocational Rehabilitation. Revised edition. Pp. vi+59. 10 cents. (Washington, D.C.: Government Printing Office.) [272]

Report on the Zoological Survey of India for the Years 1935 to 1938. Pp. lxxviii+3 plates. (Delhi: Manager of Publications.) 1.14 rupees, 2s. 3d. [272]

Memoirs of the Indian Museum. Vol. 13, Part 1. Chiroptera from the Indian Ocean in the Collection of the Indian Museum, Calcutta. By Dr. Carl Aug. Milnes-Ontell. Pp. 84+3 plates. (Calcutta: Zoological Survey of India) 4.4 rupees, 6s. 9d. [272]

Commonwealth of Australia: Bureau of Meteorology, Melbourne. Bulletin No. 24: Weather Conditions affecting Aviation over the Tasman Sea. Part 1: Weather Conditions from Records of Ships' Logs and Land Observations; Part 2: Some Adverse Aviation Weather Conditions on the New South Wales Coast. By H. M. Treloar and B. W. Newman. Pp. xii+34+iv+34 plates. (Melbourne: Government Printer.) [272]

Bulletin of the Vanderbilt Marine Museum. Vol. 7: Scientific Results of the World Cruises of the Yacht *Albatross*, 1928-1929, and *Albatross*, 1931-1932. *Albatross* Mediterranean Cruise, 1933, and *Albatross* South American Cruise, 1935. Marine Algae: Chlorophyceae and Corallinaceae; Coelenterata: Hydrozoa, Leptomedusae, Siphonophora, Scyphomedusae, Aequorea, Pennatulacea, Actinaria and Madreporaria; Annelida: Polychaeta; Echinodermata: Asteroidea, Crinoidea, Ophiuroidea; Echinodermata and Holothuroidea; Crustacea: Anomura, Macrura, Brachyura, Stomatopoda and Carapoda; Mollusca: Cephalopoda, Amphineura, Gastropoda, Nudibranchiata and Pelecypoda. By Lee Boone. Pp. 373+152 plates. (Huntington, L.I.: Vanderbilt Marine Museum.) [272]

Canada: Department of Mines and Resources. Mines and Geology Branch: Bureau of Mines. Improving the Properties of Clays and Shales. By J. G. Phillips. (No. 793.) Pp. iii+59. (Ottawa: King's Printer.) 25 cents. [18]

Field Museum of Natural History. Botany Leaflet 23: Carnivorous Plants and "The Man-Eating Tree". By Sophia Prior. Pp. 20+8 plates. (Chicago: Field Museum of Natural History.) 25 cents. [23]

Bulletin of the American Museum of Natural History. Vol. 76, Art. 1: The Social Behavior of the Jewel Fish, *Hemiodus bimaculatus* Gill. By G. K. Noble and Brian Curtis. Pp. 46+1 plate. (New York: American Museum of Natural History.) [23]

Suomen Geodietinen Laitoksen Julkaisuja. No. 26: Finnische Geodietisches Institut, 1918-1938. Pp. 128+15 plates. (Helsinki: Finnische Geodietisches Institut) [23]

U.S. Department of the Interior: Office of Education. Vocational Division Bulletin No. 197 (Trade and Industrial Series No. 59): Training for the Police Service. By O. D. Adams. Pp. viii+84. (Washington, D.C.: Government Printing Office.) 15 cents. [63]

Catalogues, etc.

Catalogue de livres anciens et modernes, rares ou curieux relatifs à l'Orient. (No. 38.) Pp. 124. (Paris: Libr. Adrien-Maisonneuve.)

Catalogue of New Books on Civil and Electrical Engineering (Including Wireles). Pp. 28. Catalogue of New Books on Physics, Mathematics and Astronomy. Pp. 32. (London: H. K. Lewis and Co., Ltd.)

The Engineer Directory and Buyers Guide, 1939. Pp. 260. (London: The Engineer.)

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Polar Exploration

THE most casual reader of the daily press will have noticed an increased frequency of references to expeditions, mostly to the Arctic, in recent years. Speaking broadly, before the Great War, interest in Great Britain in the Arctic was limited mainly to hunting parties and to one or two scientific expeditions led by senior men. Since the War, however, there have been some thirty or forty summer expeditions and half a dozen wintering expeditions in the north from this country, excluding many smaller ventures of two or three men in a party. More significant still, these have practically all been organized and manned by young men, usually from a university.

We are not concerned here with the reasons for this remarkable change, and indeed no one reason will account for it. It is important to realize, however, that it is not just a fashion or a cult, nor can it be dismissed lightly as an outlet for the energy of youth. Not only do the expeditions take themselves quite seriously, but they nearly always attempt serious work and usually return with useful and important results. Youth has certainly won its spurs in the field of polar exploration.

Now, as before the War, the real spiritual parent and patron of all exploration from Great Britain is the Royal Geographical Society; but in consequence of this new activity there has arisen a group of subsidiaries, in close and harmonious touch with the Society, who make it their business to foster and even direct such work.

Perhaps the most official and permanent of these is the Scott Polar Research Institute at Cambridge, established in memory of Captain Scott. While its slender funds still limit its assistance to matters of advice on equipment and access to past records, it is rapidly becoming a centre at which experience

can and does gather. Moreover, its half-yearly publication, the *Polar Record*, does an important service in recording and reviewing the work done in the field, by all nationalities and in both the polar regions. The Oxford University Exploration Club is another organization which has for many years produced at least one expedition a year, and has seen to its results being published. It does not confine its activities to the polar regions. The more junior but numerically larger Public Schoolboys Exploration Society is yet another, with aims somewhat similar to those of the senior organizations. Worthy of mention also, though not as directly fostering exploration, are the Antarctic Club, formed in 1924, and the Arctic Club, formed in 1932. These are social clubs only, and their functions serve as happy reunions of a private character.

The real backbone of financial support comes from none of these, however, for their resources are very limited, but from an innumerable and unnameable series of sources which have no publicity nor do they seek it. These are learned societies, colleges and institutions, and travel funds, as well as private individuals who come forward with grants so that the expense to the actual members of an expedition shall not be prohibitive.

There has been a small measure of criticism of this somewhat fortuitous method of financing expeditions. It is urged that there would be more efficiency and less wastage if there were some general fund. It is pointed out that expeditions and even parent organizations are liable to become rivals for private favours and public subscriptions.

There are two answers to these criticisms. In the first place, the freedom in the present

arrangement, whereby anyone with a keen desire to explore can find ways and means to do so, is not to be lightly given up. A regimenting of such desire would often strangle it at birth. Secondly, the reason for the support now available is almost always personal. A college or a parent or a travel fund rarely thinks of the abstract cause of exploration or science when it makes a grant; it is considering only the training or the reward of a likely individual. Much of the money now sending young men to live arduously in the polar regions would never be available as a subscription to a General Exploration Fund, however fine its aims or dignified its management. That there is need of a fund of another character will be shown later, but there is no overwhelming case for a general exploration fund for the provision of these junior expeditions.

Next in the list of current criticisms comes the remark sometimes heard that the scientific work is not of a very high order. It is quite true that the range and depth of scientific work on, say, the H. G. Watkins' Expedition to Greenland, was not comparable with that of the Wegener Expedition, there at the same time. This was partly due to a difference of aim and of resources, but mainly of selection, the Germans being established scientific workers of experience and maturity, the Englishmen being beginners or amateurs; in one the object was avowedly scientific, in the other exploration was the chief aim.

Incidentally, it has been suggested in some quarters that in polar exploration science is made the cloak for adventure. This is undoubtedly true to some extent, and some leaders have even been hypocritical about their aims in this respect, in order to get support. Such practices would, of course, defeat their own object in the end; but since it usually means that the scientific workers they do take are doubly keen, one can scarcely say that serious harm is done. In any event, it is open to question whether love of travel can really be divorced from any field-science, and if we elect to regard travel-eagerness as something trifling or unworthy, then we shall have to include Darwin and Wallace in our criticism.

Granting that some of the scientific work done is low in value—inevitable when juniors form so large a proportion of the workers—can we say we are satisfied with the organization of the work and the use made of it?

This is probably the weakest point in the present type of expedition, and there has been a case or

two which calls for criticism. To regard a visit to the polar regions as part of a scientific training is well enough, but to take it as the whole training is far from well. There have been instances of young men who, with the sketchiest of training at home, have carried out their investigations in strange places and thereby acquired an authority in their science which is far from sound. This is not confined to the polar regions of course, and in the long run does not necessarily lower the prestige of science. It is not, in our opinion, so vital a criticism as the corollary to it, namely, that a very large proportion of the work done in the field is never published, and much of the collecting is lost to all but a small circle.

The blame for this must be shared between the authorities who lend their support to the expedition, the men themselves, and the scientific public. It is still somewhat unusual to find a leader looking beyond the end of his expedition and considering means of publishing his results. There have been some notable exceptions, and one may be permitted to single out some of the expeditions organized by the Oxford University Exploration Club, which have, by hook or by crook, published fairly full accounts of their work in the proceedings of learned societies. At the same time, some of the less-known expeditions with equally valuable work have been unable to get their work published, from lack of money or influence.

There is, in fact, a very strong case here for a General Publication Fund, the officers or trustees of which would receive applications for aid in publication. Much of the work is best placed in the journals of societies, but some is not quite suitable. The workers themselves should in any event see that their notes, if not published, are preserved in an appropriate place, such as a learned society or the Scott Polar Research Instituté.

There is yet another criticism which has appeared in print and should be met. It has been asserted that the parties do not go far enough afield, being limited practically to the longitudes from West Greenland to Spitzbergen. It should be realized that there is not a single part of the Arctic except Arctic Canada which is under the jurisdiction of the British. It is therefore only with the permission of Denmark, Norway and Iceland that these parts have been visited. Those countries have been very generous indeed in the past with permission, and the case for any reluctance they have shown has never been fairly stated on their behalf. They,

in common with Canada, have never really objected to properly authorized expeditions with a good and definite purpose. Nevertheless, since they must share some of the responsibility for the safety of the party as well as for the character of the work done, they do insist on support and authorization from responsible bodies. It is to be feared that there have been cases where a body has supported an individual or an expedition without sufficiently careful inquiry into antecedents and suitability for the work.

To sum up, it will have been evident that the post-War spate of polar exploration has been spontaneous and has all the merits and demerits of spontaneity. There is reason for a measure of control in so far as thorough inquiry into

prospective expeditions goes, but over-control is likely to dry up the enthusiasm and the freedom of selection which has been such a marked feature of the work.

The authorities who support expeditions are to be congratulated on the results so far; but it is to be hoped they will realize the necessity for a helping as well as a guiding hand in the matter of putting the results gained to the best use. Last and by no means least, our admiration is due to the comparatively small band of leaders of these expeditions who have triumphed over a myriad difficulties even before reaching their goal, and who, when there, have in nearly every case set an example to their men of enthusiasm, hard work and cheerfulness.

Protection against Air Raids

Civil Defence :

a Practical Manual presenting with Working Drawings the Methods required for Adequate Protection against Aerial Attack. By Capt. C. W. Glover. Pp. xx+308. (London: Chapman and Hall, Ltd., 1938.) 15s. net.

THE title of Captain Glover's book is somewhat misleading. He has written a manual containing many useful tables, facts, diagrams and illustrations which deal almost entirely with the protection of human beings, and to some extent of animals, against air attack. Civil defence, however, embraces many other urgent problems. The protection of men and women, especially those whose work enables the nation to resist an enemy, is an essential part of civil defence. But the supply of food and the maintenance of transport for its distribution; provision of electricity for essential works; continued output of aircraft; armament and other factories of national importance; the storage and import of oil; and safety and repair of the utility services; all are as much a part of civil defence as the protection of human life. Within this limited aspect, however, Captain Glover deals with many problems; and although the general reader may perhaps be put off by the jazz paper cover, which depicts a nightmare of steel cupolas, underground tube shelters, gas-proof doors and batteries of air filters, the bolder A.R.P. instructors, engineers and workers will find much that will be of use to them in the book.

After a chapter on the probable forms of attack, which includes an interesting statistical summary

of the raids made on London in 1915-18, and a description of the various types of bombs and their effect, Captain Glover goes fully into the question of gas. Some 300,000 substances were investigated during the Great War of 1914-18, and of the dozen or so that were adopted as being of practical use, about six were notably successful. Of these, the vesicants, such as mustard gas, caused the greatest casualties per ton used. On an average, it took 500 lb. of H.E. or 60 lb. of mustard to disable one man, but the ratio of deaths to total casualties was twelve times less for gas than for non-gas cases. He therefore deduces that gas warfare is both effective and humane, and must be expected to play an important part in future wars. Details of gas-proof rooms, filter appliances, gas masks, emergency lighting and the cost of the gas and fire-fighting appliances sold by a variety of firms are given.

The second half of the book deals with buildings, trenches and shelters. Of buildings, those which are multi-story, steel-framed or of reinforced concrete are considered the most suitable both for resistance and for containing shelter accommodation. Provided the walls are splinter-proof, that is, 12 inches of ferro-concrete or 14 inches of brick, the ground floor in buildings without basements is recommended as the best level for a shelter, and the stair well gives the greatest protection. But the floor above the shelter must, as in basements, be capable of holding up the debris that may fall on it. The author favours the Swiss standard of strength required for these shelter roofs, which is considerably in excess of

that suggested by the British and German regulations. He also adds the concentrated load of 15-20 tons on a circle of 10 inches in diameter. This would only appear applicable in the case of factories and other premises where heavy machinery or fittings may fall from the upper floors.

Two types of lay-out for trenches are given; of these, the zig-zag has been found in Spain to provide greater safety than the crenellated type when considering the radius of damage from a direct hit. In various plates, such as Figs. 70 and 61, the provision of a burster layer, or thick concrete casing which is not bomb-proof, is apt to create a false impression of security. It is a sound principle, where bomb-proof protection against a direct hit cannot be provided, to keep the shelter roof as light as will hold up the splinters and debris that will fall upon it. With trenches in the open, about 18 inches of earth is sufficient. The more there is, the more difficult it is to dig people out in the event of a collapse.

On the subject of dispersal, Captain Glover gives an interesting table which shows that a number of small splinter-proof shelters gives a better chance of safety than a smaller number of larger ones. Prof. J. B. S. Haldane, on the other hand, basing his opinion on statistics and the

theory of probability, considers this a fallacy; and in his recent book, "A.R.P.", states that dispersal within a dangerous area does not reduce the probable number of casualties. Mathematically, Prof. Haldane is probably right. But from a psychological point of view, casualties over a large area are less disheartening than very heavy losses in one spot, and from a practical point of view, small dispersed shelters are easier to find or construct than larger ones. In practice, a battalion commander who kept his battalion in mass under long-range bombardment would not remain in command long. Generally speaking, in factories and public shelters, not more than fifty people should be accommodated in one place; where trenches are made, separate ones for each fifty are probably better than a connected system.

Chapter xi gives the responsibilities of the layman and recommendations for the protection of animals. These will be of use to townsmen, but farmers would probably have apoplexy at the suggestion that their farm roads should be concreted to facilitate decontamination and that their pigsties be made gas-proof. The book ends with the Home Office organization of A.R.P., details of various poison gases, a bibliography, and a useful index.

E. H. K.

Teaching Methods

(1) Interpretation in Teaching

By Dr. I. A. Richards. Pp. xxii + 420. (London: Kegan Paul and Co., Ltd., 1938.) 18s. net.

(2) Creative Teaching: Industrial Arts and Vocational Education

By Dr. F. Theodore Struck. Pp. xxv + 623. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 17s. 6d. net.

THE problem with which Dr. Richards deals is one that receives attention in the recent Spens report on secondary schools. The pedantry and formalism of the traditional teaching of grammar and of rhetoric (and to some extent of logic) have done much to kill these subjects as elements in the general curriculum and thus to create a gap which urgently needs filling. Whether or not the exercises of parsing and analysing sentences should be carried out in schools, it is clearly necessary that the art of comprehending and discussing meanings should be acquired in the course of education.

This book has the originality and liveliness which is characteristic of all Dr. Richards's work. He

has set problems in comprehension and expression to members of adult classes and discusses the results. From these he draws conclusions as to the nature of the difficulties to be met with in acquiring these arts and the ways of overcoming them.

The book itself is an object lesson in a living method of teaching grammar, rhetoric and logic. Probably most of its exercises are very much too difficult for any except the highest forms in schools; but the intelligent school teacher could easily devise his own exercises on the same principles, suitably graded for the mental ages of his pupils. Dr. Richards makes the interesting suggestion that a valuable exercise in comprehension may be provided by translation into Basic English. It is worth considering whether translation into Basic English might, at smaller cost in school time, provide the advantages to comprehension which have, in the past, been given by translation into Latin.

(2) Dr. Struck's book deals with vocational education. It is didactic, forceful and analytical. The author gives eight characteristics of the progressive teacher, nine objectives of the industrial arts,

eight means of up-grading vocational teachers, and so on.

There is much in this that may profitably stimulate self-criticism in other teachers than those of vocational schools. The book seems to be a summary of the writer's own educational

experience, and such a summary by an intelligent teacher is always of value. One wishes, however, that the author had written less of the general problems of teaching and treated rather more fully the special problems of vocational education.

R. H. THOULESS.

The Thermionic Valve: Principles and Practice

Moderne Mehrgitter-Elektronenröhren

Von Dr. M. J. O. Strutt. Band 1: Bau, Arbeitsweise, Eigenschaften. Pp. vii + 131. 12.60 gold marks. Band 2: Elektrophysikalische Grundlagen. Pp. v + 144. 13.50 gold marks. (Berlin: Julius Springer, 1937, 1938.)

THE thermionic valve is the classical example—it is even a heavily overworked example—of the everyday implement which sprang directly from the most academic physics. Its development from the useful diode to the revolutionary triode may not have been a calculated development. But the succeeding stages of advance have been guided by the ingenious and meticulous application, clearly reasoned and quantitatively evaluated, of modern physical knowledge. Of the political consequences of these developments, this is not the place to speak. Of the direct economic consequences it is sufficient to quote Dr. Strutt's estimate that a hundred and fifty million multi-electrode receiving valves are in everyday use.

To the progress through tetrode and pentode to the modern octode many nations have contributed, and the relative scientific and technical material is scattered throughout many periodicals. The Philips Laboratories in Holland, with a distinguished record of fundamental research and of technical development, have played a very important part in progress, and the author of this work has made many and notable contributions.

It is, therefore, peculiarly appropriate that the enlightened policy of the Philips concern, and the enthusiasm of Dr. Strutt, should put at our disposal in these two volumes the first connected account of the construction, characteristics and mode of operation of multi-grid receiving tubes, and of the electrophysical principles on which they are designed, computed and operated. Since the reconciliation of research and teaching has never yet been satisfactorily achieved, it would be ungracious to complain that the exposition shows signs of haste, that the arrangement of the material

might have been made more logical and convenient, and that the index in particular is ludicrously inadequate and ill-proportioned. When a leader in investigation takes time to write down for us an outline of his principles and practice, he has a right to claim immunity from criticism, alike of his haste to get back to his work and of his anxiety to tell us—however summarily in the later pages of the later volume—of the very interesting things that are in the foreground of his mind as he goes to press. The immunity should not be claimed by his proof-reader, who has done his work well but not perfectly, and a printers' error in the list of printers' errors strains tolerance. But these are small matters.

The first volume, on "Construction, Mode of Operation and Properties", treats these two latter subjects from the point of view of the static characteristics and tube data. In the second volume, on "Electrophysical Principles", the characteristics are derived from the constructional details by the application of the laws of electron-dynamics. This second volume has, as its second purpose, the tracing of the complicated motions of the electrons in multi-grid tubes, as revealed by calculation and measurement, and in particular by measurements in the short-wave region, which are shown to be of special value for the purpose.

Volume 1 is divided into three sections, dealing respectively with high-frequency amplifying tubes, mixing tubes ("The mode of operation of a mixing tube is always this, that the slope of its characteristic varies with the rhythm of the oscillator frequency") and tubes for low-frequency power amplification. The treatment is very generously illustrated by constructional and circuit diagrams, and above all by a wealth of characteristic curves and operational data. These are plotted with a greater variety of parameters, as abscissae and ordinates, than is usual, and the variety compels the close attention and stimulates the individual thought of the reader.

Volume 2 proceeds from the fundamental equations, with mechanical analogies, through

examination of the electron motions in diodes (without and with treatment of initial velocities, and under the condition of constant emission temperature at the cathode) in triodes and in the ideal tetrode. Static and dynamic tube capacities are discussed, and important and interesting sections are devoted to the characteristic tube admittances in the short-wave region and to dynamic measurements of the electron motions in hexodes, heptodes and octodes. The last few sections include brief examinations of transit-time effects, of the relatively new, rapidly widening and extremely promising field of secondary-emission tubes, of the vital question of fluctuation-noise and the construction of low-noise tubes, and of some important thermal problems in multi-grid receiving tubes. It is significant to observe that the utilization of secondary-emission phenomena has already made commercially available tubes of exceptionally high mutual conductance

(14 milliamperes per volt), and tubes of exceptionally low noise-level.

The work is made still more valuable by the use of practical units, by the prominence given to numerical evaluation throughout, and by the provision of a bibliography of approximately three hundred independent entries.

These volumes are indispensable to the circuit designer who wishes to make the best use of the lavish gifts showered on him by the valve-physicist. But it makes good reading for a much less specialized circle; to trace throughout the work the whole story of the octode, its growth from less complex multi-grid tubes, the interactions and secondary effects which must be considered in its design, is an exercise which will impress any physicist with the high quality of the scientific insight and diligence which are so generously and compactly built into the modern multi-grid receiving valve.

A Study of Drugs

A Text-Book of Pharmacognosy

By George Edward Trease. Third edition. Pp. x + 740. (London: Baillière, Tindall and Cox, 1938.) 21s.

IT is a far cry from the *materia medica* of the old days to the modern pharmacognosy. The change has come about largely as a result of the policy of the Pharmaceutical Society of Great Britain in setting this subject on a scientific basis and in demanding a high standard of attainment in it in its qualifying examinations.

The chief exponent of pharmacognosy in Great Britain for some time was the late Prof. H. G. Greenish, who developed the teaching of it at the Society's School of Pharmacy in Bloomsbury Square. He lived just long enough to revise his valued text-book of pharmacognosy in the light of the 1932 edition of the *British Pharmacopoeia*. Since his death, his successor, Mr. T. E. Wallis, has continued to enlarge the scope of pharmacognostical practice, especially in the field of quantitative micro-analysis. Simultaneously, developments have occurred in the schools of pharmacy in British and foreign universities and colleges.

Mr. Trease's book has largely replaced that of Greenish in the teaching institutions. It was first published in 1934 and has gone through two editions in four years. The present edition is fully

abreast of the recent advances in pharmacognosy, and much time and thought have been devoted to its production. The complete pharmacognosist is a man of many parts. His preliminary training in botany, zoology, chemistry and physics furnishes him with a foundation on which to build experience in the technique of microscopy, histology, morphology, taxonomy, descriptive botany, plant geography. He learns how drug-yielding plants are cultivated, how the drugs are collected, prepared, exported, stored, marketed. He must know something of their active principles and the chemical tests by which they are recognized, and he must be able to appraise quality, and detect sophistication or substitution, particularly in relation to powdered drugs.

The author has gone to great pains to secure accurate information, and has obtained the help of several collaborators who have special knowledge. He presents his subject-matter in an interesting and readable form, illustrating it where possible by numerous reproductions of photographs, drawings and diagrams. The text-book is of great practical as well as theoretical value. It is almost indispensable to students of pharmacognosy; but the older pharmacists as well as all botanists would do well to peruse it. The publishers also are to be congratulated on a carefully printed and faithfully illustrated volume.

W. O. HOWARTH.

The Culture of Cities

By Lewis Mumford. Pp. xii+586+32 plates. (London: Martin Secker and Warburg, Ltd., 1938.) 21s. net.

MR. MUMFORD is a disciple of Patrick Geddes. In "The Culture of Cities" he applies the principles of his master to the problems of the aggregations of man as city-dweller. He follows the growth of the city community as it has developed in the past, and then sketches the ideal in an essay of constructive reform.

The greater part of his book—that is the first four chapters, covering some three hundred pages—is devoted to the description of the four types into which he classifies cities as examples of communal association, and analyses the various characteristics of each type, tracing their consequences as forces moulding the life and character of the citizen. Of these types, the first is the medieval, which, as the author points out, was never far divorced from the countryside; the second is the city of court and parade, such as Paris under the ancient regime; thirdly comes 'Coketown', the product of the growth of industrialism and the assemblage of some of the most degrading conditions in which man can exist; and lastly 'Megalopolis', the contemporary city of banking and finance.

In this examination of cities of the past and present, Mr. Mumford not only shows himself to be a keen critic and acute analytical thinker, but also he gives evidence of a wide and profitable experience of many men and cities, which he brings to bear rationally on his conception of the ideal in form in relation to the needs of human development. What may perhaps be regarded as the pivotal principle of his conception is the necessity of communal control of the land—a principle to which we seem to be approximating, but with, some may think, fatal deliberation.

Wild Animals in Britain

By Frances Pitt. (British Nature Library.) Pp. viii+120+68 plates. (London: B. T. Bataford, Ltd., 1938.) 8s. 6d. net.

THIS addition to the "British Nature Library" is uniform in make-up with Seton Gordon's "Wild Birds of Britain" and Robert Gathorne-Hardy's "Wild Flowers in Britain", and it has attained the same standard of almost unique beauty of production and considerable usefulness.

But the team responsible for the book was almost bound to produce the gem that this is. It is now traditional that a Bataford book on any natural history topic is art and science combined to produce just the right thing. Most of the hundred photographs which adorn the text are by well-known Nature photographers, Millais's "Roe Deer" is reproduced as a frontispiece, and the coloured jacket is by John Nash, whose delightful colour lithographs and line drawings illuminate the companion volume "Wild Flowers in Britain".

The illustrations certainly form the perfect complement to the text of Miss Pitt, who needs no

introduction as a writer on natural history subjects. Scarcely a naturalist could have missed reading at least one of her many books, and hundreds of thousands of lay readers must have been charmed by her articles in various periodicals and newspapers. Here, as in all her works, Miss Pitt bases her descriptions chiefly on personal observation, thus making the text not only reliable but also intimate and charming. Anecdote and story mingle with text description in such a way as to give a scientific study which also stimulates friendly feeling towards the lower animals.

The book is deserving of the success which we feel sure lies ahead of it.

The Chemistry of Synthetic Surface Coatings

By Dr. Wm. Krumbhaar. Pp. 200. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1937.) 20s. net.

THE chemist is penetrating quite far into the paint industry, partly as the result of the introduction of synthetic materials, with the consequence that a good deal is known about such important subjects as the chemical reactions in the varnish kettle, driers, the surface chemistry of pigments and paints, and the physical chemistry of surface coating. These subjects form the headings of a practical little work by Dr. Krumbhaar, who is himself engaged in the industry in the United States, where the application of all sorts of new coating materials is very much encouraged. A pleasing feature of the book is a number of excellent descriptive photomicrographs.

The new knowledge has even reached the printing ink industry, where the traditional slow-drying linseed oil media are losing ground in favour of quicker drying vehicles based on synthetic resins: a useful chapter is allocated to these developments.

The book will be found both stimulating and informative.

The Children of Tane

Bird Life in New Zealand. By Mona Gordon. Pp. xii+250+8 plates. (London: J. M. Dent and Sons, Ltd.; Christchurch: Whitcombe and Tombs, Ltd., 1938.) 10s. 6d. net.

THIS book is written in a slightly romantic vein, making much play with Maori names; but it deals in an interesting manner with bird-life in New Zealand, particularly the forest avifauna and measures for its preservation. The clearance of woodlands has had a very serious effect on the native birds, and this has been aggravated by the introduction of alien species. Fortunately, several islands have been set aside as inviolable sanctuaries, although even on some of these great harm is being done to the vegetation by imported deer or goats.

Each sanctuary is described, with an account of its history and its present state. There are also chapters on such topics as the pollination of plants by birds, flightless birds, and migratory birds—under each of which heads New Zealand provides some remarkable examples.

Combination Tones in Sound and Light*

By Sir William Bragg, O.M., K.B.E., Pres.R.S.

WHEN two notes are sounded together, the listener may hear in addition other notes which are not overtones of either of the originals. They are combination tones, the frequencies of which are linear algebraic functions of the primaries. Let us denote the latter by m and n : a note of frequency $m - n$ is much more difficult to observe. There may be notes of other frequencies, $m + 2n$, $2m + n$. . . but these are weaker still. A full description of the effect is given by Jeans in "Science and Music", p. 287 *et seq.* It is possible to make experimental arrangements by which the existence of combination tones may be plainly demonstrated. Some of these arrangements are described in the present note.

The subject has had a curious history. Observation must be somewhat close and careful if combination tones are to be heard; this is no doubt the reason why no one described them before Sorge in 1745 and Tartini in 1754. Helmholtz was greatly interested in them and discussed them at length in his famous work on "Sensations of Tone". Koenig strongly opposed the theory which Helmholtz put forward in explanation. The point at issue was whether or no the extra tones were subjective or objective. Helmholtz claimed to have shown by experiment that they caused a response in tuned resonators; Koenig asserted that they had their origin only in the listener's ear. A number of other experimenters joined in the discussion. Lord Rayleigh, Waetzman, Edser and Rucker supported Helmholtz, while Preyer and Boesanquet sided with Koenig. Ellis, in the second edition of his translation of Helmholtz's book, devoted a long chapter to a reasoned comparison of the two theories.

In view of the vigour of the disputation it is strange to observe that, when certain conditions are satisfied, combination tones must have a real objective existence in the sense that resonators can be tuned to them. It is also true that, as Helmholtz pointed out, they can be generated within the ear, on account of the ear's peculiar structure. Certain preliminary conditions must be satisfied if the tones are to be objective, and it would seem that the long controversy was

maintained by failure to realize those conditions in all cases.

The discussion at last died away. It was not even referred to when fifty years later an exactly analogous problem was met with in wireless telephony and the discussion was repeated in full. The so-called side bands are combinations of the carrier wave and the audio wave, and in the sense already described, have just as real an existence. Still later, the phenomenon has been found again in the peculiar scattering of light known as the Raman effect.

The underlying principle is very simple. When vibrations of two different frequencies are imposed upon a medium as, for example, when two tuning forks are sounded, the chord consists only of the imposed frequencies and there are no combination tones in the air. But if during the production of sound the amplitude of one source depends at every instant upon the amplitude of the other, the combinational tones appear. In the first case the disturbance in the medium may be represented by

$$a \sin 2\pi mt + b \sin 2\pi nt.$$

In the second, there is sure to be a term of the form:

$$2c \sin 2\pi mt \times \sin 2\pi nt,$$

which is equal to

$$c \cos 2\pi (m-n)t - c \cos 2\pi (m+n)t,$$

and the combinational tones have an objective existence.

This conclusion is readily illustrated by experiment. In Fig. 1, A represents a coil seen edge-ways, through which either a steady current a , or an alternating current $a \sin 2\pi mt$ can be made to run. B is a smaller coil at right angles to A ; the centres of the two coils coincide. Through the second coil, either a steady current b or an alternating current $b \sin 2\pi nt$ may be made to run. The second coil can turn about a vertical axis which is perpendicular to the plane of the diagram. T is a cylindrical tube in which a slider s is mounted; the slider contains a piezo-electric microphone connected to a loud speaker. When B vibrates about its axis, which it must do if there are currents in the coils and one or both are alternating, the disk D flutters before the mouth of the tube. The tube, as a resonator, can be tuned by moving the slider.

* Friday evening discourse delivered at the Royal Institution on November 11.

In an actual experiment, the current of frequency $m = 250$ was taken from a high-frequency generator, that of frequency $n = 50$ was drawn from the lighting circuit. When the current in A was alternating and that in B was steady, the resonator responded to the 250 note. When the current in B was alternating, the response to the 250 note became much weaker but the resonator could be made to respond strongly to either 200 or 300. The torque on the B coil was proportional to

$$\sin 2\pi \cdot 250 \cdot t \times \sin 2\pi \cdot 50 \cdot t,$$

that is, to $\cos 2\pi \cdot 200 \cdot t - \cos 2\pi \cdot 300 \cdot t$.

The difference tone should be the stronger, other things being equal, because the equation of motion of the B coil may be written

$$K \cdot \ddot{\theta} = -c \left\{ \cos 2\pi(m-n)t - \cos 2\pi(m+n)t \right\},$$

where θ is the angular displacement and K is the moment of inertia of the coil and c is a constant; so that

$$K \cdot \theta = \frac{c}{4\pi^2} \left\{ \frac{\cos 2\pi(m-n)t}{(m-n)^2} - \frac{\cos 2\pi(m+n)t}{(m+n)^2} \right\}.$$

The movement of the disk at the mouth of the resonator can therefore be analysed into two harmonic terms, one of them having a frequency $m - n$ and an amplitude proportional to $1/(m-n)^2$, the other a frequency $m + n$ and an amplitude proportional to $1/(m+n)^2$. The response of the piezo-electric microphone, and the other electric and acoustic transformations of the energy which take place before the sound leaves the loud-speaker will alter the relative intensities of the two sounds, and will even introduce fresh combination tones; but the main effect is so pronounced that the verification of the theory is quite clear.

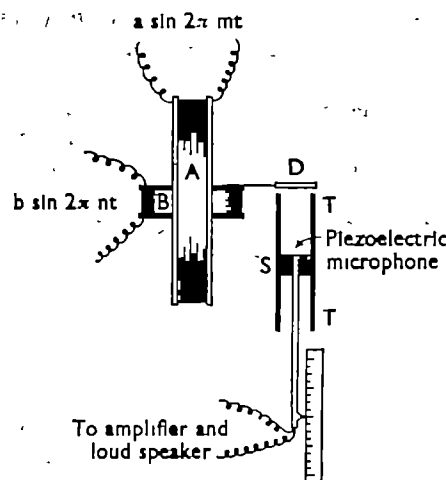


Fig. 1.

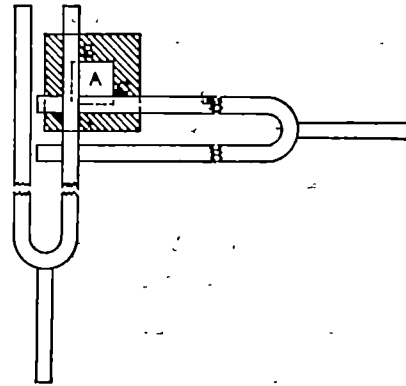


Fig. 2.

An effect depending on the multiplication of harmonic terms can also be shown in a second way (Fig. 2). The light which passes through a small square aperture in a screen is brought to a focus at a place marked A in the diagram. It is there partly intercepted by two tuning forks which are at right angles to one another. The beam of light is thereby restricted to a rectangle of which the sides may be denoted when the forks are vibrating by

$$a + b \sin 2\pi mt \text{ and } c + d \sin 2\pi nt.$$

The intensity of the light which passes on is therefore proportional to the product of these two expressions; and this product contains the term $bd \sin 2\pi mt \sin 2\pi nt$. The light falls on a photo-cell and produces an effect which is transformed into sound. The latter can be analysed by the piezo-electric resonator used in the first experiment. It is found to contain the frequencies m , n , $m - n$ and $m + n$.

If the two tuning forks are placed parallel to each other, the intensity of the transmitted light is proportional to $a + b + c \sin 2\pi mt + d \sin 2\pi nt$ and there are no combination tones due to the optical arrangement. There may be, however, faint combination tones due to the subsequent treatment of the energy in the detecting apparatus.

The way in which a detecting apparatus can generate accessory tones may be illustrated by the following example (Fig. 3). Suppose that a piezo-electric cell is inserted at the end of a short cylinder, and that a piston executes a harmonic motion, so that the volume of the air may be put equal to $v = v_0 + v' \sin 2\pi mt$. Then the pressure p , supposing the motion to be isothermal (though

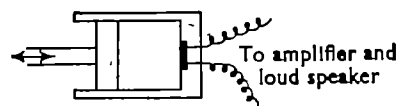


Fig. 3.

it makes no difference to the general result if it be taken as adiabatic) is given by $pv = c$, a constant.

$$\begin{aligned}\text{Therefore, } p &= \frac{c}{v_0 + v' \sin 2\pi mt} \\ &= \frac{c}{v_0} \left(1 + \frac{v' \sin 2\pi mt}{v_0} \right)^{-1};\end{aligned}$$

and this when expanded shows overtones, although the piston itself moves in a simple harmonic motion.

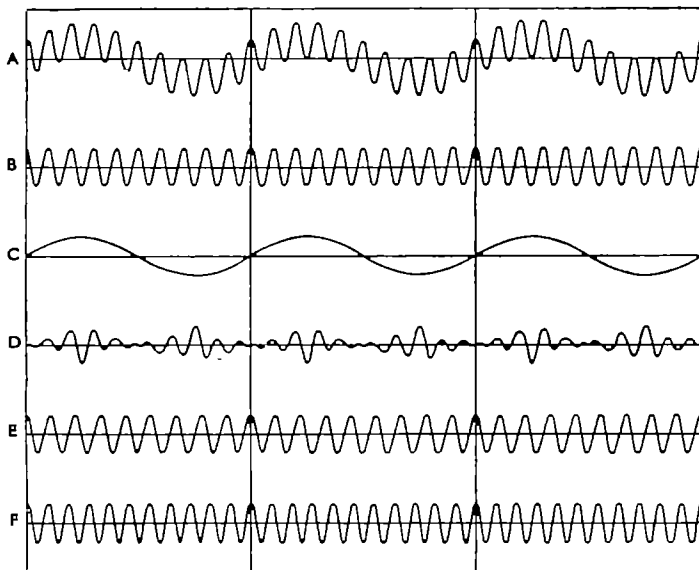


Fig. 4.

If there are two pistons operating on the one chamber,

$$p = \frac{c}{v_0} \left\{ 1 + \frac{v' \sin 2\pi mt}{v_0} + \frac{v'' \sin 2\pi nt}{v_0} \right\}^{-1};$$

and this when expanded shows a system of combination tones.

The variations of pressure can be converted into a complex sound in which the tones appear.

When a tuning fork is held before the mouth of the resonating tube used in the first experiment, the octave overtone is readily found.

When two notes are sounded on a harmonium or organ, combination tones are generally heard, though some people find a difficulty, especially at first. The combination tones of a harmonium at the Royal Institution are greatly intensified when a microphone is placed on the case of the instrument and connected to a loud-speaker. The combination tones of harmonium and organ would seem to be due to modulation, as in the simple instance just given. The pistons of the model are in the actuality replaced by the to and fro surges of air from the sounding pipes or reeds. It seems that in the

instance just given the combination tones are of greater importance in the vibrations of the wood-work of the chest than in the air outside.

In the radio transmission of sound, modulation is a necessity. Sound waves can be converted directly into electrical oscillations of similar frequency, but it is practically impossible to put into such slow oscillations sufficient energy for effective transmission. Hence a carrier wave of high frequency is employed which is modulated by sound waves and carries to the receiving station the impressions which have been made upon it. The form of the modulated wave can be represented in the customary way by such a figure as the curve *D* in Fig. 4, which may be described—approximately only—as a disturbance having a periodicity equal to that of the carrier wave, and an amplitude which varies in accordance with the impressions made by sound at the transmitting end. Strictly speaking, the disturbance is the sum of a number of different waves. One of them has the frequency of the carrier wave, and is as a matter of fact useless. Others are combination tones, and these are the real carriers; and there are other derivatives present in relatively weak amount.

In Fig. 4, the harmonic curve *B* may be taken to represent the carrier wave, that is to say, the ether wave due to the oscillator of the transmitting station, and *C* the ether wave into which a harmonic sound is transmitted. The frequency of *B* is ten times that of *C*; in practice, the factor is very much larger. If the disturbances were merely added as represented by the curve *A*, the two would be quite independent in their effects at a receiving station: the wave *B* would be detected just as if there were no wave *C*, and would convey nothing. The wave *C* would be too faint for perception. But if by proper manipulation at the sending station a wave is produced which is the continuous product of *B* and *C*, as shown in the curve *D*, then the effect of *C* on *B* is detected at the receiving station, that is to say, the sound signal is received.

The curves *E* and *F* are harmonic curves of frequencies nine and eleven times that of *C*, being the difference and sum respectively of the frequencies of *B* and *C*; and *D* can also be obtained by adding *E* and *F* together. The receiving station can detect these two separately. They are combination tones. Technically they are known as 'side-bands'.

The Raman effect is based on the same principle.

The incident light of definite frequency excites a forced vibration of the same frequency upon the molecule which it meets. If the magnitude of the response to the impressed electric force depends upon some quantity in the molecule which is undergoing harmonic oscillations, as for example

some relative oscillation of the atoms in the molecule, modulation occurs. Lines representing combination tones are found on each side of the line representing the original frequency in the spectrum of the scattered light.

¹ *Hazal, Phil. Mag.*, 19, 103 (1935).

Some Scientific Researches in the Region of Mount Everest

By N. E. Odell

ANOTHER expedition to Mount Everest has returned, with the primary object still unattained. As in the case of the four previous main attempts (1921 and 1935 were reconnaissances), the weather conditions, associated last year particularly with a very early monsoon, must be held chiefly responsible for a further failure to reach the top of the world's highest summit. While understood to be essentially a mountaineering expedition, in the intervals of strenuously pursuing the main objective an effort was made by two members of last year's party to carry out a certain amount of scientific work. It is much to be regretted that such work, on the more recent expeditions to Everest, has been in no way encouraged, but rather discouraged, by those responsible both for their organization and their leadership.

During the 1938 expedition, I had the opportunity of continuing the geological work commenced during the Expedition of 1924, and furthered by L. R. Wager in 1933¹. A. M. Heron, of the Geological Survey of India, had on the first Expedition of 1921 mapped geologically the Tibetan area lying to the north of the Everest Massif², but the stratigraphy and structure of the main Himalayan chain hereabouts was left to his successors. In 1924, a detailed study of the crystalline complex of the main range in particular was commenced by me, and I published a provisional geological map of the district surrounding Everest itself³. This work was continued during last year's Expedition, and an extensive collection was made of the various petrological types representative of the metamorphic series of the district. It is a tragedy that on the return journey almost the entire collection was stolen from one of our camps by Tibetan natives, the theft being presumably in mistake for the cash-box! However, with material collected in 1924, as well as by Wager in 1933, a comprehensive study is now being made of this particular region, although there must necessarily be gaps caused by the above irreparable

loss. From the information available, it is hoped that it will soon be possible to give a fair, though incomplete, account of the stratigraphy and age, as well as the ruling structures, of this complicated and inaccessible portion of the Himalaya.

Briefly, the age of the Everest stratified series is not younger than Permo-Carboniferous, while the intrusive granitic rocks are probably Tertiary, and date from the movements of that age, both horizontal and vertical, which have given rise to such pronounced structures as the Everest Thrust Fault (discovered last year on the south side of Everest), and the great fault-scarps confronting Tibet in many places along the northern flank of the main chain. There is, however, much important work yet to be done on these problems.

As to glaciological observations upon the unusual glaciers of this greatly elevated yet nearly tropical region, a start only has so far been made. Unlike the glaciers of the temperate zone, those of the Everest region appear to be frozen throughout their mass, a physical condition which places them in the category of 'high polar' glaciers (Ahlmann). This condition would seem to give rise to a greater brittleness and a tendency, as in the polar regions, for the glaciers to move more by fracture and shear than by what approximates to viscous flow. Not more than rough measures of the speed of these glaciers have as yet been made. Another point of interest is that the steeply inclined solar rays and intense insolation, together with a high rate of evaporation consequent upon the great altitude, give rise to remarkable and unusual wastage effects on the surface of these glaciers, of which the giant ice-pinnacles, and other *penitente* forms are examples. These same factors, coupled with the condition of the ice, have given rise to the very peculiar 'troughs', veritable ice-valleys, that are such a remarkable feature of the glaciers of the northern side of the Himalaya.

The present glaciers appear to be in a state of stagnancy, or possibly extremely slow retreat. That they once extended much farther down their

valleys is clear from the evidence of moraine-shelves along the Rongbuk valley and elsewhere. These consist of four lateral moraines, or discontinuous portions of them, one above the other, occurring at heights of from 400 ft. to 800 ft. above the valley-floor. Whether these glaciers, during the maximum Pleistocene glacierization of the region, debouched far out towards the Tibetan plains is not, from the available evidence, at present certain.

As to the study of the widespread post-glacial gravels along the southern border of the plains, and the extensive valley-terracing in the drainage-basin of the Arun River, an immense field lies open for further research. Wager⁴ has discussed the evidence of warped terraces and its possible significance in the tectonic history of the region; and it was a matter for the greatest regret that I was prevented last year from continuing the work upon this very important problem. In the valley of the Chiblung Chu and elsewhere, however, data were collected which suggest that much of the terracing in those areas may have been due to climatic rejuvenation, consequent upon Pleistocene conditions, rather than to tectonic.

Apart from the usual temperature and other meteorological observations, particular attention was paid in 1938 to determinations of relative humidity with an Assmann psychrometer, kindly lent by the Meteorological Office. In the light of the findings of G. Seligman that under Alpine conditions 85 per cent relative humidity constitutes a critical point at which wind-slab avalanches may take place, an attempt was made to test the theory under high Himalayan conditions, and especially on the slopes of the North Col. Under the difficult conditions of last year, however, no satisfactory conclusion was reached. Moreover, it had been hoped to bring into use a special high-speed anemometer and so obtain for the first time quantitative values of the wind velocity across the face of Everest. But the exceptionally early arrival of the monsoon, before we had actually reached the North Col, prevented this being done.

In spite of a good deal of preoccupation with illness on the Expedition, and apart from his being a member of the climbing party, Dr. Charles Warren was able in 1938 to collect further physiological data to amplify that obtained by his predecessors. This is now being examined, in particular samples of alveolar air, and the results will be published in due course. Specialists in this branch of science will be the first to admit that a vast amount of additional data is required before anything like a full understanding of many aspects of high-altitude physiology can be obtained.

The foregoing outline of researches attempted and accomplished, often under the greatest difficulties, should, it is hoped, be sufficient to indicate that much valuable work remains to be done by future Mount Everest expeditions. The only branch of scientific investigation that can be said in any way to have been completed is the topographical mapping, which was commenced by the Indian Survey detachment in 1921, continued in 1922 and 1924, and concluded locally in 1935 by photogrammetric methods. The field data obtained in 1935 have, however, yet to be worked up cartographically. That there is still an enormous field for scientific endeavour in this unique and little visited region must be realized when it is stated that geophysical and archaeological researches have so far never been attempted there. As far as geophysics is concerned, we are in complete ignorance as yet in regard to the state of gravity on the high plateau of Tibet. A very few determinations of the force of gravity would help us in understanding how that immense tract remains in such an elevated position without, apparently, the support inherent in folded mountain ranges themselves. A couple of trained observers for this particular purpose would be all that are necessary. Moreover, observations of terrestrial magnetism would be of great interest and value, and would amplify the important results of this kind recently obtained by Dr. Wienert of the (German) Schöfer Scientific Expedition, now working in the neighbouring territory of Sikkim and Tibet⁵, apart from those embodied in the extensive magnetic survey across Central Asia by W. Filchner during the last twelve years⁶.

As to archaeological research, along the route through southern Tibet one sees relics of many ruined mud-walled towns and villages, quite different in style of architecture from present buildings and dating back without doubt hundreds of years. Many of these structures suggest fortification, and there appears to be much in their character to recall the 'limes' (forts) of eastern Sinkiang, as described by Sir Aurel Stein. The study of these would clearly yield results of great ethnographical and historical value, and amplify the work of Sven Hedin north of the Tsangpo River.

In addition to the above studies, a large amount of important ecological and other work in natural history remains to be done. Indeed no real naturalist has accompanied the Everest expeditions since 1924.

The objection of native prejudice, that is in some quarters brought forward against scientific work on these expeditions, has often been unduly exaggerated, especially in regard to geology. For actually, at various places in Tibet, both lay and ecclesiastical members of the community have

sometimes offered fossils and other odd rock specimens for sale to members of the expeditions. With due tact and care it is quite easy in the pursuit of one's investigations to avoid offending the more unenlightened elements of a people who still largely live in an atmosphere of the Middle Ages, and who have cogently declared that Western

civilization can do nothing for them but promote unhappiness.

¹ Riddledge, "Everest 1933", §12.

² Heron, *Geog. J.*, 59, 418 (1923).

³ Odell, *Ibid.*, 66, 239 (1925).

⁴ Wager, *Ibid.*, 92, 239 (1937).

⁵ Personal communication.

⁶ Flohrer, *Geog. J.*, 62, 60 (1938).

Obituary Notices

Prof. E. B. Wilson, For.Mem.R.S.

BY the death on March 3 of Prof. E. B. Wilson, the United States has lost her foremost zoologist. During his long tenure of the professorship in Columbia University he made some outstanding discoveries in his science. He studied the growth and structure of the so-called 'trochophore' larva which is specially characteristic of the annelid worms. It is also found in the Mollusca, a group widely divergent in structure from the worms. Further, it occurs in the Polynoa Entoprocta and Phoronidea, and in a modified form it is seen in the Nemertinea. There can be no doubt that it represents in modified form the common ancestor from which all these groups diverged. If we put them all together, we see that in this way the origin of a large proportion of the Invertebrata is accounted for.

Prof. Wilson introduced the conception of 'cell-lineage' into embryology. By this is meant the study of the growth of a particular cell in the cleaving egg until it gives rise to an organ in the fully developed trochophore. He recognized two types of cell lineage which he termed respectively "determinate" and "indeterminate" cell-lineage. In the former type, which is characteristic of the trochophore group, each particular cell of the egg gives rise to a particular organ. The latter type is characteristic of the Coelenterata and Echinodermata. In this type up to a certain stage in the cleavage the cells are equipotential, that is, each of them can give rise to the whole organism.

In his later years, Prof. Wilson took up the study of the growth of the nucleus, because this is the sole carrier of heredity. This is proved by the case of the mammalian spermatozoon, which consists merely of a nucleus but which transmits all the characters of the father to the young organism. Prof. Wilson had as his colleague in Columbia University Prof. T. H. Morgan, whose famous theory of the chromosomes swept over America like a whirlwind. This theory was based on studies of the fruit-fly, *Drosophila*, and professors of "drosophily" have actually been appointed in some American universities. Wilson accepted with some reservations his friend's chromosome theory; but he was more conservative than Morgan, and refused to associate special characters with particular bits of chromosome. In 1913, Wilson received the honour of an invitation to deliver the

Croonian Lecture to the Royal Society, and he chose chromosomes as his subject.

Wilson's influence on the course of the study of embryology was very great. A large band of young workers in both the United States and Europe continued and extended his studies in cell-lineage. My own acquaintance with Wilson extended over a considerable number of years. I first met him in Naples in 1892 when we were fellow students in the Zoological Station. Afterwards, I met him in the United States when we were both members of the American Society of Zoologists and I was professor at McGill University in Montreal, a few miles from the American border. His ill-health and subsequent death were due to a tragic accident which befell him when he was conducting a body of students, men and women, on a cruise up the Pacific coast of Canada. On the return journey the boat struck a rock and foundered. Some of the students were drowned and others, including Wilson, had to spend hours in the icy water before being rescued. From this exposure, Wilson contracted rheumatism, which crippled him during the remainder of his life and ultimately led to his death. It is too sad to think of the additional work which he might have done had this accident not occurred.

E. W. MACBRIDE.

Prof. A. P. Coleman, F.R.S.

THE death of Prof. A. P. Coleman, emeritus professor of geology in the University of Toronto, will be regretted by all geologists, for he was one of the few remaining representatives of that school of teachers who had received their early training at a time when geology was still a self-contained study and had not differentiated into the varieties of interest that now divide us.

Born at Lachute, Quebec, and educated at Victoria University, Coburg, Canada, Coleman proceeded, as did many Canadians at that time, to Germany, where he obtained the Ph.D. degree of Breslau. On his return to Canada he was made professor of geology and natural history at his old University in 1888, and remained there until 1890 when he was appointed to the University of Toronto. His ability was early recognized both in England and in North America as is shown by, among other distinctions, his election to

the Royal Society, the award of the Murchison Medal of the Geological Society of London and the Penrose Medal of the Geological Society of America.

Like all of his generation, Coleman's geological interest was wide, and we have from his pen papers dealing with such contrasted subjects as ore deposits and paleontology, pre-Cambrian stratigraphy and Pleistocene geology. Wide as was the scope of his work, however, it is probable that he will be remembered most for two outstanding studies, the geology of the great nickel ore-field of Sudbury, Ontario, and the evidence and history of past ice ages. The mapping of the Sudbury district involved much more than a study of the ores themselves, for it necessitated the unravelling of the geological history of a most complicated series of pre-Cambrian strata which in its turn had far-reaching effects on the interpretation of the structure of the "Canadian Shield" as a whole. Notwithstanding the great amount of work that has been done in this area by the geologists of the Dominion Geological Survey, the Ontario Department of Mines and the International Nickel Co., there has been substantially no change made in the rock groups that Coleman differentiated in his map and report of 1913.

In assessing the merit of this study one has also to remember the conditions under which it was executed. When Coleman entered the field it was still the typical wilderness of northern Canada, without roads of any kind and, in much of the area, without even trails. Owing to the somewhat unusual topography also, canoeing did not provide that ready means of access which is common in Ontario and Quebec, so that Coleman had to carry his survey through mostly on foot. Notwithstanding these difficulties his map has survived the exacting demands made on it by mining engineer and prospector, and the only change of any moment has been the recognition of faulting in the south-western corner. Some more significant alterations have been made, however, in his interpretation of the origin of the ores themselves, and there are few geologists now working in the district who would accept his theory of the formation of the sulphides by liquation from the adjacent norite either through the action of gravity or by some form of filter-pressing.

In his other important study, that of the past ice ages, Coleman was the first to present conclusive evidence of the glacial origin of the Cobalt conglomerate and to show its similarities with Pleistocene glaciation. He was convinced that the tillite could be traced as a definite horizon throughout the Huronian rocks of Ontario, but some doubt has been cast on this thesis by Collins's identification of the Ramsay Lake conglomerate as an ancient regolith.

No reference to Coleman's work would be complete without a mention of his love for travel and exploration. He made a point of seeing for himself the most significant features of world geology and to this end travelled much in Europe, Africa, India, Australia and North and South America. It is this immediate familiarity with the field observations that is reflected in his most interesting book on "Ice Ages, Recent and Ancient" published in 1926, and one can well

guess that it was from the same source that he derived that enthusiasm that made him so highly esteemed and successful a professor in Toronto. He also had the happy gift of portraying the scenes he had visited with water-colour sketches, one of special interest being probably the earliest picture we have of Mystery Mountain (Mt. Waddington) in the Coast Range of British Columbia. He did not restrict his painting to scenery alone but also applied it, in dramatic fashion, to the illustration of his theories of ore genesis.

T. C. FLEMISTER.

Dr. Louis Fabry

We regret to announce the death of Louis Fabry, the well-known French astronomer. He was born in 1862 and belonged to a family that has given eminent men of science to their country, one brother, Prof. Charles Fabry, being the renowned physicist; another brother, Prof. Eugene Fabry, is a mathematician of repute.

At the early age of sixteen years, Louis Fabry received the degree of *Bachelier ès sciences*, and after various other academic distinctions he was appointed to the Observatory of Paris in 1884 as a student astronomer. Two years later he went as assistant astronomer to the Observatory of Nice, and in 1890 he took up work at Marseilles Observatory, from which he retired fourteen years ago.

Fabry's interests in astronomy were very wide and he wrote on a diversity of astronomical matters. In 1893 he was awarded the degree of *Docteur ès sciences mathématiques* for his thesis presented before the Faculty of Sciences in Paris, in which he showed that the absence of strongly hyperbolic orbits among the comets proved that these bodies were members of the solar system. In 1899 he dealt with the influence of his theory of cometary orbits on the hypotheses of cosmogony, and showed that the attraction of the distant stars and the lack of homogeneity in the primitive nebula, although not very considerable, were, nevertheless, not without influence, and their simultaneous intervention was sufficient to explain both the rotation of the sun and also the direct motion of the planets. In addition, these factors were responsible for causing the comets to deviate from the line which would make them fall towards the centre of the nebula, that is, the sun, and so prevented them from possessing perihelion distances that would otherwise have been practically zero.

Fabry did much useful work on minor planets, in particular, in the compilation of tables for facilitating the computation of ephemerides. The improvement of orbits by means of four observations is a well-known method but it involves rather complicated algebraic calculations. Fabry partly overcame this difficulty by means of new differential formulae which introduced considerable simplifications in the solution of the problem. The method was later applied with great success by other computers. His tables on the perturbations of minor planets with small eccentricity and also small inclination proved very effective for the computation of the orbits and

ephemerides of these bodies. Amongst his other lines of research may be mentioned his work on refraction, his tables for the determination of the geographical visibility, measurement of altitudes by the barometer, studies in certain problems of seismology, and also his zenithal apparatus, described in the *Bulletin astronomique*, 12, 148, which was capable of making observations simultaneously of the zenith and stars in the vicinity. He was four times awarded prizes by the Paris Academy of Sciences. Astronomical science has lost one whose versatility contributed so much to its progress.

M. D.

Prof. N. V. Nasonov

PROF. NICOLAI VICTOROVICH NASSONOV, who has recently died in Leningrad, was the oldest member of the Russian (now U.S.S.R.) Academy of Sciences. He was born at Moscow on February 27, 1855, and in 1874 entered the University of Moscow where he studied under the well-known zoologist, Prof. A. P. Bogdanov, and on obtaining his degree was appointed an assistant and later a lecturer at the Zoological Museum of the University. In 1889, Nasonov joined the University of Warsaw and a year later was appointed to the chair of zoology. In 1909 the Academy of Sciences elected him to membership and he was called to the post of the director of the Academy's Zoological Museum at St. Petersburg. A strenuous period of reorganising the Museum occupied his time until 1921, when he became director of the Special Zoological Laboratory of the Academy which had been founded by the famous A. O. Kovalevsky. By 1925 this Laboratory, which at first occupied three rooms and had a staff of three men of science, had developed into a large Laboratory of Experimental Zoology and Animal Morphology. It was only in 1935, when eighty years of age, that N. V. Nasonov was persuaded by his medical advisers to retire from active administrative work, but even then he continued researches on regeneration until his death.

The published works of N. V. Nasonov are more than a hundred and seventy in number and deal with a variety of subjects. His earlier morphological work was mainly done on insects and other Arthropoda (ants, Strepsiptera), but later he produced excellent papers on sponges (Clonidae), on the development of the ostrich, on the anatomy and systematics of Turbellaria, a monograph of the wild sheep of the Old World, to mention but some of the problems investigated by him with painstaking accuracy and discussed with a broad evolutionary outlook. During the latest period of his work at the Zoological Laboratory, N. V. Nasonov concentrated his attention on regeneration problems, and published a series of outstanding contributions dealing with physiological factors of regeneration, with the morphogenetic function of cartilage, etc.

N. V. Nasonov was well known beyond the borders of his own country, since at various times he visited and worked at the biological stations at Trieste, Marseilles, in the museums in London (1913) and Berlin, and carried out expeditions to Egypt, Sinai and Japan.

N. V. Nasonov's death means the loss of one of the oldest generation of Russian men of science who in the second half of the last century laid the foundation for the development of biological sciences in that country, and whose work served to create for Russian biology an honoured place in the front rank of world science.

B. P. UVAROV.

Prof. H. A. Cummins, C.M.G.

WE regret to announce the death of Prof. Henry Alfred Cummins, emeritus professor of botany in the University College, Cork. He was a member of a family prominent in Cork medical and university life. An elder brother was professor of medicine in the same College.

Cummins was born in 1864. Having taken the M.D. degree in the Royal (now National) University of Ireland, he joined the Royal Army Medical Corps, and was immediately plunged into a series of campaigns. He served in the Sikkim Expedition (1888), Ashanti (1895-96) and in the South African War (1899-1901), during which he was mentioned in dispatches. On the outbreak of the Great War he was recalled for service with the R.A.M.C., and was again mentioned in dispatches. During his military career, he cultivated a keen taste for botany, and managed to collect specimens wherever he might be, even going so far as to shoot epiphytes, otherwise inaccessible, from high forest trees.

In 1909, shortly after his retirement as Major, Cummins was appointed professor of botany in University College, Cork, a constituent college of the National University of Ireland. He held this position until 1931.

Cummins had a personality of considerable charm. He followed his original interests in spermatophytes with histology and cytology. Just before his retirement, he carried out experiments on the reclamation of estuarine shores near Cork by means of the rice grass, *Spartina Townsendii*. These appear to have been the first attempts at such reclamation in Ireland.

J. C. SPERRIN-JOHNSON.

WE regret to announce the following deaths:

Prof. F. J. Cheshire, O.B.E., formerly director of the Optical Engineering Department, Imperial College of Science, London, on March 24, aged seventy-eight years.

Prof. Vasili Y. Danilevsky, of Kharkov, known for his work in physiology and endocrinology, on February 25, aged eighty-seven years.

Mr. L. J. Newman, Government entomologist of Western Australia, on December 8, aged sixty years.

Baron Joji Sakurai, honorary professor of chemistry in the Imperial University of Tokyo, president of the Imperial Academy and the National Research Council of Japan, on January 28, aged eighty years.

Prof. John H. Schaffner, professor of botany in the Ohio State University, an authority on the taxonomy and phylogeny of the Ohio and Kansas flora, on January 27, aged fifty-five years.

News and Views

Social Relations of Science

FOR many years past, the columns of *NATURE* have borne witness to the growing importance of science in everyday life, and the corollary that men of science should interest themselves actively in the social implications of their discoveries has been frequently urged. That they are not indifferent to the movement was apparent from the discussion on the subject in *NATURE* of April 23, 1938, and from the decision, taken by the General Committee of the British Association at the Cambridge meeting last summer, to establish a Division for the Social and International Relations of Science. The circumstances of the formation of the Division are stated in *NATURE* of August 27, 1938, p. 380. It was very appropriate that the first chairman of the new Division should be Sir Richard Gregory, who was editor of *NATURE* when the subject was discussed in these columns, and it was equally appropriate that he should open the first public meeting of the Division, held in the University of Reading on March 28, when various aspects of the utilization and production of milk were described by half a dozen leading authorities. The highly controversial subject of pasteurization received a considerable amount of attention, and rightly so, for it is with such problems, involving scientific, economic and even political issues, that the Division may be expected to deal. Indeed, one of the prime reasons for the existence of the Division, namely, the need, in controversial issues, for propaganda based on scientific facts rather than personal points of view was well exemplified by this first meeting. It was announced that further meetings of the Division are being arranged to be held in London in May and in Manchester in June.

Henry Edward Armstrong Memorial Fund

It is proposed to establish a Trust Fund to the memory of the late Prof. Henry E. Armstrong. At the Finsbury Technical College, and later at the Central College, South Kensington, Armstrong and his co-workers, Ayrton and Perry, tried out and established the principles of technical education in Great Britain, and thus encouraged the foundation of polytechnics and technical colleges throughout the realm. Friends, old colleagues and past students have decided to establish a Trust Fund to perpetuate the memory of his dynamic personality. The aim, financially, is a modest one, so that all, including those who met him in other walks of life, may feel that they are contributing an integral part to the memorial whatever the dimensions of their individual contribution. The hope is for a memorial fund totalling about £3,000. This will provide a guarantee fund to give, as it accumulates, sufficient to ensure the publication (or to give substantial financial assistance in the publication or preparation) of any original works, within the ambit of Prof. Armstrong's recognized interests,

that would not otherwise see the light of day. It will also be within the terms of the Trust to arrange for suitable public lectures by the authors of the works. An additional detail of the plan is that the publication itself will carry as frontispiece a portrait of Prof. Armstrong, a biographical note and a reference to the foundation and objects of the Trust. Furthermore, the fund will provide for a memorial plaque, or bust, for the City and Guilds College, South Kensington, and perhaps replicas elsewhere. The administration of the fund, it is proposed, shall be undertaken by six persons, one each from the Council of the Royal Institution of Great Britain; the Royal Society; the City and Guilds of London's Institute; the Royal Society of Arts: one additional member whom the above representatives may appoint and the author of the most recent work published under the Trust. Subscriptions should be sent to the Hon. Treasurer, Sir Alfred Chatterton, The Coppice, Beckenham, Kent.

The Gatty Marine Laboratory, St. Andrews

MARINE biologists will be pleased to learn that preparations are being made to reopen the Gatty Marine Laboratory at St. Andrews, and that it is hoped to have it in full working order when the British Association meets at Dundee this year. The laboratory, which has been closed for some twenty years, was built in 1896 and presented to the University by Dr. C. H. Gatty. It replaced the wooden building (previously a fever hospital) on an adjacent site where the late Prof. W. C. McIntosh established in 1884 the first permanent marine laboratory in Great Britain. St. Andrews has been a classic ground for the marine naturalist ever since the time of Edward Forbes, nearly a century ago. It is true that with the decay of the local fishing industry and the increasing pollution of the inshore waters due to the growth of the city the facilities for collecting are not so good as they used to be; but the interest of the locality is by no means exhausted. It is to be hoped that Sir D'Arcy Thompson and Prof. R. J. D. Graham will be adequately supported in their efforts to make St. Andrews once again a centre of teaching and research in all that concerns the life of the sea.

Economic Aspects of Defence

A PAMPHLET, "Economic Aspects of Defence", by Mr. Harold Macmillan, M.P., directs attention to the economic factors which are involved in our present rearmament programme and to the futility of rearmament unless it is accompanied by an adequate foreign policy (London: Macmillan and Co., Ltd., 1939. 1s. net). In this respect, he is highly critical of the Government policy urging that as a result Britain has been growing weaker instead of stronger during the period of rearmament, and he urges that the first

step in the building up of our defence policy should be to recreate as quickly as possible the alliance of peace-loving powers in the League of Nations. He also urges the importance in rearmament of simultaneous attention to the problem of unemployment. By a full utilization of the labour-power of those now unemployed and by the elimination of waste due to competitive redundancy in production and distribution, we could increase our production of armaments and of consumers' goods as well. The available labour power and capital resources of the nation should be distributed according to a plan of increased national productivity. Defence preparations, he insists, involve consideration of overseas trade and our general economic relations with other countries; the productive efficiency of our economic system as a whole; the accumulation of supplies of storable foodstuffs and raw material and technical questions regarding the kind of war material to be produced, the location of the necessary factories and the organization of reserve productive capacity.

MR. MACMILLAN urges the creation of a single authoritative foreign trade organization which, under the general direction of the Overseas Trade Department, would bring together and combine the activities of the Import Duties Advisory Committee, the experts in charge of the Exchange Equalisation Fund's operations, representatives of finance to advise on foreign lending, and representatives of the exporters' selling organizations and of the importers' buying organizations. He reiterates the plea for a National Economic Council and urges an Industrial Reorganisation (Enabling) Act to afford industry the opportunity of putting its own house in order and achieving the necessary output, and discusses in some detail an attack on the unemployment problem. A Ministry of Supply is regarded as essential, and Mr. Macmillan stresses the compatibility of his proposals with the promotion of social and individual freedom. In his final chapter on nationalism or internationalism, he argues that a policy of static resistance is not enough. If a correct foreign policy sustained by adequate economic and military strength is the first task, this must be followed by the creation of the national foreign trade organization supported by a powerful internal economic organization conducted on rational lines for the full utilization of our capital and labour resources. These measures would enable us to evolve a method of economic collaboration which would eliminate the causes of war.

Social and Political Implications of Science

CONTINUOUS survey and co-ordination of teaching and research work of the University in the natural and social sciences in terms of its relation to the political and social problems of the day—such was the task undertaken in 1933 by a group of faculty members of the University of Wisconsin. They established an organization known as the "Science Inquiry" which has had the effect of concentrating the attention of much of the University staff on scientific problems facing the State and the nation.

A guiding principle has been that attacks upon such problems should be comprehensive rather than departmental so that instead of fragmentary findings "there may emerge at least the beginnings of integrated programmes with improved perspective and balance and with the application of these problems to State needs kept to the front". Among its publications are bulletins on the regional approach to conservation of natural resources, on transportation, and on the fight against crime; also (in preparation) international relations, public utility and power regulations, technological unemployment, communications, and consumption from the points of view of the producer and consumer. It is claimed on behalf of "Science Inquiry" that it has "evolved a group consciousness on the part of the faculty of common human problems which already is having a notable influence on the direction and emphasis of individual activities in teaching as well as research at the University".

U.S. National Youth Administration

A REPORT prepared for the Advisory Committee on Education of the United States by P. O. Johnson and O. L. Harvey on the National Youth Administration describes the organization and programme of the work of the Administration with a brief evaluation of some of its achievements. The National Youth Administration was set up as an agency within the Works Progress Administration in June 1935 and is thus primarily a relief agency, operating with funds earmarked for the general appropriation by Congress for emergency relief. Its two chief programmes are student aid and work projects, and its detailed operation in the several States varies according to local needs and problems. The number of young persons between 16 and 24 years of age receiving aid on the major programmes rose from about 470,000 a month in the first six months of 1936 to 580,000 a month in the same period of 1937 but has since declined owing to the reduction in the total budget. The student aid programme provides for those youths who are otherwise financially unable to continue their schooling. The work projects programme provides work experience for those whose interest in further schooling is relatively weak but who require work experience as a qualification for admission to private employment and earning a living. The guidance and placement service gives vocational guidance and attempts to place unemployed youth in employment. The apprentice-training programme was only an incidental function of the National Youth Administration and has recently been transferred to the Department of Labour. The programme of educational camps for unemployed women proved expensive to maintain and has been terminated for this and other reasons. The experiments have directed attention to many inadequacies in the provision for vocational guidance and, apart from the prevention of demoralization or restoration of morale, the National Youth Administration has demonstrated the possibilities of concerted action in the solution of the problems of youth, and particularly the value of proper direction and wise planning.

Recent Developments in British Surveying Instruments

BRIGADIER M. N. MACLEOD delivered the Thomas Young Oration of the Physical Society on March 24, taking as his subject "Some Recent Developments in British Surveying Instruments". Referring to the aerial camera as a surveying instrument, he pointed out that all parts of the ground must be photographed from two separate points. Plotting is done by combining, stereoscopically or otherwise, two such pictures. Plotting from tilted photographs requires complicated apparatus. In the first plotting machines the air positions of the camera and the direction of its optical axis had to be determined by a "resection in space" from control points on each photograph. There are theoretical as well as practical objections, however, to such independent determinations. In 1926, Dr. Fourcade propounded the idea of first determining the *relative* positions of the air cameras without reference to ground points, and devised a stereo-goniometer for this purpose. This principle has been made the basis of a new British automatic plotting machine constructed for the War Office and about to be delivered to the Ordnance Survey. In the majority of automatic plotters, the photographic picture is reconstructed stereoscopically and the image of a mark in the stereoscope is superimposed optically on the view. The visual or 'floating' mark can be moved about by the plotting mechanism and can be made to coincide in depth as well as in alignment with any point in the view. The apparent movements of the mark are transmitted mechanically to a plotting pencil. In all automatic plotters, however, much time is taken in the preliminary adjustment for reconstructing the stereoscopic view and determining its scale and orientation. It is hoped that the new instrument will enable this preliminary setting to be done decidedly more quickly than is the case in any existing foreign model.

Prehistoric Fire-Dog

COLONEL J. C. WYNN FINECH, a governor of the National Museum of Wales, has lent to the Museum for purposes of exhibition for a period of two years the remarkable example of Celtic iron-work known as the Capel Garmon fire-dog, which was found at Carreg Caedog Farm, near Capel Garmon, in 1852 by a labourer when digging a drainage trench. It is described (*The Times*, March 16) as constructed of two vertical bars, bent over at the top to form a neck, on to which is fastened a crest and the schematized head of an ox. The bars stand on semi-circular arched feet, and are connected by a horizontal bar thickened towards the middle, presumably to support the weight of the logs. The uprights are ornamented on each side by a ribbon of iron, bent in semi-circular loops, and with spiral coils at the top and bottom. The ribbon between the loops is attached to the upright by heavy decorative rivets. Other finds of a generally similar character have been made in south-eastern England in tombs belonging to the Belgic culture of the Iron Age, to be dated *circa* 100 B.C.-A.D. 50, while others, again approximately of the same period, have been found on the Continent

in areas occupied by the Celts, who seem in this instance to have adapted an object of Mediterranean type to their own uses. It is pointed out that the Mediterranean influence may perhaps be seen in a very special fashion in the crest of the Capel Garmon fire-dog, which with its thin vertical strip pierced at intervals with circular holes and bearing a thick bar flattened and curled at its lower end, and in its row of knobs representing the plume socket, suggests a Greek helmet crest. None of the fire-dogs so far discovered is as elaborate as the Capel Garmon specimen, as they lack the crest, the loops on the uprights, and the rivet-heads. The discovery of pairs of fire-dogs together suggests, although it is not known with certainty, that two formed a set, one being placed on each side of the fire, which was laid in the centre of the house.

New Egyptian Royal Tomb at Tanis

FURTHER details of the Egyptian royal tomb recently discovered at Tanis in the Nile Delta (see *NATURE*, March 25, p. 512) suggest that the results of its examination may prove of even greater interest than was anticipated at first. Another chamber has now been discovered and opened. It also proved to be intact. It is thought that the explorers may be fortunate enough to find still other chambers which have not been plundered; while there is the even more stimulating possibility that this may be the first only of a whole series of royal burials belonging to the twenty-first and twenty-second dynasties. Again, the walls both of the chamber in which the royal sarcophagus has been found and of that since opened are covered with paintings and inscriptions, from which presumably many historical data will be recovered, such as were, strikingly, absent from the tomb of Tutankhamen. Among those in the chamber of the sarcophagus is the cartouche of King Psusennes, identified with the King Shishak, who plundered Jerusalem in the reign of Rehoboam in 930 B.C. Many finely sculptured jars, some with beautifully carved stoppers, much jewellery of gold and precious stones and a huge sculptured human foot have been found. Within the silver mummy case of King Shishak was an inner casing of gold and leather. The first pictures of the tomb, funerary chambers and finds to reach England appeared in *The Times* of March 27.

Archaeological Expeditions to the East

THE departure for the East of two archaeological expeditions is announced, one proceeding to Iran and Afghanistan, and the other to Aden. Of these the former, conducted by Mr. Arthur Upham Pope, an authority on Sassanian art and archaeology, is the first section of a new architectural survey expedition of the American Institute of Iranian Art and Archaeology, of which Mr. Pope was one of the founders and the principal promoter. The members of the expedition will be engaged in studies preparatory to a complete history of Iranian architecture, a much-needed undertaking which, when complete, will contribute materially to the advancement of Iranian

cultural and historical studies. On the second expedition, Mr. L. P. Kirwan, a well-known archaeologist, will visit the Aden Protectorate for the purpose of inspecting and examining a number of archaeological sites between Aden and Lahej. He will visit Amadiya on the Andhali Plateau, which will be surveyed, and the ruins of Qohlan in Wadi Beihan. Mr. Kirwan will also examine and report on the archaeological material in the Aden Museum, which is now in process of being reorganized.

Exhibition of Chinese Art

AN exhibition has been arranged in the North Court of the Victoria and Albert Museum, South Kensington, which illustrates comprehensively the whole range of Chinese art from the prehistoric period at about 3000 B.C. down to modern times. With the exception of a small series to be seen in the Department of Ceramics, this exhibition includes all the objects of Chinese art of all kinds now in the possession of the Museum. It includes the Museum's share of the Eumorfopoulos collection, which provides some of the most striking and widely known exhibits. The arrangement of the exhibition is chronological and cultural. Each exhibit is grouped with others, whatever their character or material, whether of jade, textile, painting or pottery, provided they belong to the same period and are of the same cultural origin. The first and earliest exhibit is a neolithic pot of about 3000 B.C. A special feature of the exhibition is the important collection of ritual bronzes, which has been provided with special case-labels incorporating small photographs, illustrating the main features of style. A collection of Buddhist sculpture of the fifth and sixth century A.D. is on loan from Baron von der Heydt. Especially noteworthy are two wooden sculptures, one a figure of Kuan Yin, Goddess of Mercy, dating from the twelfth century, and a statue of a seated man, belonging to the fifteenth century. The exhibition is to be permanently on view.

British Museum (Bloomsbury): Recent Acquisitions

ACCESSIONS to the collections of antiquities and ethnographical objects in the British Museum (Bloomsbury) of exceptional interest were reported at the meeting of the Trustees on March 11. Of these one is a remarkably fine example of the Irish twisted gold torque, which has been accepted on loan for temporary exhibition from the Duke of Westminster. It is made from a single bar of gold, 50 inches long and weighing 26 oz. It has been chiselled and beaten into four flanges and then twisted and bent into a circle. The ends are recurved to fit into one another to form a fastening. It is of a type characteristic of the Middle Bronze Age and dates from about 1200 B.C. It was found in 1816 at Bryn Sion Farm, Flintshire. Another accession to the Department of British Antiquities is a collection of fragments of pots of dark earthenware, freely ornamented towards the top with hatchings, pitting, and finger-nail marks, presented by Mr. J. P. T.

Burchell. They were excavated by him in the Ebbsfleet Valley, Kent, at a depth of 10 ft. in stratigraphical conditions, which make it certain that this pottery is older than the neolithic period as at present understood. It is possible that this may prove to be the oldest pottery as yet found in Britain. It would seem to be connected with mesolithic types found on the Continent, such as those from the Danish kitchen-middens. It differs from British 'Neolithic A', and may indeed prove to be a predecessor of 'Peterborough' ware. Another accession of considerable archaeological interest is a human face, almost circular in outline, carved on a piece of Bath stone found near Charterhouse-on-Mendip. It has almond-shaped eyes and a small round hole for a mouth. It dates from the period of Roman occupation; but is thought to represent a native barbaric tradition. Of the ethnographical accessions the most striking is a wooden totemic figure of an eagle made by the Siwash Indians of Vancouver Island. It stands about four feet high, with wings half-spread, and is painted in gaudy colours, and has a fierce human face painted on the breast.

British Museum (Natural History): Recent Acquisitions

THE Mineral Department of the British Museum (Natural History) has acquired through Mr. Arthur Russell a small collection of foreign minerals from the collection of Philip Rashleigh, F.R.S., of Menabilly, near Fowey, Cornwall (1729-1811). The main part of the Rashleigh Collection is in the Truro Museum. Mr. Arthur Champion has collected rocks from various localities on a remarkable motor journey he made in 1937 from Dakar to Nairobi. The collection includes specimens from French West Africa and the Belgian Congo as well as from Senegal, Gold Coast and Nigeria. A fine specimen of the mineral thortveitite has been received from Prof. T. Vogt of Trondhjem, Norway, and suitable specimens have been sent him in exchange.

Broadcasting in 1938.

THE report of the Governors of the British Broadcasting Corporation for the year ended December 31, 1938, as presented to His Majesty's Postmaster-General, has recently been published as a white paper (Cmd. 5951. London: H.M. Stationery Office. 6d. net). The scope of the report is indicated by the headings of the main sections into which it is divided, namely, programmes, public relations, engineering and administration. During the year under review, the Corporation suffered a loss by the resignations of its first director-general, Sir John Reith, and of the deputy director-general, Vice-Admiral Sir Charles Carpendale. Mr. F. W. Ogilvie was appointed to the first position, while Mr. O. G. Graves became the new deputy director-general. The staff of the B.B.C. is now more than four thousand, and these have provided to nearly nine million licensed listeners a home broadcasting service of some 79,500 hours in 1938, with the remarkably small breakdown time of 0.028 per cent. In addition, nearly 33,000 hours

of Empire programmes were provided, while the aggregate time of operation for the television sound and vision transmitters has increased from 1,619 hours in 1937 to 2,679 hours in 1938. Among the increased programme facilities provided during the past year were daily news services in Arabic for listeners in the Near and Middle East, and in Spanish and Portuguese for listeners in Latin-American countries. Towards the end of the year, also, daily news services, intended primarily for European reception, were broadcast in French, German and Italian.

On the engineering side, a new medium wave transmitting station was opened at Aberdeen in September; and the construction of a new high-power transmitting station at Start Point in South Devon, and of a medium-power station at Clevedon, Somerset, is proceeding satisfactorily. The number of transmitters normally in use at the Daventry short-wave station has been increased from four to six, so that larger areas may be covered for longer periods. Further expansion is in hand at this station, including the provision of new transmitters and aerial systems. The scope of the television programmes has been considerably extended during 1938 by the provision of increased studio facilities at Alexandra Palace, by the purchase of a second mobile television unit for outside broadcasts, and by the establishment of improved relay link arrangements for such broadcasts. The report concludes with a statement of the financial position as at December 31, 1938.

Antarctic Whaling

THE *Polar Record* for January, a journal which has now widened its scope to include various articles in addition to news of polar expeditions, contains some details of the International Whaling Agreement of 1938. The measures agreed on in 1937 included a minimum size limit for various species, the restriction of the Antarctic whaling season from December 8 to March 7 and the prohibition of pelagic whaling in temperate and tropical waters. Last year the conference went further, though it was decided that restrictions on the numbers of whale catchers were impracticable at present. It was, however, agreed to prohibit the killing of humpback whales in waters south of lat. 40° S. for one year. This species is more vulnerable than blue and fin whales, and it is hoped thus to save the stock from exhaustion. It was also decided to prohibit all pelagic whaling for at least two years in the Pacific waters south of lat. 40° S. between long. 70° W. and 100° W. These waters so far have no pelagic or other whalers and so may well serve as a sanctuary for hunted species. In spite of these restrictions, it is admitted that the industry as a whole is probably taking an unduly large number of whales.

Australian Cancer Research

THE present position of organisations combating cancer in the Antipodes can be seen from the report of the ninth Australian Cancer Conference held in Sydney during April 5-8, 1938 (Canberra: Govern-

ment Printer, 1938). In many centres of the Commonwealth, new radiological plant has been installed and old apparatus improved, and attempts are being made to improve facilities for diagnosis in country districts. In an address given on the occasion of the Conference, Prof. E. C. Dodds pleaded for development of general research in basic sciences as being probably the best way of helping existing lines of cancer research. Dr. Robert Fowler discussed the research value of clinical records with particular reference to the 'follow-up' of cancer patients, and considered in some detail the indexing of cases. In a population of six and a half millions in Australia there were more than 7,500 deaths from cancer during 1936. A statistical examination of this cancer mortality was made by Dr. M. T. Holmes, who also summarized the results of treatment with radium at Australian centres over a nine-year period. Of 35,000 cases treated with radium, less than 10 per cent showed no improvement. Examination of data along similar lines should indicate how methods of treatment develop and how they compare with those of other countries.

The Dutch Physical and Medical Congress

THE twenty-seventh Dutch Physical and Medical Congress will be held at Nijmegen during April 11-13, 1939, under the presidency of Dr. G. Holst. General lectures will be given by Dr. G. Holst on "The Properties of Magnetic Materials" and by Prof. B. Brouwer on "The Significance of the Hydrodynamic Relations within the Skull Cavity and the Semicircular Canal for Neural Surgery" on April 11, and by Prof. L. S. Ornstein on "Physics and Biology" and by Prof. E. Gorter on "Very Thin Films" on April 12. The scientific work of the meeting will be dealt with in the four sections: Mathematical and Physical Sciences, Biological Sciences, Medical Sciences, Geological-Geographical Sciences, some seventy papers having been promised. A full programme of social functions, visits to factories, laboratories, hospitals and other places of interest has been arranged. Information can be obtained from the "Natuur en Geneeskundig Congresbureau", Bureau Vreemdelingenverkeer, Keizer Karelplein 9, Nijmegen, Holland.

Kathleen Schlesinger Research Fellowship

THE Medical Research Council invite applications for the Kathleen Schlesinger research fellowship which has been provided from a fund established by the late Mr. Eugen M. Schlesinger and Mrs. Schlesinger in memory of their daughter. It will be awarded to a suitably qualified person who will devote his or her whole time to "investigating the origin and nature of cysts of the brain whether arising from tumours or not or to such studies of other conditions of the central nervous system as the Council may from time to time permit". It will ordinarily be tenable at the National Hospital for Diseases of the Nervous System, Queen Square, London, and for a period of one year in the first instance. The stipend will be at the rate of £300 per

annum, with up to £50 per annum for research expenses. Further information can be obtained from the Secretary, Medical Research Council, 38 Old Queen Street, Westminster, S.W.1.

Earthquakes in Japan and Greece

An earthquake, reported as the strongest for five years, shook several parts of the island of Kyushu at 12.22 p.m. local time on March 20 (3.22 G.M.T.). The shock was felt in Fukuoka but appears to have been strongest in Miyasaki where property and power lines were damaged and twenty people injured. The nearest active epicentre to this region appears to be $31^{\circ}8' \text{ N.}$, $131^{\circ}8' \text{ E.}$ where shocks occurred on 1929 5 m. 21 d., and 6 m. 11 d. There are three lines of weakness near the island of Kyushu according to Imamura: two pass through Nagasaki and run roughly east-north-east and south-south-east whilst the other is just off, and approximately parallel to, the south-east coast.

An earthquake shock of considerable intensity was felt on March 27 in Athens and other Greek towns though no great damage is reported. The epicentre of the shock was probably near Chalcis though very little information is at present available. It will be remembered that the centre of the disturbances on July 20, 1938, was near $38^{\circ}35' \text{ N.}$, $23^{\circ}8' \text{ E.}$, near Soala Oropos.

Royal Geographical Society: Awards

HIS MAJESTY THE KING has approved the award of the Royal Medals of the Royal Geographical Society as follows: The Founder's Medal to Mr. Arthur Mortimer Champion, for his surveys of the Turkana Province and the volcanoes south of Lake Rudolf; the Patron's Medal to Prof. Hans Ahlmann of Stockholm, for his exploration and glaciological studies in the Arctic. The Council has awarded the Murchison Grant to Mr. Robert Benthall, for his mapping and geological investigations in Ellesmere Land; the Back Grant to Lieut.-Commander R. E. D. Ryder, for his captaincy of the *Penola* and his marine surveys on the British Graham Land Expedition; the Cuthbert Peek Grant to Mr. W. Vaughan Lewis, for his physiographical studies in Great Britain and Iceland; the Gill Memorial to Mr. J. V. Harrison, for many years' exploration in Central and South America and Southern Iran.

Announcements

COLONEL J. A. MANFOLD has been appointed director of hygiene at the War Office in succession to Major-General H. H. A. Emerson, who will retire shortly.

THE Herbert Jackson Prize for 1938 of the L.M.S. Railway Co. has been awarded to Mr. J. N. Bradley, an assistant metallurgist in the Company's Research Laboratory at Derby, for his paper entitled "The Separation of Mixed Gunmetal and White Metal Borings". A Jackson Medal has also been awarded

to Mr. C. W. Newberry, research assistant in the engineering section of the same Laboratory, for a paper entitled "An Investigation into the Occurrence and Causes of Locomotive Tyre Failures". The Herbert Jackson Prize is awarded annually by the L.M.S. in memory of the late Sir Herbert Jackson (an original member of the L.M.S. Advisory Committee on Scientific Research), to a member of the Company's research staff for the best written account of an investigation carried out in the Companies' Laboratories during the year.

At the annual general meeting of the Ray Society held on March 23, the following officers were re-elected: *President*, Sir Sidney F. Harmer; *Treasurer*, Prof. F. E. Weiss; *Secretary*, Dr. W. T. Calman. Dr. John Ramsbottom was elected a vice-president, and Mr. E. R. Martin, Mr. D. M. Reid, and Col. R. B. Seymour Sewall were elected new members of Council. It was announced that a "Bibliography of the larvae of Decapod Crustacea" by Dr. R. Gurney, and the first of two volumes on "The Comity of Spiders" by Dr. W. S. Bristowe are in the press and will be published shortly. The first volume of a work on "British Water Beetles" by Prof. F. Balfour-Browne is nearly completed and will form the issue to subscribers for 1939.

THE University of Pavia has arranged a celebration in honour of the eighteenth-century physiologist, biologist and volcanologist, Spallanzani (1729-1799), which is to be held in Pavia on April 11-14. A monument to Spallanzani is to be unveiled and a programme of scientific addresses, mainly on modern genetical problems and the physiology of reproduction, is being prepared by delegates invited from various countries, including Prof. R. Ruggles Gates, Prof. F. A. E. Crew and Dr. C. F. Pantin from Great Britain. Meetings of the societies for experimental biology, botany, geology and veterinary medicine are also being held at the University, and on April 15 a visit will be paid to the Spallanzani Museum at Reggio Emilia.

IN 1937 the birth-rate in the U.S.S.R. was 18-19 per cent higher than in 1936 and the increase in population was a little more than 2 per cent. During the first ten months of 1938 there were 100,000 more marriages in the Soviet Union than in the corresponding period of 1937.

PROF. V. A. FOCK, of the University of Leningrad, writes that the transcription of his name in the article on the U.S.S.R. Academy of Sciences in *NATURE* of February 25, p. 343, namely, Fok, is incorrect and should be as here indicated.

ERRATUM. In the list of "Forthcoming Books of Science" in *NATURE* of March 11, p. 428, the volume by Prof. E. J. Conway to be published by Messrs. Crosby Lockwood and Son, Ltd., should be entitled "Microdiffusion Analysis and Volumetric Error".

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 564.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Activity of the Succinic Dehydrogenase

It has long been held that the succinic dehydrogenase requires no co-enzyme or intermediary hydrogen carrier to link its activity with that of the cytochrome system.

Ahlgren¹, however, working with a preparation made by extracting washed horse muscle with a solution of disodium hydrogen phosphate, found that with added succinic acid it induced an oxygen uptake which, though vigorous at first, rapidly fell to near zero. In the presence, however, of a *Kochsaff* from rabbit-muscle, the uptake was greater and much longer sustained, indicating that a thermostable factor may be necessary to complete the activity of the enzyme. He found, on the other hand, that the presence of the *Kochsaff* had no effect whatever on the rate at which the enzyme preparation reduced methylene blue.

Ahlgren's results have much interest but do not perhaps yield quite definite conclusions. The significance of the effect of muscle-*Kochsaff* as observed by him seems to be lessened by the experimental results we have to report.

We have ourselves obtained, from pigs' heart muscles and rabbits' skeletal muscles, preparations of the succinic enzyme which, in the presence of the substrate, actively reduce methylene blue anaerobically, but prove quite unable to induce any oxygen uptake, though in a system containing adequate concentrations of cytochrome c and its oxidase. In what follows, the method by which such preparations have been obtained will be briefly described, together with some details of their behaviour.

In an attempt to purify or concentrate the enzyme we have tried the solvent power of ethylene glycol, dodecyl sulphate, formamide, saponins and bile acids, and also glycerol and phenol. With the exception of bile salts, none of these was satisfactory. In our final procedure we have started with the muscle residue left after thorough extraction with sodium and lithium chlorides (Hopkins, Morgan and Mann)². This is first extracted with a solution of bile salts. In most experiments a commercial preparation of tauroglycocholate in 10 per cent solution was employed, but we have later used pure sodium deoxycholate (4 per cent) with advantage. The material insoluble in such solutions, being centrifuged off, the supernatant solution is clear, or shows at most a slight opalescence. It is cooled to 0° C., and mixed with an equal volume of ice-cold ethyl alcohol. The resulting precipitate is centrifuged off and washed with cold alcohol until free from bile salts. The alcohol precipitate is then extracted with 20 per cent urea solution. Finally, the urea is removed by dialysis and the precipitate, which rapidly separates, constitutes the preparation used in our experiments.

It is insoluble in water, and we have employed it in the form of a milky aqueous suspension.

It is easy to show that a factor not involved in the activation of the succinic acid hydrogen atoms, but essential for their transfer to the cytochrome system, is, at the stage of extraction with bile salts, dissociated from the enzyme and is itself not soluble in bile salt solutions. That the hydrogen activation is independent of such a factor is made sure by the consistently high activity of these solutions as displayed by the Thunberg technique, in spite of the fact, which separate experiments have shown, that bile salts somewhat inhibit (reversibly) the enzyme activity. The failure of hydrogen transference can be shown spectroscopically or manometrically. The chloride extracted muscle reduces cytochrome freely, but if to the bile solution (with substrate) oxidized cytochrome be added, there is no reduction at all, or, at most, a very slow and feeble one. It is easy to show that the cytochrome oxidase is present in these bile extracts.

Manometric results demonstrate unequivocally that, in a system containing succinates, cytochrome and its oxidase, the bile salt solution induces no oxygen uptake. This is equally true of our final preparation in spite of its high activity with the methylene blue technique.

The addition of methylene blue (1 mgm. in 3 c.c. of solution) to a system containing the purified product results in an oxygen uptake which, though relatively slow in the bile solution, is rapid in the final preparation. None of the known coenzymes can act as the missing carrier of hydrogen, nor can glutathione, vitamin B₁, adrenaline, ascorbic acid, nicotinic acid amide. With flavin-adenine dinucleotide a slight but probably not a significant uptake of oxygen may be observed. A muscle-*Kochsaff* similar to that used by Ahlgren has even less effect. If very high concentrations of cytochrome c are added to the bile solution there is a slow oxygen uptake. With the final preparation this is not observed.

It is of some interest to compare the contents of the original bile extract with those of the final product. In the former, in addition to the succinic dehydrogenase, the lactic dehydrogenase is present, but not the glycerophosphate enzyme which contact with bile salts destroys. Cytochrome oxidase and cytochromes a, b, c are present, though the spectra a and b are weak. Diaphorase (flavoprotein) is present. In the final preparation the lactic enzyme is not found, nor is the cytochrome oxidase. It contains some cytochrome c, but the spectra of a and b are not visible. Diaphorase is still present.

The striking difference between the glycerophosphate and the succinic enzymes is noteworthy, the latter being completely resistant to the action of

the bile salts. On the other hand, the lactic enzyme, while resistant to bile salts, is wholly destroyed by urea. This recalls the equally striking difference between these enzymes under the influence of glutathione (Hopkins and Morgan)².

The following table summarizes some typical results of our experiments.

30 mgm. dry weight of enzyme preparation, 0.3 ml. *M/2* succinate, pH = 7.0, temperature 37°.

Methylene blue (400 γ)	Reduction in minutes	Oxygen uptake (μl/30 min.)
1. Salt extr. heart muscle	5	1. Salt extr. heart muscle 230
2. Salt extr. heart muscle in presence of deoxycholate ..	12	2. Salt extr. heart muscle in presence of deoxycholate .. 170
3. Bile extract ..	6	3. Bile extract alone .. 9
4. Final preparation ..	5	4. " " + 1 mgm. MB 100
		5. " " + 0.2 c.c. Koch's salt .. 15
		6. Final preparation alone .. 0
		7. " " + 1 mgm. MB 180

F. GOWLAND HOPKINS.

C. LUTWAK-MANN.

E. J. MORGAN.

Biochemical Laboratory,
Cambridge.

¹ Ahlgren, G., *Scand. Arch. Phys.*, **30**, 16 (1938).

² Hopkins, F. G., Morgan, E. J., and Lutwak-Mann, C., *Biochem. J.*, **32**, 1839 (1938).

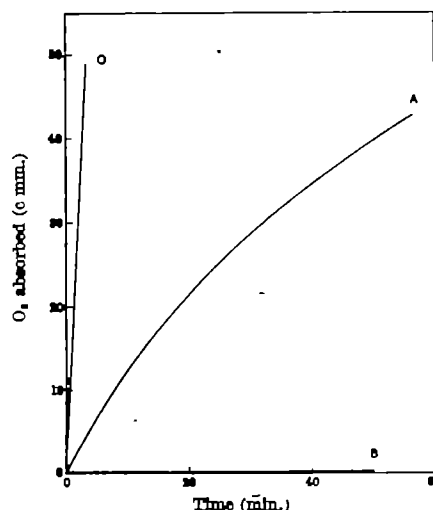
³ Hopkins, F. G., and Morgan, E. J., *Biochem. J.*, **32**, 611 (1938).

Lactic Dehydrogenase and Cytochrome

THE bulk of the respiration of most animal tissues, yeast, etc., takes place through the alternate oxidation and reduction of cytochrome. The reduction of cytochrome is mainly due (a) to a small group of dehydrogenases which are believed to reduce cytochrome directly, and (b) to flavoproteins which transport hydrogen from other dehydrogenases through coenzymes I and II. A typical dehydrogenase of the first class is the lactic dehydrogenase of yeast, which does not depend upon these coenzymes or flavoprotein, but which in the crude state reduces cytochrome *c* readily in the presence of lactate. Some months ago we observed that a partially purified preparation of this dehydrogenase failed to reduce cytochrome, though it still reduced other hydrogen acceptors like methylene blue. We are at present engaged in the purification and isolation of this enzyme. We find that the purified enzyme still reduces methylene blue freely in the presence of lactate, but is completely inactive towards cytochrome. The following experiment shows this very clearly.

Absorption of oxygen was measured in Barcroft manometers in the usual way. Curve A shows the oxygen uptake of the purified lactic dehydrogenase + lactate + methylene blue: any methylene blue reduced is, of course, re-oxidized with uptake of oxygen. Curve B shows the uptake of the dehydrogenase + lactate + cytochrome *c* + cytochrome oxidase: had any cytochrome been reduced it would have been re-oxidized by the oxidase with uptake of oxygen. Curve C shows the uptake of *p*-phenylenediamine + cytochrome + cytochrome oxidase, showing the presence of an excess of oxidase, which was highly active in oxidizing cytochrome reduced by the *p*-phenylenediamine.

These results show that an additional catalyst is necessary for the reduction of cytochrome, possibly a hydrogen-carrier acting between the dehydrogenase and cytochrome. This is present in the crude preparations, but is removed in the purification process. We have shown that this catalyst is not identical with any of the known coenzymes, the flavoproteins of yeast or muscle, or the flavine mono- or di-nucleotides. It is of interest that Haas¹ finds that although



CURVE A: 1 c.c. LACTIC DEHYDROGENASE + 0.3 c.c. *M.* LACTATE + 0.1 c.c. *M/1,000* METHYLENE BLUE + 1.6 c.c. BUFFER.

CURVE B: 1 c.c. LACTIC DEHYDROGENASE + 0.3 c.c. LACTATE + 0.5 c.c. CYTOCHROME *c* + 1 c.c. CYTOCHROME OXIDASE + 0.2 c.c. BUFFER.

CURVE C: 0.2 c.c. *p*-PHENYLENEDIAMINE + 0.5 c.c. CYTOCHROME *c* + 1 c.c. CYTOCHROME OXIDASE + 1.3 c.c. BUFFER.

his flavoprotein reduces cytochrome, it loses this property when highly purified. It is possible that the same or a similar catalyst is involved. If this catalyst is necessary for the reduction of cytochrome, it follows that it must play a very important part in cell respiration.

MALCOLM DIXON.

Biochemical Laboratory,
Cambridge.

L. G. ZERFAS.

Feb. 22.

¹ Haas, *Biochem. Z.*, **226**, 378 (1938).

A New Method of the Determination of Saturation by Vitamin C

THE only reliable method for determination of the saturation of the living body by vitamin C has so far been that of Tillmann-Harris-Ray. It consists essentially of the daily administration of 300 mgm. of ascorbic acid intravenously, until at least half of this amount reappears in the urine. If the body was saturated, the ejection of this quantity takes place within 1-4 days afterwards. If hypovitaminosis dominates, then the ejection is delayed. So far, by examining blood directly only extreme values can be evaluated: above 1 mgm. per cent indicates saturation, while below 0.4 mgm. per cent indicates hypovitaminosis. Concentrations ranging between cannot be evaluated properly, because

0.5 mgm. per cent may already signify saturation, while in contradistinction 0.9 mgm. per cent may, in certain circumstances, indicate hypovitaminosis.

It seemed probable that intravenous injection of 300 mgm. of ascorbic acid after a previous determination of the vitamin C concentration prevailing in blood may disclose, after repeated determination, whether saturation or hypovitaminosis was originally present. In the latter case, the amount of vitamin injected may be expected to make up the amount and the subsequent determination would disclose this fact by giving the same or an only slightly increased value compared with that of the first determination. If, on the other hand, saturation originally prevailed, the values of the second determination would disclose an increased amount, the organs storing the substance either slowly or not at all.

The validity of this assumption was proved experimentally. If the first determination disclosed less than 1 mgm. per cent concentration, and 300 mgm. were injected, at least double the amount was determined two hours afterwards, indicating that originally saturation dominated. If hypovitaminosis was originally prevalent, the ultimately determined amount was the same as the original, or slightly increased, but never twice as much.

In cases which displayed a concentration higher than 1 mgm. per cent from the start, this was not always doubled after the subsequent injection, the surplus being somehow ejected. In some cases it was possible to ascertain that the ejection was due to the renal function. The practicability of the test is not impaired by this since concentration above 1 mgm. per cent signifies saturation anyhow. All cases were controlled by the Tillmann-Harris-Ray test and the intracutaneous method of Rotter.

For determining the blood concentration, the method of Berend-Fischer was applied, this being sufficiently simple for clinical purposes. Out of forty cases investigated, only one proved a failure.

ANDRÉAS GÓTH.

Department of Int. Medicine,
Count Albert Apponyi Polyclinic,
Budapest.
Feb. 14.

Free and Bound Vitamin B₁ in Milk

We have shown¹ that the fluorimetric assay² of vitamin B₁ in milk gives values about 50 per cent lower than the biological test. The difference was not due to the presence in milk of free cocarboxylase or of the monophosphate, as in no case could more than a trace of fluorescence due to oxidized phosphorylated anserin be observed in the aqueous layer after extraction with iso-butanol.

We now find that after incubation of raw milk or of reconstituted dried milk with taka-diastase (containing taka-phosphatase, protease and doubtless other enzymes) at pH 3.7-4.0, the fluorimetric assay is almost doubled. Peptic digestion gives very similar results even when the phosphatases of milk have been inactivated by heating.

It seems probable, therefore, that, in addition to free vitamin B₁ there is present in milk a vitamin B₁-protein complex. Ultra-filtration experiments support this view. After filtration of milk through 'Cellophane' the serum contains only free anserin and the substance which yields vitamin B₁ after incubation with pepsin or treatment with taka-

diastase is concentrated in the protein fraction. The recovery is nearly quantitative.

The evidence suggests that the bound vitamin B₁ is not adsorbed but is a constituent of the protein molecule.

J. HOUSTON.
S. K. KON.

National Institute for
Research in Dairying,
University of Reading.
Feb. 28.

¹ Henry, Houston and Kon, *Chem. and Ind.*, 57, 974 (1938).

² Jansen, *Rec. Trav. chim.*, 55, 1045 (1936).

³ Foley and Matlick, *Biochem. J.*, 57, 1113 (1933).

Production of Diacetyl by Faecal Streptococci

In an investigation of the metabolism of both 'resting' and growing cells of lactic acid bacteria we have found that only the faecal streptococci (*Str. faecalis* and *Str. liquefaciens*) produce considerable quantities of diacetyl, which is recognized to be responsible for part of the aroma of milk products. No other lactic acid bacterium studied in this way produced diacetyl.

The bacteria in massive suspension were held in phosphate buffer plus glucose at pH 6.25, or grown in milk and yeast milk. Diacetyl was only produced in the presence of oxygen. Distillation with ferric chloride greatly increased the yield of diacetyl so that of the acetoin produced in the fermentation only a small part had been oxidized to diacetyl, which was identified by smell, the Voeges-Proskauer reaction and the formation of nickel dimethylglyoxime.

Aroma in butter and other milk products is usually attributed to the fermentation of citric acid by the citric fermenting streptococci¹ and it has also been claimed that the heterofermentative lactobacilli can produce the aroma substances². It may be emphasized that both these groups are quite unable to form the aroma compounds from glucose under 'metabolic' conditions.

PRODUCTION OF AROMA CONSTITUENTS UNDER ANAEROBIC CONDITIONS

	"Metabolic" tests (Washed cells in glucose-phosphate)		Cultural tests (Growing bacteria in milk and yeast milk)	
	<i>Str. faecalis</i>	Heterofermentative streptococci and lactobacilli	<i>Str. faecalis</i>	Heterofermentative streptococci and lactobacilli
Volatile acid	+	+	0	+
Alcohol	0	0	0	+
Diacetyl + acetoin	+	0-	+	0

It is well recognized that milk produced in a very clean manner yields a mild flavoured cheese and that the best and fullest flavoured cheese are frequently made under conditions favouring the seeding of the milk with many organisms, of which the faecal streptococci may be directly concerned in the production of flavour.

J. G. DAVIS.
H. J. ROGERS.
C. C. THREL.

National Institute for Research in Dairying,
University of Reading.
Feb. 22.

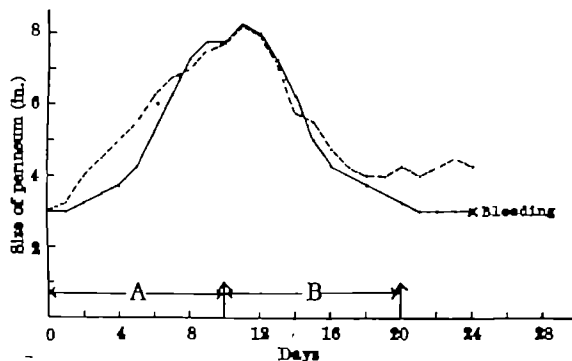
¹ Hammer, *Res. Bull. Is. Agr. Exp. Sta.*, 63 (1930).

² Ritter, *Landw. Jahrb. Schweiz.*, 218 (1934).

Quantitative Inhibition of Oestrone by Progesterone in the Baboon, with Reference to this Phenomenon in other Animals

THE object of this preliminary note is to direct attention to the remarkable variation existing in different species of mammals in their sensitivity to the action of the ovarian hormones.

Experiments have been performed on the prepubertal baboon (*Papio porcarius*) and the size of the perineum has been used as an indicator of activity since the variations of the perineal swelling during the menstrual cycle have been shown to be as useful an indicator as the vaginal smear method¹.



A, 10 daily injections of oestradiol;
B, 11 daily injections of oestradiol and progesterone.

GRAPHS ILLUSTRATING THE DIFFERENT EFFECTS PRODUCED BY 1 MGm. AND 2 MGm. PROGESTERONE GIVEN SIMULTANEOUSLY WITH OESTRADIOL IN THE SAME IMMATURE BABOON.

- 1 mgm. oestradiol benzoate injected daily for 10 days, followed by the simultaneous injection of 1 mgm. oestradiol benzoate and 1 mgm. progesterone daily for 11 days. Note the incomplete deturgescence and absence of bleeding within 96 hours.
- 1 mgm. oestradiol benzoate injected daily for 10 days, followed by the simultaneous injection of 1 mgm. oestradiol benzoate and 2 mgm. progesterone daily for 11 days. Note complete deturgescence and bleeding within 96 hours.

Prepubertal baboons were first given 1 mgm. oestradiol benzoate for 10 days to produce perineal turgescence and then given simultaneous daily doses of 1 mgm. oestradiol benzoate together with varying amounts of progesterone. When 1 and 2 mgm. progesterone are administered under these conditions the induced perineal turgescence rapidly disappears and the perineum returns to rest. Bleeding follows within 60-90 hours after the last injection. When, however, only 1 mgm. progesterone is injected together with 1 mgm. oestradiol benzoate, the deturgescence is much slower, and bleeding does not occur within 96 hours after the last injection, as shown in the accompanying graphs. On this basis we conclude that 1 mgm. progesterone is just insufficient to inhibit the action of 1 mgm. oestradiol benzoate on the perineum of the baboon, whereas 2 mgm. progesterone completely inhibits 1 mgm. oestradiol benzoate.

It is important to compare our findings with those of other investigators who used methods similar to our method on other animals which, however, were castrated.

(a) Robson², in the mouse, found that 750 μ gm. progesterone was required to induce an inhibitory effect on 0.2 μ gm. oestrone (that is, 3,750 progesterone: 1 oestrone by weight). In the rabbit, however, Robson³ found that the effect of 0.75 μ gm. progesterone could be completely inhibited by 0.01 μ gm. oestrone (that is, 75 progesterone: 1 oestrone by weight). These results indicate that the rabbit is fifty times more sensitive to progesterone than the mouse.

(b) Leonard, Hisaw and Fevold⁴ found that in rabbits castrated during oestrus 10 R.U. oestrone seemed to be the smallest quantity required to prevent the action of 1 Rabbit Unit 'corporin'. In the monkey, on the other hand, Hisaw⁵ discovered that $\frac{1}{2}$ Rb.U. 'corporin' is at least partially effective in counteracting 100 R.U. oestrone. These experiments indicate that the monkey is twenty times more sensitive to progesterone than the rabbit.

(c) Our own experiments indicate that 2 mgm. progesterone is completely effective in inhibiting the action of 1 mgm. oestradiol benzoate on the perineum of the baboon (that is, 2 progesterone: 1 oestradiol benzoate by weight). Robson², using oestradiol in the mouse, found that 750 μ gm. progesterone were required to induce an inhibitory effect on 0.05 μ gm. oestradiol (that is, 15,000 progesterone: 1 oestradiol by weight). These findings suggest that the baboon is about 7,500 times more sensitive to progesterone than the mouse.

From the above homologies (a), (b), (c), we may express mathematically the sensitivity to the action of progesterone of the various animals discussed as follows:

baboon: monkey: rabbit: mouse :: 7500: 1000: 50: 1.

It is suggested that as we ascend the phylogenetic scale in the animal kingdom there is an increasing sensitivity to the action of progesterone, and it is possible that in the human female an even greater sensitivity to the action of progesterone may exist.

JOSEPH GILLMAN.
H. B. STEIN.

Departments of Anatomy and
Clinical Pathology,
University of the Witwatersrand,
Johannesburg.
Jan. 31.

¹ Gillman, J., *S. Afr. J. Med. Sci.*, **2**, 44 (1937).

² Robson, J. M., *J. Physiol.*, **53**, 371 (1933).

³ Robson, J. M., *J. Physiol.*, **53**, 100 (1933).

⁴ Leonard, S. L., Hisaw, F. L., and Fevold, H. L., *Amer. J. Physiol.* **100**, 111 (1933).

⁵ Hisaw, F. L., *Amer. J. Obst. and Gyn.*, **20**, 638 (1936).

Transmutations of Uranium and Thorium Nuclei by Neutrons

WE have recently bombarded layers of uranium oxide and thorium oxide with a mixture of fast and slow neutrons and investigated chemically the active substances obtained on glass plates about 1 mm. away. These active bodies, which result from the bursting of the particular nucleus¹, were dissolved off for analysis with aqua regia, tests showing that no comparable activities came from the glass itself.

In the case of uranium we have been able to assign half-lives of 86 min. to barium, 4 hr. and 40 hr. to lanthanum and 16 min., 75 min. and 72-76 hr. to elements of the 'trans-uranium' type (precipitated

with platinum as carrier from 2*N* hydrochloric acid solution with hydrogen sulphide). We consider the appearance of the 16 min. and 72-76 hr. activities (presumably identical with Hahn, Meitner and Strassmann's¹ 16 min. eka-rhenium and 66 hr. eka-iridium) on the glass plate to be conclusive proof that these substances must be due to recoiling fragments of the bursting uranium nucleus, and that they are not 'trans-uranium' elements coming from uranium by a chain of β -processes.

We have been looking also for possible 'trans-uranium' elements resulting from the decay of uranium (23 min.), which is certainly a uranium isotope. Some weak activities which have some of the properties of 'trans-uranium' elements have been found. More rigorous tests are in progress, however, to make their identity certain.

The activities which are obtained by recoil on the glass plates when thorium is bombarded have also been studied. As a great number of periods were observed, we have for the present classified only some of them into groups according to their chemical behaviour. We found, for example, bodies of 80 min., 14 hr. and 12 days half-lives with the properties of rare earths (lanthanum carrier), 6 hr. with those of barium, 70 min., $4\frac{1}{2}$ days and about 11 hr. (which latter appears to grow from the $4\frac{1}{2}$ -day body) with the properties of noble metals. Blank tests showed that thorium B and thorium C activities were negligible.

In addition, from samples of specially purified thorium nitrate irradiated in bulk, activities of $2\frac{1}{2}$ hr. and 22 hr. were extracted which had the properties of bromine. Since the $2\frac{1}{2}$ hr. period has been assigned² to ⁸²Br, it is natural to identify this with our $2\frac{1}{2}$ hr. period. Two weak selenium activities (some hours and some days) were also observed.

These experiments were possible only through the kind collaboration of the High Tension Laboratory staff, who provided the neutron sources (lithium + deuteron). We are also indebted to Dr. R. S. Krishnan for his aid in taking readings with the counter set.

E. BREITSCHER.

L. G. COOK.

Cavendish Laboratory,
Cambridge.
March 11.

¹ Joliot, F., *C.R.*, **208**, 241 (1939).

² Hahn, Meitner and Strassmann, *Ber.*, **66**, 906 (1933); **70**, 1874 (1937).

³ Snell, A. H., *Phys. Rev.*, **53**, 1007 (1937).

Liquefaction of Helium

ON March 7, we succeeded in liquefying helium by using an apparatus based on the Simon expansion principle. We obtained with one expansion, starting from a pressure of 80 atm. and a temperature of 14.6° K., a quantity of about 65 c.c. of liquid helium. The maximum capacity of our apparatus is about 120 c.c. It was also possible to lower the temperature to 3.3° K., by reducing the pressure above the helium.

We made also one expansion starting from a pressure of 30 atm. and a temperature of 24° K., and we arrived at a temperature of 11° K.

It is worth pointing out that the time which is necessary to obtain liquid helium by this method is relatively short. On March 7 we obtained helium in 6 hours. On March 14 we repeated the experiment, and then only 4 hours was required to obtain liquid

helium. It will no doubt be possible to reduce this time to only 3 hours. In this time is also reckoned the time which is necessary to liquefy the hydrogen used for this experiment.

During these experiments I was assisted by M. van Dingenen and M. A. Werner.

A. VAN ITTERBEEK.

Physical Laboratory,
University,
Louvain.
March 15.

Effect of Foreign Gases on the Continuous Absorption Spectrum of Bromine

ALTHOUGH much attention has been devoted to the broadening of spectral lines in the presence of foreign gases, little systematic work has been done on the effect of foreign gases on intensities of absorption spectra. We have therefore examined the effect of the following gases on the continuous absorption of bromine, using an objective method of photographic photometry: hydrogen chloride and bromide, carbon dioxide, oxygen and nitrogen.

With bromine and the foreign gas at partial pressures of 2 cm. and 60 cm. respectively, the effect is to increase the intensity of the main absorption continuum ($\lambda_{\text{max.}} = 4150 \text{ \AA.}$) without altering the general shape of the absorption curve. The *A* and *B* components of this 'continuum' are affected about equally, and there is practically no shift in the position of the maximum. The table of absorption coefficients at the maximum serves to show the magnitude of the effect.

Gas	Bromine alone	Bromine plus 60 cm. of				
		HCl	CO ₂	HBr	O ₂	N ₂
<i>K_{max.}</i>	152	191	184	182	167	163

Experiments with varying partial pressures of hydrogen chloride and carbon dioxide indicate that the increase in intensity is proportional to the partial pressure of the foreign gas.

The ultra-violet absorption continuum of bromine between 3300 $\text{\AA.}$ and 2500 $\text{\AA.}$ ² is affected to a much greater extent, the intensity being increased as much as ten-fold by 60 cm. of hydrogen chloride or bromide. In this region, numerical values of the absorption coefficient may have little meaning, since in the presence of oxygen they are not independent of the partial pressure of bromine.

N. S. BAYLISS.

A. L. G. REES.

University of Western Australia.
University of Melbourne.
Jan. 27.

¹ Aston, Alcock and Bayliss, *J. Chem. Phys.*, **4**, 474 (1936).

² Alcock and Bayliss, *Trans. Far. Soc.*, **24**, 1371 (1928).

Theory of Mesons and Nuclear Forces

IN a recent note¹ on the static interaction between nuclear particles, Dr. C. Møller and Prof. L. Rosenfeld describe the results of a canonical transformation which makes it possible to separate dynamic and static interactions, and they state: "The static interaction is in all cases exactly the same as that obtained as a first approximation in the perturbation method". They referred to certain work done previously² by

me, and I wish to point out that the above statement does not correspond to my results. If this statement applies to the interaction between two Dirac electrons, this is only because in that case we have but *one component* of the field giving static effect, namely, the electrostatic potential. For nuclear interactions, the field must have at least *two components* (usually expressed as one complex field: the meson field). If one tries as before to separate each component into the static solution of the wave equation and the transformed field component, one finds that this transformation is no longer canonical. This is due to the fact that these static parts do not commute because they are formed with the aid of the non-commuting 'isotopic spin matrices' of the heavy particles.

However, canonical transformations exist, which separate a static part of the field (different from the static solution of the wave equation). These transformations introduce a static interaction, which is *not the same* as the one obtained as a first approximation in the perturbation method. Its exact form will be discussed elsewhere, but we can state that, expressed as a power series, its first term corresponds to the first approximation in the perturbation method.

The equations for the transformed fields (pure radiation fields) are, in the static approximation, obviously satisfied by the particular solution: transformed fields equal to zero. (The term "static approximation" means that all effects due to *particle velocity* have been neglected.) However, if these fields are considered as quantum mechanical variables, it is known that their squares can never be zero (zero point energy of the radiation field). This fact leads to an additional, also purely static, displacement of the nuclear energy levels proportional to Planck's constant $\hbar$.

E. C. G. STUECKELBERG.

Institut de Physique de l'Université,
Genève.
Feb. 17.

¹ Møller and Rosenfeld, *NATURE*, **143**, 241 (1939).

² Stueckelberg, *C.R.*, **207**, 387 (1933); *Phys. Rev.*, **54**, 830 (1938).

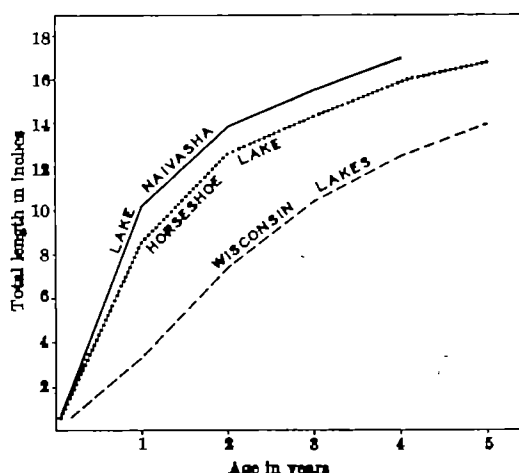
Growth of the Large-mouth Black Bass, *Huro salmoides*, in Lake Naivasha, Kenya

RECENTLY, measurements and samples of scales from twenty large-mouth black bass caught in Lake Naivasha were received from Dr. Richard H. Le Pelley, of the Scott Agricultural Laboratories, Nairobi, Kenya. The sizes of these fish are about the same as are taken in good bass-fishing lakes in the Mississippi valley. Although the temperature range of Lake Naivasha is very small, the scales of these fish have annual rings much as in bass taken in temperate regions. The ages of these twenty bass have been read as follows:

Age (years)	Weight	Total length (inches)	Age (years)	Weight	Total length (inches)
4	2 lb. 8 oz.	17	2	2 lb. 0 oz.	14
3	2	15	2	1 14	14
3	2 0	15	2	1 6	14
3	1 14	15	2	1 8	13
3	2	13	2	1 4	13
2	3 4	17	2	0 12	12
2	3 4	17	1	0 8	11
2	2 0	15	1	0 7	10
2	1 14	15	1	0 8	9
2	1 8	15	1	0 7	9

Excerpts from Dr. Le Pelley's letter give the essential facts about this bass population and Lake Naivasha.

"As far as I can find out, the following information on the introduction of this fish to Kenya is accurate. The young fry were obtained from somewhere in Europe where the introduction [from America] had been made previously. Nearly all died on the journey, but the remainder, about fifty-three young black bass about three inches long, were loosed in Lake Naivasha in February, 1929. They flourished and bred, and fishing began in October, 1931. The fish is plentiful to-day. Previous to 1925 the only fish in the lake was a minnow-like fish *Haplochilus antinorii*. In 1925 *Tilapia nigra* was introduced and this multiplied enormously. Both these species, as well as frogs and other animals, form the food of the bass. The largest black bass recorded, taken from Naivasha in 1937, was 6½ pounds.



"Lake Naivasha lies at an altitude of about 6200 feet; is about 100 square miles in area; approximate position 36° E. longitude, 1° S. latitude; 15 metres deep, temperature 62° F., with probably a very small range only.

"Black bass have also been introduced into one of our rivers—the Athi River, where they appear to be established."

An average growth curve has been computed from measurements of the distances between annuli along the anterior radii of the scales. For comparison, growth curves for large-mouth bass in Horseshoe Lake¹ in southern Illinois, and for the lakes of Wisconsin², are included. In the Illinois lake, the first year of growth was unusually rapid, as the result of abundant animal food for young bass and lack of competition with other carnivorous fishes. In the Wisconsin lakes, the growing season for bass is about half that of Horseshoe. These northern lakes have ample food for the larger sizes; but fingerlings find food scarce and competition with other species keen.

The Naivasha bass averaged 14 per cent heavier than bass of the same lengths from a population which is regarded as normal for Illinois, and the bass of the latter, in turn, are heavier than Wisconsin bass of the same lengths.

In Illinois, most large-mouth bass form their annuli in May and June, and it has been of interest to find out when they form their annuli in a lake so near

the equator with a very small temperature range (Illinois bass tolerate 32°F. to 90°F.). In no case did the Naivasha scales show an annulus near the edge. The amount of scale-growth outside the last annulus averaged 97 per cent of the corresponding whole year's growth in the scales of older fishes. Since these scales were collected on March 17, it would seem to indicate that annuli would be formed very soon—probably in April. It may be expected that they also spawn at this time, since spawning and annulus formation are known to occur at about the same time.

DAVID H. THOMPSON.

Illinois Natural History Survey,
Urbana, Illinois.
Jan. 27.

¹ Thompson, David H., and Bennett, G. W., "Lake Management Reports, 1. Homestead Lake near Cairo, Illinois", *Biol. Notes, Ill. Nat. Hist. Surv.*, 8, 1 (1938).

² Bennett, G. W., "The Growth of the Large Mouthed Black Bass *Huro schreineri* (Lacépède), in the Waters of Wisconsin", *Copeia*, 2, 104 (1937).

Course of Pollen Tube Growth in *Carica papaya* and *Cucurbita* spp.

In a recent paper, Gustafson¹ states with reference to pumpkin and crookneck summer-squash (*Oucurbita* spp.) that the "application of pollen to one side of the ovary did not limit the development of the seeds to that side, and the seed distribution was quite uniform even when as much as five-sixths of the stigma had been removed. . . . It was expected, however, that the seeds might develop only on that side of the ovary where the pollen was applied and the side without seeds would be apertrophied". Work on the course of pollen tube growth in *Carica papaya*, carried on by us in Florida in 1936 as part of a Bankhead-Jones project, has a bearing on this subject. The Caricaceae are related not distantly to the Cucurbitaceae, but the former have superior ovaries in contrast to inferior ovaries in the latter. However, the general place of entry of the pollen tubes in relation to the extent and display of the placental surface is similar.

The paraffin embedding method was used in this work, and the pollen tubes were stained with acid fuchsin to which light green was added according to the formula of Buchholz. In *Carica papaya*, the pollen tubes grow from the stigma through the central region of the style to the apical end of the ovarian cavity, and then emerge into, and grow on, the surface of the ovarian cavity to the ovules. The ovarian cavity is relatively large (approximately 18 mm. long in the material used), and under the conditions of the experiment it took about five days for the pollen tubes to reach the ovules at the proximal end, although the ovules at the apical end were reached in about one and a half days. Since the tubes enter the ovarian cavity directly at the centre at the apical end, it would make no difference from which part of the stigma the tubes started, and the direction of growth after entering the ovoid or rounded cavity, other things being equal, would be dependent on chance alone. If sufficient viable pollen is applied to any part of the stigma, the thousand ovules (more or less) in the ovarian cavity may all be fertilized, unless some such condition as incompatibility or difference in state of receptivity intervened. If insufficient viable pollen is applied, then the ovules in any region equidistant from the apical end of the cavity will have an equal chance

of being fertilized so long as there remain a sufficient number of pollen tubes. This would explain the uniform seed distribution in the fruits of *Cucurbita* spp. even if pollen was applied to one side of the stigma only.

The complete results will be published in the *Journal of Agricultural Research*.

HAMILTON P. TRAUB.

CHARLES T. O'ROCK, JUN.

Division of Fruit and Vegetable
Crops and Diseases,
Bureau of Plant Industry,
U.S. Department of Agriculture,
Field Laboratory,
Orlando, Florida.
Feb. 4.

¹ Gustafson, F. G., *Amer. J. Bot.*, 25, 237 (1938).

Ferrous Iron in Soils

THERE has been a controversy in the literature concerning ferrous iron in soils on three points, namely: (1) Is ferrous iron present in large quantities in ordinary healthy soils? (2) Can soil fix iron in the divalent form? (3) Does the downward movement of iron in soils, such as the podsoles, take place in the ferrous condition?

The details of the experiments undertaken to elucidate the problems outlined will be given elsewhere. In this communication merely the results and conclusions are presented. In all the work reported the ferrous iron was determined by the dipyriddy method¹, and the experiments were conducted on black chernozem and grey wooded podsol soils.

To study the formation of ferrous iron and its downward movement black and podsol loams were kept submerged under distilled water in percolators. During the first twenty-six days of the experiment no ferrous iron was found in the percolates. After the experiment had continued for sixty-five days small quantities of ferrous iron were found in some of the percolates, ranging from 9-27 gamma in the volumes of liquid collected during twenty-two hours. Only traces of ferrous iron were found in water extracts of portions of soil taken from the percolators.

The same portions of soil were then extracted with approximately 3 per cent solution of aluminium chloride. An average of 750 gamma of ferrous iron was extracted from 1 gm. of black loam and 425 gamma from 1 gm. of the podsol loam, these figures being given on the basis of oven-dried soil.

This experiment indicates that soils must be water-logged for a considerable period of time before iron moves in the ferrous state, and that certain soils, at least, can hold a considerable amount of iron in the divalent form, which is not easily removed by water, but can be extracted by aluminium chloride solution. Approximately 75 per cent more ferrous iron was extracted from the black soil than from the podsol soil, indicating that the presence of organic matter under anaerobic conditions encourages formation of ferrous iron.

In another experiment it was shown that from a solution of ferrous chloride approximately 1,600 gamma of ferrous iron were absorbed by 1 gm. of moist black loam, and 1,300 gamma by 1 gm. of moist podsol loam, within a two-hour period, the black loam absorbing all the iron supplied. After a twenty-four hour interval 10.56 N solutions of

potassium chloride, ammonium chloride and aluminium chloride released respectively 12 per cent, 15 per cent. and 26 per cent. of the ferrous iron absorbed by the podsol loam. In the case of black loam aluminium chloride solution released 8 per cent of the ferrous iron absorbed. The black loam absorbed more ferrous iron than the podsol loam, and the iron was retained more efficiently by the former than the latter. A part of the iron absorbed by these soils may have reverted to the trivalent insoluble form, as was suggested by Wilkoszewski², but a certain amount of iron remained in ferrous condition and was probably held in the base exchange complex.

The extraction of ferrous iron with potassium chloride, ammonium chloride and aluminium chloride solutions from samples of podsol loam in which formation of ferrous iron had been induced gave similar results. In this case pH values of the extracting solutions in contact with the soil were determined because the hydrogen ion concentration of these may have influenced the extraction of iron from the soil.

pH of water	..	7.4
pH of KCl solution	..	6.18
pH of NH ₄ Cl	..	5.92
pH of AlCl ₃	..	2.92

From these results one may assume that ammonium and potassium displace the ferrous iron from the base exchange complex. Aluminium chloride solution, which is the best of the extracting agents used, may extract the iron from soil in two ways: by virtue of its high acidity and by displacement of ferrous iron by the aluminium cation.

Three per cent aluminium chloride solution extracts of soil surface (0-8 in.) and subsurface (12-18 in.) samples taken at widely divergent points showed, in the case of black soils, no ferrous iron or only traces; but in the case of podsol soils generally a little more, the figures ranging from traces to about seven parts per million for the surface samples and from traces to twelve parts per million for sub-surface samples, on the basis of oven-dried soil.

These figures show that only very small quantities of ferrous iron could be extracted from these soils. From the percolation and field experiments reported in this communication it may be suggested that the reduction of iron in soil has not been a major cause of downward movement of this element in podsol soils.¹

V. IGNATIEFF.

Soils Department,
University of Alberta,
Edmonton, Canada.
Feb. 11.

¹ Ignatieff, V., *J. Soc. Chem. Ind.*, 56, 407.

² Wilkoszewski, B., *Arch. der sch. Phys. u. nat.*, 44, 165.

"Animal Treasure"

In a review of my book "Animal Treasure" which appeared in NATURE on April 23, 1938, there occurred the passage "some of the statements have been seriously challenged by Mr. Arthur Loveridge in the *Scientific Monthly* of January 1938". I have just returned from a year's collecting trip to Surinam and have only recently seen both the review and the original criticisms mentioned.

I propose submitting a detailed reply to Mr. Loveridge's article in *Scientific Monthly* to the editor of that journal with the view of publication. There Mr. Loveridge made twenty criticisms in numbered paragraphs to prove that "Animal Treasure" was "to so large an extent a compound of misstatement, misinterpretation, exaggeration, sentimentalism and emotionalism". Since I am replying to Mr. Loveridge in detail elsewhere, I shall mention only a few points here. I feel, however, impelled to bring this to the notice of readers of NATURE, since Loveridge's article was mentioned in the NATURE review, and his criticisms have received widespread attention.

Perhaps the most important of Mr. Loveridge's criticisms is that I have blundered when he quotes from my book that: "We captured six diurnal animals in Africa that belonged to groups all the other members of which are exclusively nocturnal. All six animals—a snake (*Gastrophyscus senecagadina*), a squirrel (*Furiscivorus pansis*), a monkey (*Cerco-pithecus pogonias*), a rat (*Demomys hypoxanthus*), a flying squirrel (*Anomalurus beccrofti*) and, finally, a lemur (*Galago demidovii*)—were bright green above and yellow beneath, whereas their near-related and nocturnal species were all of other colours" (p. 167). He states that the snake, squirrel and monkey belong to diurnal groups and none of the animals conform to my description except the snake, and "by courtesy" the squirrel. I regret the necessity of correcting Mr. Loveridge in these observations as all the animals referred to are bright greenish above and yellow below¹. They still show the full yellow in the preserved specimens at the British Museum. The dorsal coloration has faded (as green always does) to olive or misty-grey-olive. Mr. Loveridge states that the pelage of mammals undergoes 'no radical changes on preservation beyond a slight dulling and fading with the passage of time, but here again I would point out that the reaction to which I have referred is, contrary to the view of Mr. Loveridge, well known to museum workers, furriers, etc.

Mr. Loveridge also states that I cannot even copy accurately from other authors. In "Animal Treasure" I referred (without quoting) to Mr. G. L. Bates as having found a male *Nectophryne batesii* sitting on a brood of eggs. Quoting from Dr. G. A. Boulenger, Mr. Loveridge claimed that Mr. Bates had found a female *N. batesii* with empty oviducts under the trough or hollow of a plantain-leaf petiole crouched in the midst of a mass of eggs. I accept Mr. Loveridge's quotation²; Dr. Boulenger's description is from Mr. Bates's original field notes. I had cause to examine this specimen, which is in the British Museum, and it proved to be a male as stated by Mr. H. W. Parker³, assistant keeper in the British Museum (Natural History). Further, Mr. Loveridge's statement that the eggs were "beneath the base of a banana leaf apparently lying on the ground" is incorrect; a plantain-leaf petiole is customarily several feet from the ground.

"Animal Treasure" has never been claimed by me to be a purely scientific work, but as a popular introduction to the public of some of the wild life of West Africa.

All Mr. Loveridge's other criticisms, whether purely scientific or vaguely censorious, can be, and are being, refuted in like manner. It therefore seems necessary to point out that his judication rests merely upon his own opinions at present.

Full details of the actual scientific results will be found in the publications listed below^{4,5,6,7,8}.

A large work on the 1,500 mammals, with coloured plates of several species (notably the green and yellow monkey) and full details of all controversial points raised above is in the Press and shortly appearing as a volume of the *Transactions of the Zoological Society of London* (24). The reptiles, Mollusca, Myriapoda and certain arachnid groups are not yet worked out in full.

IVAN SANDERSON.

23, Upper Berkeley Street,
Portland Square,
London, W.1.
Feb. 18.

¹ See Sanderson, *Trans. Zool. Soc. Lond.*, 24 (in the Press).

² *Ann. Mag. Nat. Hist.*, (8), 13, 71.

³ *Proc. Linn. Soc. Lond.*, 2, 25 (1935).

⁴ *Rev. Geog. Soc.*, 55, 2 (1935).

⁵ Parker, H. W., *Proc. Zool. Soc. Lond.*, 1, 135 (1936).

⁶ Sanderson, *Proc. Zool. Soc. Lond.*, 1, 165 (1936).

⁷ Boewer (on Opiliones), *Veröff. Deutsch. Kolon-u. Uebersee Mus.*, Bremen, 1 (1936).

⁸ Bayliss (on Parasitic Worms), *Ann. and Mag. Nat. Hist.*, (10), 17, 257 (1936).

Foam on the Dead Sea—and off the Mæander River

A FOAM-FORMATION like that described in *NATURE* of March 15, p. 468, is to be seen off the mouth of the Mæander (*Mendere*) River in western Asia Minor,

when the river is in flood. The turbid river water establishes a sharp frontier with the clear sea-water, and when the breeze is on-shore, the sea-water *breaks* on the river water with sufficient force to accumulate a band of foam, several inches wide, which in turn retains scum and floating debris from the river. The foam band is carried by wind and current into arc-forms, which are the more conspicuous by reason of the contrast of water-colour within and without. For the salt and fresh waters do not readily mix, and the summary deposition of the silt at the point where the flood water is checked probably explains the very steep gradient of the delta escarpment.

Checked in front, the flood water escapes along-shore and retains its café-au-lait hue for many miles. I have encountered it south of the channel between Kos and Kavø-Krio (fifty miles), and west of Nikaria Island (sixty miles), according to the direction of the wind and resulting 'wind-rip' current. When the wind is between south-east and south-west, in the Ægean, the water is piled up to the north, and escapes by inshore channels; when the wind is in the north, the water is driven south, and is replaced by northerly currents inshore. Best known of these inshore currents is the famous and incalculable '*Gephyra*', between Eubœa and the mainland of Greece.

New College,
Oxford.

JOHN L. MYRES.

Points from Foregoing Letters

PREPARATIONS of the succinic dehydrogenase are described by Sir F. Gowland Hopkins, C. Lutwak-Mann and E. J. Morgan which, while very active in reducing methylene blue, fail completely to induce an oxygen uptake in a system containing succinates, cytochrome c and cytochrome oxidase. It is clear, therefore, that some factor is necessary for transferring the hydrogen atoms activated by the enzymes to the cytochrome system.

M. Dixon and L. G. Zervas state that cytochrome c is not reduced by the purified lactic dehydrogenase system of yeast, but that an additional intermediary catalyst is necessary and that this may play an important part in cell-respiration.

C-hypovitaminosis can be recognized by blood-test, by determining the concentration of the vitamin in serum, before and after the intravenous injection of 300 mgm. of ascorbic acid. According to A. Göth, in case of saturation, the value determined after two hours should be at least twice that previously found; if less, hypovitaminosis dominates.

J. Houston and S. K. Kon find that, in addition to free vitamin B₁, milk contains the substance also in a bound form, most probably as a vitamin B₁-protein complex.

Of many types of lactic acid bacteria studied by J. G. Davis, H. J. Rogers and C. O. Thiel, only *Str. faecalis* and *Str. liquefaciens* invariably produced diacetyl from glucose, both under "resting" and under growing conditions. This finding is discussed in relation to the production of flavour in milk products.

Experiments indicating that progesterone has a greater ability of inhibiting the action of œstrone in the higher animals (baboon, monkey) than in lower animals (rabbit, mouse) are described by J. Gillman and H. B. Stein.

By analysis of the recoiling fragments of exploding uranium nuclei, E. Bretscher and L. G. Cook find that the existence of true 'trans-uranium' elements cannot generally be maintained. Results of observations on disintegration of thorium by neutrons are also given.

N. S. Bayliss and A. L. G. Rees find that the addition of foreign gases to bromine increases the intensity of the main bromine continuum by amounts from 7 per cent in the case of nitrogen to 25 per cent in the case of hydrogen chloride. The ultra-violet absorption of bromine is increased as much as ten-fold.

Defining *static interaction between particles* as the value of the interaction energy for zero particle velocity, E. C. G. Stueckelberg shows that for nuclear interaction its form is different from the static solution of the wave equation of the meson field.

Data submitted by D. H. Thompson show that the large-mouth black bass, *Huro salmoides*, introduced since 1929 in Lake Naivasha, Kenya, grows faster and is heavier than specimens of the same length in Illinois.

H. P. Traub and C. T. O'Rork, jun., find that pollen tubes enter the ovarian cavity of *Carica papaya* directly at the centre at the apical end, no matter which part of the stigma they started from. This explains the uniform distribution of the seeds in this and related families (Cucurbitaceae).

Small amounts of ferrous iron (of the order of 0.1 per cent) have been extracted by V. Ignatieff from certain soils (black loam and podsol loam) which have been waterlogged for more than two months.

J. L. Myres points out that foam-formation like that described in *NATURE* of March 15, p. 468, in the Dead Sea occurs off the Mæander River in western Asia Minor, and is due to the breaking of the sea-water on the river water when the wind is on-shore.

Research Items

Excavations at Chametla, Sinaloa

IN a report on three weeks' excavation in the vicinity of Chametla in the southern part of the State of Sinaloa, Miss Isabel T. Kelly describes a pioneer investigation which was undertaken under the auspices of the Institute of Social Sciences on behalf of the University of California (*Ibero-Americana*, 14, 1938, Univ. California Press). Chametla lies on the Baluarte River, some kilometres down stream from Rosario. The modern unimportant village occupies a site which, according to contemporary accounts, was once the centre of a native State of some importance. It is to be assumed that the pre-white economy was purely agricultural. The valley abounds in low mounds, which mark former dwelling sites. There are also several large artificial mounds; but these were not examined. No architectural remains were found, though Oviedo reports adobe structures. There was no sign of metal, except a smooth disk, possibly a post-conquest copper coin. Axes, manoes and chipped obsidian occurred; but the material was overwhelmingly ceramic. This pottery is of considerable intrinsic interest, excellent in quality and diversified in character—especially in view of its marginal location. The fundamental wares are a red-rimmed utility and black-banded wares, which persist through a succession of polychrome styles. In a tentative chronology the early occurrence of Chametla polychrome is well defined, while among later decorated wares, though distinct varieties are much confused, certain complexes with chronological significance appear to emerge. Apparently the succession does not endure down to conquest times. Even more surprising than its richness is the fact that this pottery is unique, and has no resemblance, generic or specific, to any known wares of other cultures. As to its provenance, having no affinities with Sonora to the north, nor the plateau on the east, while the Pacific lies to the west, the southern and coastal area alone remains. It would appear to be a spur of high culture along the coast, originating ultimately in Central America. But both the Chametla valley and the Pacific coast are at present *terra incognita*.

Anatomical Features of Fossil Skulls

SIR ARTHUR KNITH has re-examined the anatomical features of the Piltdown skull and of the Swanscombe skull (*J. Anat.*, Jan. 1939). This is Part 2 and the concluding portion of a very careful and detailed analysis. The Piltdown skull reveals several simian characters that had been previously overlooked, and it exhibits a degree of asymmetry not equalled in modern man. The recognition of this asymmetry allows of a more satisfactory reconstruction being made. Its cranial capacity is now estimated at 1368 c.c. The author concludes that the Swanscombe, the Piltdown, London and Bury St. Edmunds skulls represent a related group which may be termed the Piltdown group and so far it has only been found in England. They are of a different group from that of Neanderthal man. Swanscombe man is older than Neanderthal man, unless the Heidelberg jaw is to be regarded as representing a Neanderthal type. Thus in early Pleistocene times the Pithecanthrop and

Sinanthropic type was evolving in the east while the totally different Piltdown type was being evolved in the west. This latter general type continued into the mid-Pleistocene.

Distribution of Antibody in Tissues

C. F. Wang and H. Wu (*Chinese J. Physiol.*, 13, 429; 1938) have studied the antibody content of the different tissues of rabbits immunized with egg-albumin and have come to the following conclusions: (1) The maximum antibody content was found to be in the blood and in the tissues in the fifth to seventh week of immunization. (2) All the antibody could be removed from the tissue by perfusion. (3) The distribution of antibody in the tissues was in the following decreasing order: lungs, bone-marrow, kidneys, spleen, heart and liver. (4) Antibody was sometimes found in the uterus and testes. (5) No appreciable amount of antibody could be found in the stomach, brain or skeletal muscles. These findings are in harmony with the view that the antibody is formed in the organs of the reticulo-endothelial system.

Acrodynia and Fatty Acids

F. W. Quackenbush, B. R. Platz and H. Steenbock (*J. Nutrition*, 17, 115; 1939) found that on a basal diet of purified casein, glucose and salts, supplemented with carotene, calciferol, synthetic B₁ and riboflavin, rats developed skin lesions in 4-5 weeks; an acute dermatitis when restricted to the basal diet, and a chronic form, "rat acrodynia", when given fat supplements at subcurative levels. Complete healing of either the acute or chronic form was obtained by the administration of peanut oil or wheat-germ oil. Cured animals remained free from all symptoms while the fat supplements were continued or until the end of the survival period, which was usually several months. Aeration or ultra-violet radiations did not destroy the activity in peanut oil. It was resident in the fatty acid fraction. Cures were produced with half a drop of wheat-germ oil, corn oil or Wesson oil, 10 drops of coconut oil or 25 drops of butter fat. The lesions were not prevented or cured with hydrogenated coconut oil.

Polygamous Weavers

R. E. and W. M. Moreau continue their valuable studies of the ecology of African birds by observations on the comparative habits of two weaver birds, *Huplectes nigroventris*, the Zanzibar red bishop, and *H. horreacea*, the crimson-crowned bishop (*J. Anim. Ecol.*, 7, 314; 1938). Both birds have breeding seasons shorter than the vegetation growth would allow, but the former already has young when temperatures are at their highest and continues to breed through the 'long rains' until the middle of the cool season, whereas the latter breeds only at the coolest months of the year. In neither species does the size or position of the breeding territory bear any relation to availability of food of adults or young nor has it regular topographical features, yet while the red bishop occupies constantly a relatively large territory (900 ± 300 sq. yd.), the

crimson-crowned territory may be compressed to under 10 sq. yd. Notwithstanding this relative divergence in spatial occupation, a male of the last named in its small kingdom has up to five breeding females active in it at the same time and raising up to eight clutches in a season, although the red bishop has never been found to have more than three wives in his large territory. Indeed, in the breeding population of both species females are in the ascendant, outnumbering males by quite four to one, and the authors are endeavouring to discover whether this curious disparity is due to differential birth rate or to subsequent mortality.

Birds of Canton Island

CANTON ISLAND, one of the Phoenix Islands, is a low-lying coral atoll, 7 miles long by 4 miles broad, lying in a rainless belt 1,100 miles north-north-east of Fiji. Its birds were studied in 1889, and now again, in 1937, a second survey has been made, by Major G. A. Buddle (*Records Auckland Inst. Mus.*, 2, 125; 1938). The survey shows few changes in close on half a century, as perhaps was to be expected on an island undisturbed by human visitors, and occupied only by sea-birds and passing migrants. Twenty species of birds are recorded. The wideawake terns described as breeding in large numbers in 1889 have completely disappeared, but terns are a fickle people. Neither the migratory turnstone nor sandpiper noted in 1889 was seen, but a new visitor was recorded in *Fregata magnificens*. Major Buddle's observations were made from May 27 to June 8, 1937, during the visit of the New Zealand Total Solar Eclipse Expedition. Since then the British and American Governments have interested themselves in Canton Island as a probable air-base, and it is now permanently occupied by representatives of both peoples. Its bird life is likely to be considerably modified in the next fifty years.

Advances in Indian Helminthology

SIX contributions to Indian helminthology have recently been made by Dr. Har Dayal Srivastava (*Indian J. Vet. Sci. and Animal Husbandry*, Dec. 1938). Two of them deal with amphistomes found in Indian food fishes and two new genera and another new species are described. One is an account of a new species of alveocolid from *Chiloscyllium indicum*. Another describes a new gorgoderid trematode from *Balone strongylura*. The fifth is a study of the gastrostomatous parasites of Indian food fishes, and includes a key of the members of the genus *Bucephalus*; three species are here described for the first time. A new species of *Bucephalopsis* and two new species of *Proserhynchus* are also described as well as additional details of other species of the former genus. The last paper is a study of the life-history, pathogenicity and biological control of *Cotylophorum cotylophorum*, an important schistosome carried by the snail *Indoplanorbis exustus*.

Nitrogen Content of Apple Trees

J. E. KIRCH (*J. Pom. and Hort. Sci.*, 16, 346; 1939) has investigated the content of nitrogenous materials in the terminal shoots of Lane's Prince Albert apple trees as affected by the five rootstocks *M II*, *M V*, *M VII*, *M IX*, and *M B*. The data show that the nitrogenous fractions in bark and wood were strikingly similar for all five rootstocks, and

the variation from month to month did not differ significantly between stocks. The total nitrogen in the woody portions of the shoots, however, was higher for *M IX* than for the other stocks, which did not differ significantly from each other. Stock *M IX* seems to be associated with high amide content in the scion, especially in the young shoots, high asparagin content apparently being characteristic of this stock. The carbohydrate content of trees on *M IX* is also high relative to other stocks, and the carbohydrate/nitrogen ratios do not therefore differ appreciably. The seasonal cycles of the nitrogen fractions and C/N ratios are given and it is concluded that the chemical data, so far as terminal shoots are concerned, do not reflect the pomological differences between stocks. *M IX* alone induces any significant change in the chemical composition of the shoots of long-established trees.

Anatomical Manifestations of a Virus Disease

THE first macroscopical symptom of many virus diseases is a clearing or yellowing of the veins of a host plant; but later, the green parts of a mosaic-mottled leaf may run along some of the larger veinlets. Miss F. M. L. Sheffield, of Rothamsted Experimental Station, has made anatomical studies of this apparent reversal of chlorophyll content in *Hyoscyamus* virus III as it attacks the tobacco plant (*Ann. App. Biol.*, 25, No. 4, 781; 1938). The yellow colour of cleared veins is due to retardation of chlorophyll formation; no anatomical or cytological abnormalities occur at this stage. When bands of green tissue appear along the veins, however, the green parts are thicker than normal, whilst the interveinal yellow areas are thinner. Intracellular inclusions are abundant in all tissues except the xylem, but the virus is 6-11 times more concentrated in the yellow cleared tissue than in the green, banded tissue. The findings agree, in general, with those of other workers using different host-virus combinations.

Tetraploid Pears

A bud sport from the 'Fertility' pear ($2n = 34$) has occurred in Messrs. Seabrook's Nurseries. This new form, called 'Improved Fertility', exhibits increased size in all its parts. The average weight of each fruit is 197.5 gm. compared with 125 gm. in the original form. M. B. Crane and P. T. Thomas (*J. Genetics*, 37, 287-300; 1939) have analysed the new form and found it to be a tetraploid $2n = 68$. This 'Improved Fertility' is more self-fertile than the original diploid form and may give rise to further desirable tetraploid varieties of pears. The diploid form, although known in commerce for sixty years, is comparatively unstable and sometimes shows aberrant cell divisions.

Strength of the Earth's Outer Shells

R. A. DALY has recently reconsidered this question on a world-wide scale in the light of the evidence of gravity anomalies, the figure of the earth and physical geology (*Amer. J. Sci.*, 35, 401; 1938). From recent data obtained by Hirvonen in the glaciated tract of north-west Europe "it appears that the asthenosphere can have at most only a minute fraction of the strength attributed to it by either Barrell or Jeffreys". The positive or negative loads would in this case have to be borne either by the earth's crust or by a 'centrospheric' shell, either or both of which would

need to have considerable strength, especially to shearing stress and bending moments. Further, the gravity anomalies obtained in peninsular India are hard to reconcile with the present earth model unless a triaxial figure of the earth is used, corresponding with one of those deduced by Hirvonen, Helmert, Berroth or Heiskanen. The proposed new model also contains proportions of sial and crystalline sima to account for the facts of physical geology, the whole being supported on a vitreous substratum which has a configuration similar to the earth's geographical features but more accentuated, this substratum producing the isostatic compensation. The elevations in the vitreous substratum directly under the continents and mountain chains are called 'anti-roots'.

Configuration of Chitosamine

CHITOSAMINE, the amino-hexose from chitin, has been alternatively described as glucosamine or mannosamine and numerous attempts to solve this problem of configuration have been made. W. N. Haworth, W. H. G. Lake and S. Peat (*J. Chem. Soc.*, 271; 1939) have now shown that a dimethyl 2:3-anhydromethyl mannoside gives rise, with alkali or sodium methoxide, to both a glucose derivative and an altrose derivative. The opening of the anhydro-ring in the dimethyl 2:3-anhydromethyl mannoside by ammonia gave rise to a derivative of 3-amino-altrose on the one hand and of 2-amino-glucose on the other. The latter substance was shown to be identical with chitosamine, which may now be considered configurationally to be glucose amine and therefore related to the parent sugar glucose.

Deuterium Content of Mixtures

An improved method of determining the deuterium content in mixtures of H_2O and D_2O is described by K. Linderström-Lang, O. Jacobsen and G. Johansen (*O.R. Lab. Carlsberg, Série chimique*, 23; No. 5; 1938). The apparatus consists of a vertical glass tube containing a heterogeneous mixture of kerosene and bromobenzene the density of which varies linearly with the height. One drop of the aqueous solution is added and falls to a position of equilibrium in which its density is equal to that of the medium there. The position of the drop is read off by a horizontal microscope and compared with the positions of standard drops of known densities. Only a very small amount of the water (1 cub. mm.) is required. The experimental procedure is described, particularly the purification of the water samples before measurement.

Sliding Friction and the Contact between Surfaces

F. P. Bowden and L. Leben (*Proc. Roy. Soc.*, A, 169, 371; 1939) have investigated in detail the sliding of one surface over another. The lower of two surfaces was moved slowly and very regularly, another surface was pressed against it and dragged against a spring control which measured the frictional force. It was found that the sliding always took place in a series of jerks. The upper surface was first carried forward with the same velocity as the lower, then there was a rapid slip, followed by a further period of sticking, and so on. This effect was observed with ordinarily clean surfaces and with surfaces lubricated with mineral oils. If certain long-chain fatty acids were used as lubricants, the sticking and slipping disappeared and motion became con-

tinuous. The friction between surfaces of like metals showed a large and violently fluctuating frictional force instead of the regular slipping and sticking. The experiments suggest that friction is due to a welding together of the materials at local points of contact. When the welded junctions are broken, the metal is distorted to a depth large on an atomic scale. Bowden and D. Faber, in the following paper, have estimated the area of contact between metal surfaces from the electrical resistance of the interface, and by visual examination of the impressions formed. They conclude that for flat stationary surfaces the area of intimate contact may be only 1/10,000 of the apparent area. The area of true contact is not greatly affected by the size, shape or roughness of the surface, but it depends mainly on the pressure. The local pressures are probably such that steel and similar materials undergo plastic deformation. Measurements made with moving surfaces show that the area of contact is not constant, but changes rapidly with the sticking and slipping of the sliding surfaces. The variations in contact area were compatible with the view that sliding consists in the alternate formation and rupture of metallic junctions.

A Falling-Weight Time Switch

BEFORE a meeting of the Physical Society of London, held on March 10, Eric J. Irons read a paper prepared by him in co-operation with G. A. Bennet in which they described a falling-weight time switch. In this apparatus, the simultaneous release of two steel balls, the one from a fixed height and the other from a variable but known height H effects the operation of two switches at a time interval which is shown to be a linear function of $\sqrt{H}$. An electrical circuit is arranged so that the fall of the first ball disconnects the battery and allows the condenser in circuit with it to discharge through a resistance R , until the impact of the second ball opens a switch and breaks the circuit. The potential difference between the plates of the condenser is estimated at this instant by observing the kick of the galvanometer which is simultaneously put in circuit with it. The logarithm of this value plotted against $\sqrt{H}$ gives a straight line, which substantiates the required relation and whose gradient yields the value of g with an accuracy of one half of one per cent. In the second part of the paper, the authors explained the application of the two-sphere arrangement to the study of the relation between current and time in an inductive circuit.

Colour Photography of the Lunar Eclipse of Nov. 7, 1938

B. BURRELL has recently published a paper with this title (*J. Brit. Astro. Assoc.*, 49, 4; 1939) in which he describes the results of his records of this eclipse on colour-recording film. He used Agfacolor as a suitable material and obtained altogether forty-eight exposures, the telescope being a 3-inch refractor, mounted on an equatorial head. As there was no driving-clock, guiding was done by the finder; but this proved rather difficult, especially when the centre of the disk was in the umbra, as the eye was then dazzled by the strong penumbral light. A table shows the results obtained for various phases of the eclipse. The centre of the umbra at the beginning of totality was a very deep brown, shading to orange at the N. limb. Later the whole umbra brightened up considerably until about 0h, after which it remained constant.

The South-West Essex Technical College and School of Art

WHEN the historian of the future makes a survey of the development of education in Great Britain, he will undoubtedly consider the rapid advance in all forms of technical education as the characteristic feature of the present period. We who live in the period may perhaps be too near the gradual evolution to appreciate fully its magnitude and far-reaching effects. Yet, when one county, and that not a large nor highly industrial one, can, within a few years, erect two large technical colleges, only a few miles apart, each costing more than

The building is, in plan, shaped like the letter E and faces south. It covers an area of two and a quarter acres and is designed in the Georgian style, faced with multi-coloured bricks that contrast with the rusticated plinth, cornice and window dressings. It contains four floors, and the main entrance, placed at the top of a bold flight of steps, is rendered beautifully conspicuous by its portico of artificial stone supported by six Corinthian columns and surrounded by a pediment. The west wing, forming the upper prong of the E, is occupied by the departments of



£200,000 and accommodating 6,000 evening and 1,100 day students, there can be no doubt that this mechanized age has forced the pace of technical education very considerably.

The increased demand for more adequate facilities for practical education, together with the rapid development of many suburban districts due to the migration of the population, led the Essex Education Authority in 1933 to devise a regional scheme. The county was divided into four regions having centres at Colchester, Chelmsford, Dagenham and Walthamstow. Technical schools were already in existence in several districts, but to meet modern requirements, it was decided to enlarge and re-equip those at Colchester and Chelmsford and to erect entirely new buildings at Dagenham and Walthamstow. The South-East Essex Technical College, situated on spacious grounds on the south side of Longbridge Road about two miles from Barking station, was officially opened in 1936 and a brief account of this huge college appeared in *NATURE* of March 27, 1937. The fourth region is served by the South-West Essex Technical College and School of Art, situated on a large site in Forest Road, Walthamstow. This magnificent edifice was opened on February 28, 1939, by the Right Hon. The Earl de la Warr, president of the Board of Education. It is designed to serve the Boroughs of Walthamstow, Leyton, Chingford and Wanstead and Woodford together with the smaller districts of Waltham, Epping and Ongar.

science, commerce, domestic science and building, with a well-equipped gymnasium at the north end. In the east wing are to be found the School of Art and, at the northern extremity, a second gymnasium. Between the two gymnasia, provision in the form of a separate one-story building has been made for the engineering workshops. The central prong of the E actually forms the main axis of the College and contains the large and spacious assembly hall on the ground floor with the swimming bath below in the basement, and above, the library on the first floor with a refectory and kitchens on the second floor. The great hall, 100 ft. long, 55 ft. wide and 22 ft. high, will seat more than one thousand people and is provided, at the north end, with a stage 20 ft. deep completely equipped for modern dramatic and operatic productions. The swimming pool, fitted with springboards, diving stage, changing and shower rooms, is 100 ft. by 42 ft. and is illuminated by specially devised ceiling lights.

The frontage block—the vertical stroke of the E—contains staff rooms in the basement; chemical and physical laboratories, with storage and lecture rooms on the lower ground floor; administrative offices, board-room, etc., on the ground floor, and above, on the top floor, special rooms for bookkeeping, commodities and retail trades. One special room should be noted in this block. On the ground floor nearly opposite the board-room is the nursery where mothers may leave their children in the care of a trained nurse

while they are attending classes! The corridor floors are covered with grey mottled rubber to render the movement of students as silent as possible, and supplementary to the main staircases, passenger lifts have been installed.

It was John Ruskin who wrote, many years ago, "The entire object of true education is to make people not merely do the right things but enjoy the right things". Yet, the pioneers of technical education were mainly concerned with providing a training which was severely utilitarian. But, as Dr. H. Lowery, the principal of the College, aptly points out, "A new problem . . . has arisen—it becomes necessary to provide training for *leisure* as well as for *vocation*". Here then is a new function implying heavy responsibilities for the modern college. It is essential to recognize and to cater for the proper use of leisure, and here, in this magnificent new institution, ample opportunities are afforded for developing the true recreational and communal spirit. To quote

Dr. Lowery again, "it is our desire that the College shall become one great educational and recreational community centre where men and women may meet in their leisure time for the purpose of engaging in matters of common interest, thereby securing the fullest opportunity for self-expression".

The material building of this huge college has been very efficiently carried out by the general contractors, Messrs. F. R. Hipperson and Son, Ltd., of London, to the plans of Mr. J. Stuart, the architect, but an even greater work will now be undertaken by the principal and his large staff in laying the foundations of another edifice which will undoubtedly reveal itself in the trained mind, skilled craftsmanship, cultured recreation and, what is most important of all, trustworthiness and reliability of character. As R. W. Dale once wrote: "The immediately possible is hardly worth living for. It is the ideal that kindles enthusiasm and gives inspiration and vigour to all human effort".

F. G. W. B.

Peneplains and Related Land Forms

IT is now nearly fifty years since W. M. Davis introduced the term 'peneplain' for the surface of low relief which might be expected to mark the end-stages of a long period of sub-aerial erosion under stable conditions. The term was received with a certain suspicion and lack of cordiality among British workers and it has been used comparatively little in their writings. Geographers and geomorphologists will therefore note with interest that the Geological Society recently discussed some of the questions at issue.

In introducing the subject, Dr. F. Dixey's main contention was that the term 'peneplain' is properly applicable to local areas which, though extensive, are far from being of continental dimensions. The common presentation of a cycle of erosion as running its course in a region of homogeneous rocks and resulting ultimately in the base-levelling of a whole land mass leads, in his view, to an unwarrantable attempt to limit the application of the term peneplain. He directed attention to the "two-peneplain topography" described by A. D. Coombe in Uganda, and common indeed throughout Africa, and he showed that such conditions must inevitably arise where weak and resistant rock-masses are juxtaposed. The lower surface opened out in weaker rocks, such, for example, as unfaulted strips of Karroo sediments, may have the characteristics of a true peneplain, even though locally interrupted by residual masses and abutting elsewhere against steep slopes. Thus there arose veritable flights of peneplains as between the northern end of the Nyasa rift and the Luangwa valley. Here the following erosion surfaces are distinguishable: a late Jurassic surface at about 7,000 ft., a late Cretaceous or Early Tertiary surface at 5,000 ft., a Miocene surface at 4,000 ft., and a late Tertiary surface developed at about 3,000 ft. on friable Cretaceous rocks in local troughs. Further, a sub-Cretaceous surface has been exhumed locally by erosion and stands at about 2,000 ft. This surface and the late Tertiary surface rank as local peneplains in Dr. Dixey's sense, though others have denied them

such rank because they are enclosed by highland areas.

Most other contributors to the discussion expressed agreement with Dr. Dixey, and Mr. J. M. Edmonds described somewhat comparable conditions in the Anglo-Egyptian Sudan. Dr. K. C. Dunham, however, noted that the Rio Grande and the Gila River are flanked by erosion surfaces, up to 80 miles long and 30 miles wide, produced by lateral corrosion. These would apparently rank as local peneplains in Dixey's scheme, but he thought this constituted an extension of the term peneplain and one unlikely to prove acceptable to American workers.

The discussion ranged widely over other cognate matters and several points of view were represented. Prof. O. T. Jones deplored the lack of any agreed definition of the features of a peneplain. He maintained that, in one sense, the whole of England and most of Wales is a peneplain rising gently from sea-level to more than 2,000 ft., and truncating all formations from the Pre-Cambrian to the Pliocene. Despite the considerable relief of parts of this surface, such relief can scarcely amount to 10 per cent of the thickness of strata removed by erosion. He also emphasized the probable importance of wind erosion in producing extensive surfaces of low relief.

Other speakers were, by implication at least, unwilling to accept so wide and general a connotation for the term 'peneplain'. Dr. Hollingworth pointed out that Davis's conception of a single peneplain in the Appalachian region is now challenged by several alternative and mutually inconsistent interpretations, most of which agree, at least, in representing the surface as complex and composite. Similarly, Mr. J. F. N. Green expressed the belief that many surfaces in the south of England which might be regarded as peneplains on general inspection have proved susceptible of dissection into distinct terrace-like features, separated by bluffs. Mr. A. A. Miller and Dr. S. W. Wooldridge raised a further issue in pointing out that many of the 'high-level platforms' of Britain, as well as most of the 'fossil' surfaces.

that is, exhumed planes of unconformity, have been finished, if not formed, by marine agency. In many such cases it is clear that the drainage pattern has not been inherited from a previous cycle, as must inevitably be the case with a true peneplain. Thus, closely spaced wind-gaps in the Old Red Sandstone ridges of southern Ireland indicate a consequent drainage initiated upon the surface which bevelled the structures. Similarly, the transection of antilinal lines by rivers in southern England indicates that over wide areas the drainage originated upon the emergent floor of a Pliocene sea. Nevertheless, the whole of the region was not submerged; in parts of the Chalk areas of Wessex and the central Wealden area the reconstructed hill-top plane reveals the characteristics of a true peneplain and the drainage was adjusted accordingly. It seems, moreover, that the Thames in earlier stages of its history cut wide

benches by lateral corrosion which may fairly be grouped with Crickmay's 'panplains' and the American examples adduced by Dr. Dunham.

The discussion gave a clear indication, if such be needed, that the findings of geomorphology in the field of erosion surfaces now challenge the close attention of the stratigraphical geologist and the geophysicist. Erosion surfaces, some trimmed by marine erosion and others demonstrably of sub-aerial origin, have been proved to have a wide extension and to maintain essentially unwarped attitudes over great distances. As such, they constitute an important record of the later geological history of the continents, supplementing the sometimes scanty evidence of deposition. Further, their existence cannot be ignored by those who seek to understand the nature and extent of isostatic adjustment in the lithosphere.

S. W. WOOLDRIDGE.

Physics in the Textile Industries

RESEARCH physicists working in industry continue to increase in number, and the Institute of Physics, by holding conferences on industrial physics, does much to bring them together to discuss their mutual problems. But the conferences are open to all interested, and the physicist has opportunities of making contacts with those of other professions whose problems are essentially physical.

The third conference, held in Leeds during March 23-25, was devoted to "Physics in the Textile Industries". The textile industries have been built up by many years of experimenting coupled with notable inventions, and it has behind it a wealth of knowledge which must be learnt by the physicist if his work is to be of utmost advantage to the industry. Meetings such as that held in Leeds are thus of great value in enabling the physicist to discuss problems not only with other physicists, but also with those conversant with the industry. Simultaneously, the industrial technical man has an opportunity of learning possible applications of physics and physical devices to his industry. This is particularly important for the older textile industries, where few factories have physicists on their permanent staff, and advances which physics has to offer must be introduced and cared for by the technical men.

The conference was held in the Physics Department of the University of Leeds. It was formally opened by the Vice-Chancellor, Mr. B. Mouat Jones, and was presided over by Prof. R. Whiddington. Following established practice of the Institute, the lectures and discussions were informal, and will not all be published.

The formal opening was followed by an address by Prof. Whiddington on "The Physics of Humidity". He discussed with demonstrations the properties of the small but important amounts of water in the atmosphere, and indicated why relative humidity is for the textile industries a much more convenient measure of the quantity of water vapour in the air than the fundamental measure, vapour pressure. He then described properties of substances dependent on water content, and illustrated experimentally the large heat effects associated with change in water content of textile fibres. He concluded with an experi-

ment showing the swelling of a wool fibre with increase of water content, using as a micrometer the capacity of a condenser in a heterodyne circuit. Thursday morning's programme was completed by a lecture from Dr. Ezer Griffiths, of the National Physical Laboratory, on "Industrial Humidity Control and Measurement". He illustrated with many slides the requirements of humidifying plant and humidity controls, and described the various ways of measuring relative humidity, indicating the method most convenient to each industrial process where this is important.

The afternoon of March 23 was devoted to a visit to the Department of Textile Industries in the University, followed by Dr. C. C. Paterson's presidential address to the Institute of Physics. He chose as his subject "Colour and Colour Rendering". This was a lecture of exceptionally beautiful and instructive demonstrations. Dr. Paterson pointed out the high efficiency attainable from discharge tube lamps, and contrasted their spectra and colour-rendering properties with daylight and other sources of illumination. The colour triangle and C.I.E. units were simply and elegantly explained, and there followed striking demonstrations of the difference between matched white lights for colour rendering. He pointed out that the appraisal of colour matching value is a pressing but unsolved problem. The lecture concluded with illustrations of the improvement in colour quality and efficiency attainable in discharge tube lamps by use of fluorescent materials.

The lectures on March 24 were by Dr. M. O. Marsh, of the Cambridge Instrument Co., Ltd., who chose "The Contribution of Physics to the Development of Industrial Process Control", and by Mr. D. Harrison, who spoke on "Automatic Regulators for the Textile Industries". These lectures brought to the notice of all the many instruments now available for industry, and features of their design gave an impressive illustration of the potentialities of physical knowledge when applied to industry.

The final lecture of the meeting was on "Heat Effects in Fibres and other Systems". It was given by Dr. C. G. Darwin, director of the National Physical Laboratory. It was a delightful lecture on a difficult

and controversial subject. Kinetic effects have of recent years been used to explain the long-range elasticity of many natural substances, particularly rubber, and suggestions have from time to time been made that the same principles may lie behind the exceptional elasticity of muscle, wool fibres, and various synthetic materials. Dr. Darwin outlined the thermodynamic and statistical arguments of equipartition of energy and entropy, and used them in a critical survey of explanations of long-range elasticity. He showed, too, how these same kinetic principles led to the use of adiabatic demagnetization for attainment of very deep temperatures.

On Friday evening and Saturday morning, members of the Conference saw much of science in the textile industries at the laboratories of the Wool Industries Research Association. Alternative visits on Saturday morning to the Bradford Conditioning House and to Messrs. Prince-Smith and Stells, Ltd., Keighley, enabled members to appreciate the extent of testing of textile materials, and the ingenuity that has been used in design of textile machinery.

An exhibition of apparatus, instruments and books cognate to the subject of the conference was held in

the physics laboratories of the University. Twenty-six firms and research organisations, including the National Physical Laboratory, had stands at the Exhibition. A special section devoted to popular applications of physics calculated to demonstrate its varied application to everyday matters, especially in the manufacture and use of textiles, aroused much interest. Representative instrument makers contributed exhibits which served to show how many and varied are the instruments available to help the textile manufacturer overcome many of the difficulties inherent in producing a uniform product from variable raw materials. The exhibition was of inestimable value in suggesting to textile manufacturers the large variety of problems that physics may tackle.

The Institute of Physics assumed a difficult task in choosing "Physics in the Textile Industries" as the subject for its third conference. Physics is becoming better recognized by textile manufacturers, but its progress in the industry has proved difficult and slow. The success of the conference and the attention it has attracted should advance the application of physics in one of the largest industries of Great Britain, and in turn help it to meet ever-increasing competition from abroad. A. B. D. CASSIE.

Forest Administration in Malaya

THE Forestry Department of the Straits Settlements and the Federated Malay States was organized in 1901 and the Malayan Forest Service, which includes all senior officers serving in Malaya, was created in 1926. Afterwards, the protected States of Johore (1920), Kedah (1923), Kelantan (1933), Brunei (1933) and Trengganu (1936) set up forestry departments of their own, to the charge of which officers of the Malayan Forest Service were appointed. A Research Branch was commenced in 1918, and has greatly developed and undertaken important work, its sections now consisting of botany, wood anatomy, silviculture, chemistry, entomology, forest economy and timber testing. In connexion with the Research Branch, a vernacular school is maintained for the training of the subordinate staff. The Research Branch and School are now much on the same lines as the classic example at Dehra Dun, India.

Decentralization took place in 1935, and the Malayan forest organisation is now defined as a group of ten forest departments held together by a common and interchangeable staff of trained officers "with a central coordinating body (including the director of forestry), with executive control in some territories and advisory duties in others, that always exerts some influence towards co-operation and a broadly common forest policy". So long as the central co-ordinating body is listened to, progress in the future should be as good and better than the past. But decentralization is a dangerous thing in forestry—as can be seen in many parts of the forestry world in the British Empire. The required area of forests to be reserved in the interest of the individual country as a whole, stock mapping in forests under exploitation or shortly to be exploited, and, that safeguard of the forests, the working plan—these three essentials to a correct administration of a country are in one or more cases, and often in all three, lagging seriously behind what is needed in many parts of the Empire.

When this is the position—and in how much of our Empire outside India is this the case—decentralization and the withdrawal or even lightening of the control of a central authority responsible for a large region of country is seriously to be deprecated.

That this latter contention merits attention is shown by the statement contained in the "Annual Report on Forest Administration in Malaya for 1937" (F.M.S. Govt. Press, Kuala Lumpur, 1938). The Director writes, "Some uneasiness has however been caused by sudden and unexpected demands for the release of extensive areas that have always been regarded as permanent reserves. Thus, in Tabang the Teluk reserve of 83,000 acres had to be relinquished for inclusion in the King George V National Park, in this way preventing the exploitation of some particularly good *merbau* forest, conveniently situated near the railway. In Perak practically the whole of Pasir Panjang Ulu reserve of 19,000 acres was earmarked for a *padi* irrigation scheme, innumerable applications were received for permits to prospect for minerals and a strong bid was made by Sakai to settle in an old-established reserve that is by no means too large to meet the needs of the surrounding population and in which regeneration operations have been carried out for years at considerable expense to Government. This department is far from being unsympathetic to the claims of these various communities and realizes that adjustments will be necessary, but the long-range policy that is inseparable from conservative forestry makes it imperative that conflicting interests should be planned far enough in advance to enable systematic forest operations to be undertaken with some prospect of fruition".

Sympathy may be expressed with a department placed in such a situation, but the forestry authorities do not appear to understand that it is one of the objects of and duties of the working plan to safeguard forests from calamities of this type and others.

On the subject of working plans, the Director writes, after alluding to plans for the mangrove forests of Perak and Selangor, "Whereas the plans for the mangrove follow the usual pattern, those for inland forests are much less detailed and will continue so until greater stability is reached in the consuming industries and the threat of revocation is removed. Reference has been made (above) to the existing uncertainty with regard to the permanence of tenure, without which no serious planning is possible".

Why? This was not the policy followed in India; nor is it in Europe. In the centre of France a fine beech forest exists. There is also an industry working out kaolin within the forest. A working plan has been in force for the area for more than eighty years; and yet the manager of the kaolin industry can come to the forest officer any day and say he wants to commence to excavate at such and such spot, thereby involving one or more compartments, which necessitates some adjustments in the working plan and possibly of the yield for some years to come. Once a working plan has been sanctioned for an area of forest by the central authority the latter is not so ready to go back on a considered policy. Areas now threatened in Malaya might never have come into this unenviable position had they been placed under a working plan.

This report is of considerable interest and contains abridged reports of the activities of the Forest Departments of Johore, Kedah, Kelantan, Trengganu and, Brunei.

University Events

CAMBRIDGE.—At a special congregation to be held on June 6, it is proposed to confer the honorary degree of Sc.D. on Prof. W. N. Haworth, Mason professor of chemistry in the University of Birmingham, and on Sir Henry Dale of Trinity College, director of the National Institute for Medical Research, London.

At King's College, Dr. A. E. Alexander has been elected to a fellowship. Dr. Alexander, who was educated at Brookenhurst County School and the University of Reading, obtained a first class in Part II (Chemistry) of the Natural Sciences Tripos in 1935 and was awarded the Gordon Wigan Prize in 1937. He was elected to a Ramsay Memorial fellowship in 1937 and now holds a Rockefeller travelling fellowship.

LONDON.—Dr. G. A. D. Haslewood has been appointed to the University readership in biochemistry tenable at Guy's Hospital Medical School. Since 1935 he has been assistant in pathological chemistry at the British Postgraduate Medical School.

Mr. P. A. Sheppard has been appointed to the University readership in meteorology tenable at the Imperial College of Science and Technology. Since 1934 he has been technical officer in the Department of Meteorology at the Chemical Defence Experimental Station, Porton.

It has been resolved to institute a certificate of proficiency in natural history, and regulations have now been adopted for it.

SHEFFIELD.—Dr. J. Monteath Robertson has been appointed lecturer in physical chemistry, in succession to Dr. S. Glasstone, who has resigned.

Science News a Century Ago

Photography in Germany

Writing from Paris on April 2, 1839, a foreign correspondent of the *Athenaeum* said: "The announcement of Daguerre's discovery has turned the brains of half the world: you sober English have certainly not escaped the infection; and the speculating Germans, as you have noticed, are hard at it. I learn, by letters just received from Munich, that Profs. Steinheil and Robel are astonishing the natives with their Photogenic pictures. It is said that they have discovered the process of the Daguerre, but it seems to me more than probable that their process rather resembles that of Mr. Talbot; and that by their invention pictures can be obtained not only with the aid of the camera obscura but by the direct agency of light so that they take, in an instant, copies of pictures traced upon blackened glass. . . . Daguerre's pictures are, it is known, traced upon copper (?) but Messrs. Steinheil and Robel imprint theirs upon paper."

Application of Döbereiner's Discovery

In a letter to the *Mechanics' Magazine*, sent from Sandwich on April 5, 1839, W. H. Weekes referred to "a suggestion of my own made many years since, with a view to effect the simultaneous lighting of street lamps throughout a town or district". Weekes had been accustomed, by means of a private press, to keep memoranda in printed form, and one of these dated January 24, 1826, he sent to the editor of the journal. In this memorandum he had written: "One of the most interesting facts as connected with the recent advancement of modern chemical science, perhaps, is the important discovery of that intelligent continental philosopher Döbereiner, who has ascertained the peculiar property of *spongy platinum* to become ignited by exposure to the action of a stream of hydrogen gas, and the consequent inflammation of the gas itself, from contact with the ignited metal; thus furnishing a most ingenious, elegant and useful mode of obtaining instantaneous light. . . . Now, will similar results obtain from the action of *spongy platinum* on the gaseous compound carburetted hydrogen or coal gas? Of this I think there can be little doubt, and if proved the spongy platinum may unquestionably be rendered applicable to the purpose of lighting street lamps spontaneously."

Johann Wolfgang Döbereiner, the German chemist who discovered the property of spongy platinum referred to, was born December 15, 1780, and died March 24, 1849.

Seasons and Infantile Mortality

THE issue of the *British and Foreign Medical Review* of April 1839 contains the following information: "The season of the year evidently exercises great influence on the rate of the mortality of children. According to Trevisan, of 100 children born in Italy in the winter 66 die in the first month, and only 19 survive the first year; on the other hand, of 100 children born in summer so many as 83 survive the first year, of 100 born in the spring 48, of 100 born in the autumn 58. In Belgium the rate of mortality in the first month of children born in January, compared with that of children born in July is 33.21 to 17.19."

Societies and Academies

London

Royal Society (*Proc.*, B, 127, 1-139; 1939).

T. SVEDBERG and others: A discussion on the protein molecule.

F. C. COURTICE, C. G. DOUGLAS and J. G. PRIESTLEY: Carbohydrate metabolism and muscular exercise.

W. S. STILES: Directional sensitivity of the retina, and the spectral sensitivities of the rods and cones.

C. RIMINGTON: A re-investigation of turacin, the copper porphyrin pigment of certain birds belonging to the Musophagidae.

P. K. DE: Role of blue-green algae in nitrogen fixation in rice-fields.

Paris

Academy of Sciences (*C.R.*, 208, 609-684, Feb. 27, 1939).

A. LACROIX: Submarine volcanoes, in connexion with some rhyolitic pumices collected on the atoll Marutea du Sud (Tuamotu Archipelago).

R. ROSCA: Asymptotic transformations of curves in elliptic space.

A. TERRACINI: Existence of surfaces having given principal lines.

J. TOUCHARD: Differential equation of third order sines.

G. KOWALCZEWSKI: An unknown property of the plane projective group.

V. ROMANOVSKY: Eddies in thick sediments: application to polygonal strata of the Arctic. Layers of sugar, salt or sand, covered with a layer of water and heated nearly to boiling point, give convection 'cells' identical in form with the polygonally marked areas of Greenland and Spitsbergen.

L. ESCANDE: Experiments on the outflow of a weir barrage.

G. DEMBANT and P. WEHLE: Definition of turbulence.

J. VILLY and R. JAMIN: Law of variation of the force opposed by the air to the translation of a movable body.

H. MINNIB: Evolution of galactic clusters.

H. GROUILLER: Photographic and colorimetric photometry of the eclipsing double star β Lyrae.

J. VIGNAL: Probable chief cause of imperfection of modern levellings.

I. OPATOWSKI: Integration of the equations of motion of an electrified particle of variable mass subjected to the action of electric or magnetic fields of any kind.

J. MARIANI: Existence of an elementary quantum of length.

L. NIEL and B. PERSOZ: New method of measuring true specific heats of metals at high temperature. The metal in the form of a wire, 0.5 mm. thick and 10 cm. long, in a furnace at a given temperature is heated by an intense current for about 0.1 sec. and the rise of temperature measured by using the wire as a branch of a double Thomson bridge.

S. NIKITINE: Theory of transversal photodiachroism.

P. SAVITCH: A gaseous radio-element formed by the bombardment of uranium by neutrons. The new

element is a gas emitting β -radiation and its period is about 20 min.

F. JOLIOT: Observation by the Wilson method of the cloud trajectories of the products of the explosion of the uranium nucleus. On one photograph out of 902 taken, a track indicating an atom of ionizing power four times that of an alpha-ray was found.

T. KAHAN: Transmutations of light nuclei and their theoretical interpretation. A series of reactions in cascade is suggested.

J. THIBAUD and A. MOUSSA: Disintegration of uranium by neutrons and the partition of this element. Chemical separation shows that uranium breaks up into lanthanum and bromine, which are transformed by a series of β -disintegrations into strontium and a rare earth respectively. Particles of energy of the order of 50 Mev. are released.

A. DOGNON and C. PIFFAUT: Absence of denaturation by heat of superficial solutions of serum albumin.

F. PUCHET: Thermal dissociation of osmium palladium dichloride.

J. BOUGAULT, E. CATTILAIN and P. CHABRIER: Action of Raney nickel on some organic sulphur compounds.

M. BASSIERE: Crystalline structure of the acids: constitution of the asohydric anion.

R. COMBES and Mlle. M.-T. GRETTE: Action of alpine climate on plant metabolism. Exposure to low temperature at night or to alpine conditions has similar effects on habit of growth and also leads to accumulation of soluble glucides.

R. ULRIKH: Quantitative variations of fatty acids, sterols and phospholipids during maturation of the fruits of ivy.

A. DEMOLON and H. BURGEVIN: Utilization of fertilizer elements in the production of the grain of cereals: role of straw.

J. VELLARD: Variations of globulin resistance *in vivo* under the influence of snake venoms.

MILLES, A. RAFFY and R. RIOART: Influence of variations of salinity on oxygen consumption in cephalopods.

J. LAURET and R. DURAND: Modification of pathogenic activity of two strains of rat typhus virus maintained by passage through white mice. A dried stable product can be prepared which may perhaps be suitable for inoculation of man against typhus.

G. HORNUS: Experimental pulmonary pentaoxis of white mice.

L.-A. MARTIN: Adsorption of the virus of the infectious anaemia of the Equidae on aluminium hydroxide.

W. KOPACZEWSKI: A particular modality of phenomena of shock.

A. BESSEMDKA: Local cutaneous bacterio-therapy in rabbit epithelioma (Brown-Pearce).

Moscow

Academy of Sciences (*C.R.*, 20, No. 6, 1938).

A. G. PINSKER: A function in the space of Hilbert.

A. B. SEVERNY: Gravitational instability of a material sphere.

N. MOISEWITSCH: (1) Construction of stability regions in Liapounoff's sense. (2) Stability regions in the space of phases.

A. ALICHANOV, A. ALICHANIAN and M. KOZODANV: Measurement of c/m , for β -particles of RaO.

A. ALICHANOV and G. LATYSHEV: Spectrum of RaO positrons.

VS. OMERIAJEV: (1) Wave-length measurements of deuterium and hydrogen Balmer lines. (2) Influence of noble gases on the intensity of lines of hydrogen and deuterium Balmer series.

V. FABRIKANT and G. ROKHLIN: Effect of magnetic field upon the radiation of mercury discharge.

V. FABRIKANT and K. PANEVKIN: Excitation of atoms in a discharge of rare gases.

W. LEWSCHIN and E. RICHMANN: Investigation of the phosphorescence mechanism of samarium phosphorescent substances by studying the deterioration of their luminescence.

N. BALASCHOWA and A. FRUMKIN: Electro-kinetic behaviour of platinum at different potentials.

N. A. FIGUROVSKY: Method for determination of the differential volume of pores of porous bodies.

N. A. STRAKOV: Mosaic flocus of silicate glasses.

M. A. ILJINSKY: Characteristics of the phenomena taking place at the boundary line between two solid phases in an indifferent liquid medium.

V. I. NIKOLANV and S. K. KALININ: Strontium as a chemical indicator.

K. M. GORBUNOVA: Deposition of metals on mono-crystals.

P. A. ZEMBATOVICHENSKY: Problem of the origin of kaolin.

G. V. SAMOKHVALOVA: Influence of low temperatures on fish.

M. N. MEISSHUL: Alterations of chondriosomes of yeast organisms in the course of respiration and fermentation.

N. V. SEMIGANOVSKAYA: Dependence of the development of wheat plant on the geographical origin of the seed.

S. S. SMIRNOV: Question of glacial-masine relics in fresh-water fauna.

A. N. STOUTITSKY: (1) Thyreotropic response in the chick embryo. (2) Parathyreotropic response in the chick embryo.

M. P. ALEXUPR: Regeneration processes in the developing bone.

Z. IGNATIEVA: Differentiation of neuroblasts in cultures.

Tokyo

Imperial Academy (Proc., 15, No. 1, 1-21; 1939).

SHŌKICHI IYANAGA: Proof of the invariance of fundamental groups by the subdivision of complexes.

KAKUJI GOTO and HIDEMO SHISHIDO: Constitution of tuduranine. This is an accessory alkaloid of sinomenine in the root of *Sinomenium acutum* Rehd. et Wils., and is shown to be the 1-form of 3-oxy-5, 6-dimethoxy-N-por-sporphine.

KOZO HIROTA and JURO HORIUTI: An electrical phenomenon of a palladium filament occluding hydrogen.

YOSHIAKAZU TOYOHARA: Inclination of the strand along a sandy seashore.

SOICHI FUKUDA: Acceleration of development of the silkworm ovary by transplantation into the young pupa. Rapid development is obtained by transplantation into a pupa of either sex, regardless of the presence or absence of gonads.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

PROFESSOR OF ECONOMICS in University College, Swansea—The Registrar (April 3).

JUNIOR LECTURER IN SCIENCE (advanced electrical theory) in the Royal Military Academy, Woolwich—The Under-Secretary of State (O.S.), The War Office, London, S.W.1 (April 8).

LECTURER IN HORTICULTURE AND NATURE STUDY in the Strandmill Training College, Belfast—The Principal (April 15).

ASSISTANT LECTURER IN DOMESTIC SUBJECTS in the University of Reading—The Registrar (April 17).

LECTURER IN PHYSICS in the School of Science, Khartoum—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, London, S.W.1 (May 15).

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Liverpool Observatory and Tidal Institute. Annual Report, 1938. Pp. 18+3 plates. (Liverpool: Liverpool Observatory.) [93]

Monographs of the Geological Department of the Hunterian Museum, Glasgow University. 8: On a Second Collection of Fossils and Rocks from Kenya made by Miss M. McKimmon Wood. With some further Geological Observations on the Coastlands of Kenya, by Miss McKimmon Wood, and Reports on the Collections by Dr. Ethel D. Currie, Dr. J. W. Gregory, O. D. Ovey, Dr. G. W. Tyrrell and Agnes T. Neilson, Dr. J. Wehr, and Dr. S. Williams. (Glasgow University Publications, 40.) Pp. iv+116+12 plates. (Glasgow: Jackson, Son and Co.) [93]

Home Office. Report on the Psychological Treatment of Crime. By Dr. W. Norwood Best and W. H. de B. Hubert. Pp. iii+166. (London: H.M. Stationery Office.) 2s. 6d. net. [93]

Other Countries

University of Colorado Studies. Series B: Studies in the Humanities. Vol. 1, No. 1: Edmund Burke and his Kinsmen; a Study of the Statesman's Financial Integrity and Private Relationships. By Dixon Wecker. Pp. 112. (Boulder, Colo.: University of Colorado.) 1 dollar. [63]

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 42, Part 3: On the Nemato-Parasites of the Pacific Ocean. By Tsunenobu Fujita. Pp. 239-266+plates 10-14. (Tokyo: Maruzen Co., Ltd.) [63]

Bernice P. Bishop Museum. Bulletin 152: Distribution and Variation of *Achillea millefolium* Michx. in the Waialeale Mountains, Oahu. By D'Alto A. Welch. Pp. ii+164+13 plates. Bulletin 153: A Mammal of the Recent and Fossil Marine Pelycypod Mollusks of the Hawaiian Islands. By William Healy Dall, Paul Bartosh and Harold Alfred Rehder. Pp. iv+234+58 plates. Bulletin 154: Flowering Plants of Samoa. 2. By Erling Christoffersen. Pp. 78+3 plates. Bulletin 155: Report of the Director for 1937. By Peter H. Buck (Te Rangiroa). Pp. 80. Bulletin 156: Hawaiian Shore Fishes. By Victor Pletschmann. Pp. ii+56+18 plates. Bulletin 157: Ethnology of Mangareva. By Te Rangiroa (Peter H. Buck). Pp. viii+230+3 plates. Bulletin 158: Zonitid Snails from Pacific Islands. Part 1. 1: Southern Genera of Microcystinae. By H. Burrington Baker. Pp. ii+102+20 plates. (Honolulu: Bernice P. Bishop Museum.) [63]

Proceedings of the First Session of the Indian Statistical Conference held in Calcutta, January 1938. Edited by Prof. P. C. Mahalanobis. Pp. v+812+2 plates. (Calcutta: Statistical Publishing Society; London: P. S. King and Son, Ltd.) [63]

The Coconut Research Scheme, Ceylon. Bulletin No. 4: Geneticist's Annual Reports for 1936 and 1937. Pp. ii+58. (Lunenburg: Coconut Research Scheme.) [63]

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Scientific Research and the National Register

OF the importance of the part that will be played by men of science in the activities of any country that is, unhappily, engaged in modern warfare, there is no question. All are agreed on that point, and it is deeply to be deplored that the same agreement is not to be found concerning the contribution which they can make, and are ready to make, towards the solution of many of our peace-time problems, nor is the same desire shown to develop organizations which may serve to harness their abilities to that end. It is the tragedy of the times in which we live, that the forces of peace are unorganized, though collectively they are impressive enough in magnitude, and that the threat of war should be needed to orient and to organize man's activities to serve a common national need.

The best for which we can hope, in the present state of muddled thinking on the part of those to whom the nations of the world have confided their destinies, is that, should the shadow of war be lifted from the world, the organizations which the threat of war has called into being may be redirected and extended to serve more worthy ends. This has been done successfully in the past. The Ordnance Survey of Great Britain, which has developed almost beyond recognition since its inception at the end of the eighteenth century, and the pacific activities of which far transcend its wartime usefulness, took its origin from a war-measure ; and it needed the stress of the war of 1914-18 to call into being the Department of Scientific and Industrial Research. The plain truth is that man is an unimaginative creature, and Bastiat's argument concerning what is seen and what is not seen is pertinent to many more realms of thought than the economic one. Everyone's imagination is shocked by the thought of a great modern city

pounded to a heap of smoking ashes ; it is not so easy, in a bustling cheerful town, with cinemas filled to overflowing, and shops exhibiting merchandise gathered from the four corners of the earth, to realize that the country is faced with grave problems of malnutrition, problems the solution of which demands as close co-operation, as much teamwork, and as high and devoted enthusiasm as ever were brought to bear on a war-time problem. To-morrow is time enough for the problems which are not seen ; the threat of war brings with it problems to be attacked to-day.

Among the needs of Great Britain at the present time is a register of names of those possessing professional, scientific, technical and higher administrative qualifications. Concerning the war-time value of such a register, there is no question ; and it should be equally evident that it will have a high value for a nation which is awakening to the need for a successful attack on the problems of peace. It is the first step towards that co-ordination of our expert services which is so urgently needed ; on the scientific side, it is the first instalment of that catalogue which will help us make a mental picture of the research activities of the country—to show us, in fact, what lack of co-ordination exists, what avoidable overlappings are evident, what gaps in our research problems need filling, and where border-line problems may most profitably be attacked.

The National Service Department of the Ministry of Labour is compiling such a register, and the register, in the event of war, will provide for the Government a list of persons willing to serve in their professional capacities in some appropriate way. The emphasis here is on the word 'appropriate'. The National Service Department is fully

alive to the consequences of the errors of assignment made in the war of 1914-18, and is anxious to avoid a repetition of those errors, and to ensure that each man who offers his services is assigned to that task for which his knowledge, training and capacities best fit him. To that end the Royal Society has been asked to co-operate by compiling the section of the register dealing with persons "*normally engaged in, or qualified to undertake, scientific research*". These terms of reference should be carefully noted, for the register will defeat its own ends if it consists of an *omnium gatherum* of all persons who may be said to have had a scientific training, or who, without any special qualifications for research, are normally engaged in more or less routine work of a scientific character.

The officers of learned societies, and the heads of scientific departments in university and similar research institutions, have been asked by the Royal Society to furnish a list of those persons to whom an inquiry should be sent, and it is important here to note the relation between the Scientific Research Register and the Universities Register which was undertaken some months ago. Possibilities of overlap, confusion and of endless filling-in of forms are present in the minds of many inquirers, and it should be borne in mind that the Scientific Research Register undertaken for the Ministry of Labour by the Royal Society, as it is the latest, will probably be the last of its kind, and that it differs in three important respects from the Universities Register. In the first place, inclusion in the Scientific Register implies an *obligation*, "to serve [in wartime] in an appropriate way in their professional capacity and to accept such suitable work as is offered to them". It is perhaps desirable to emphasize this obligation, and to point out that the sub-committees set up to advise in the several subjects and to consider in advance the most suitable employment of individuals, consist of scientific men, who will approach their task with full knowledge. No obligation was, of course, implied in the Universities Register.

Again, the names of individuals included in the Scientific Research Register will not be included in the Universities Register. It is necessary to have a single register for all persons normally engaged in, or qualified to undertake, scientific research. It is obvious that a large proportion of such persons will not be in the universities, and it is therefore desirable to separate the two registers.

In the third place, the cards for the Universities

Register do not supply certain items of information which are regarded as important for the Scientific Research Register. In particular, no provision was made for that detailed classification of the individual's special qualifications, which is particularly important for the rapid and efficient use of the register.

The Ministry of Labour has set up a special Committee for Scientific Research of the Central Register Advisory Council, which will have the duty of dealing with the information given on the cards of this latest register. The names of the members of this Committee, which are given on another page (p. 592), and of the co-opted members of the various sub-committees, afford sufficient guarantee that the problems of assignment will be handled efficiently and sympathetically, and that there is little danger, say, of the expert chemist's finding himself allotted to the elucidation of a problem in hydrodynamics, or being haled off to busy himself with minor work of an administrative kind.

The Scientific Research Register, it must be remembered, is part of a larger scheme, for the Ministry of Labour is engaged in compiling a Central Register of nine sections of which the Scientific Research Register is one, the remaining registers being devoted to General Engineering, Mining and Metallurgy, Industrial Chemistry, Architecture and Public Utilities, Universities and Teaching, Administration and Management, Accountancy, and Journalism, Languages, etc. It is inevitable that overlap will occur, and in such cases cross-references will be made.

The institution of such a register marks a great advance in the co-ordination of the national services of Great Britain and in the availability of the nation's experts. It is a signal advantage to have the information contained therein collected by one Department, and set out in a consistent fashion, so as to be readily available. The immediate stimulus for the production of this register is the spectre of war, on a scale and of an efficiency which are terrifying to contemplate. This, however, should not deter scientific workers from doing their part in making the register as comprehensive as possible; for, with due provision for keeping it up to date, it should be a lasting foundation on which to build up a scientific service covering all the activities of the nation in peace as well as in war, in preparation for the time when the gifts of science to mankind shall become the keystone of progressive civilization.

Scientific Biography and Correspondence

(1) Copernicus :

the Founder of Modern Astronomy. By Angus Armitage. (History of Science Library.) Pp. 183. (London : George Allen and Unwin, Ltd., 1938.) 10s. net.

(2) Galileo and the Freedom of Thought

By Dr. F. Sherwood Taylor. (Library of Science and Culture.) Pp. xv + 212 + 5 plates. (London : Watts and Co., 1938.) 7s. 6d. net.

(3) The Mathematical Work of John Wallis, D.D., F.R.S. (1616-1703)

By Dr. J. F. Scott. Pp. xi + 240. (London : Taylor and Francis, Ltd., 1938.) 12s. 6d.

(4) Briefe Franz Xaver Freiherrn von Zach und seines Nachfolgers Bernhards von Lindenau von 1791-1816 an P. Martin Alois David Herausgegeben von Otto Seydl. (Publikace Pražské Státní Hvězdárny, C. 11.) Pp. 206. (Praha : Státní Hvězdárny Republiky Československé, 1938.) n.p.

THERE may appear to be little to connect these four works beyond the evidence they bear in common to a wider interest in the history of science. This is very welcome. Two of them bear witness further to the active encouragement now given by the University of London to the cultivation of the historical aspect of science. The object is admirable. But it cannot fail to be noticed that success in this line of research is exceedingly difficult of attainment. To the ordinary qualifications of a historian must be added a mature judgment of scientific values. Separately, these are not common qualities ; in conjunction they must be rare indeed.

(1) This book on Copernicus is rather a curious one. It is clearly intended for a wide circle of readers. Perhaps on that account it conveys the estimate of Copernicus which has come to be traditional, as its question-begging sub-title implies. But the true nature of his great work is very fairly explained. It is shown that the mind of Copernicus was Aristotelian to the core and that he followed Ptolemy in the main with great fidelity. So far from being the founder of modern astronomy, it would be far truer to regard his work as the final chapter of the ancient science. It might have been written at any time in the preceding twelve centuries. Indeed, Dreyer has raised the question why the critical step was not taken by Ptolemy himself, and has suggested his own answer. Perhaps the clue is sufficiently revealed in the present

book (p. 155), where the Copernican is claimed as a heliocentric theory, whereas it is stated a few lines before that the longitude of Mars might be 3° in error precisely because the computation is based on a theory which is not heliocentric.

The sketch of the life of Copernicus is drawn from German authorities. It is interesting for the striking justification in a case of episcopal nepotism by which Copernicus profited. His opportunities for education were extended far beyond the ordinary limit, and when he returned to his canonry, ecclesiastical duties seem to have formed the least part of his life. His freedom from theological bias ceases to be surprising.

The account of all earlier planetary theories given in an introductory chapter is necessarily brief. But this was not really needed. What is essential for an understanding of Copernicus and of Kepler is a full explanation of the work of Hipparchus and Ptolemy and, above all, of the terminology associated with the Ptolemaic system. The reader would have gained greatly if his attention had been concentrated on this one vital theory to the exclusion of all competing detail.

The true founders of modern astronomy were Tycho Brahe, Kepler and Galileo. Tycho rejected the Copernican theory, and Kepler superseded it within little more than half a century. Therefore the problem confronting those who wish to maintain that the theory has any great historical importance is to show that, nevertheless, Tycho in his observations and Kepler in his analysis were seriously influenced by it. That is a question which is not approached in this little book.

Though Copernicus had undoubtedly a distinct individuality, his impact on the succeeding age may be quite conveniently attributed to two personalities. There is the Ptolemy-Copernicus concerned with the production of ephemerides, of real though limited interest to the technical astronomer ; there is also the Aristarchus-Copernicus, who is identified in the popular mind with the heliocentric theory. Mr. Armitage has the merit of recognizing the first, but his valuations are based on the second.

(2) The book on Galileo is very readable, but it is disappointing in some respects. The historical background, which includes the counter-reformation, is clearly drawn, and this is a great merit. Details of personal appearance and character and an account of the family relationships add life to the portrait. Of the astronomical observations an adequate description is given. This was the work

of a pioneer in the field, and it is entitled to all the honour which it has received. But, as recriminations over priority show, others were ready to take up and carry on this work, and further advance depended mainly on the improvement of optical resources. The future of telescopic observation was assured, and even in the first step Galileo may have been anticipated by Harriot.

The real importance of Galileo rests on his position as the founder of dynamics. Therefore it might naturally have been expected that the most careful attention would be directed to this part of his work, to his experiments and to his deductions. In this respect the present book is very disappointing. The only reference to the parabolic motion of projectiles is contained in a few lines at the end of the book. The material and Galileo's mode of presentation have not made the task of the biographer easy; but his success must be judged mainly by his treatment of Galileo's achievement in the field of dynamics. Here the account is inadequate.

Two chapters, occupying a quarter of the book, are devoted to the conflict with the Church and the final trial and condemnation of Galileo in 1633. Translations of the principal documents are reproduced at length. The issue may have its importance in ecclesiastical history, but its significance in the history of science is slight. For Galileo, in his declining years, the penalties were heavy, but to these events he owed no small part of his enduring fame. Moreover, as Galileo stood as a champion of Copernicus, the latter owes no little in popular estimation to the same circumstances. All this is very strange because, as can be seen clearly enough now, Galileo, so far from being the bold innovator and leader of the advancing tide, was in sober fact a quarter of a century behind the times.

As early as 1597 Galileo had been in correspondence with Kepler. But when the *Astronomia Nova* appeared in 1609, he must have missed its importance completely. He was not an astronomer in the sense of Tycho; he was rather the first astrophysicist. He was not interested in the theories of Ptolemy-Copernicus, and he never progressed beyond the ideas of Aristarchus-Copernicus, in which he was confirmed by the weak argument from analogy afforded by the satellite system of Jupiter. Otherwise he would not have wasted his time on futile arguments, many of which were thoroughly unsound. But until a more precise meaning was given to the heliocentric theory, no decision could be reached by mere argument. This meaning was given by Kepler when he found that, relative to the sun, both the earth and Mars moved in elliptic orbits with the sun at one focus. After this first approximation, it was not necessary

to wait for the measurement of stellar parallaxes, or even the discovery of aberration, for independent confirmation. The line of further progress was definitely set.

Galileo can scarcely be blamed for failing to appreciate the fundamental importance of Kepler's work. Huygens was equally blind and, making all allowance for half a century's progress, Huygens was a greater man than Galileo. But one contemporary mind did realize immediately the significance of Kepler's work. That was Thomas Harriot.

Galileo, as we are reminded here, was born in the same year as Shakespeare. He died, exactly one year after the death of Horrocks, in that same year which saw the birth of Newton.

(3) A life of John Wallis could scarcely fail to be interesting. Not that he required to be rescued from obscurity, as is here supposed. He has probably not fared worse than most eminent mathematicians, who are always prophets without honour, especially in England. Among mathematicians Wallis holds a high place, and if knowledge of his work has been fragmentary, he has been largely judged perhaps on the *ex pede Herculem* principle, which is not ungenerous. It may be doubted whether the present book adds to his stature or does him full justice.

The most valuable chapter of the book is the fourth, where a full account is given of the representation of π as the limit of a product sequence. The magnitude of the effort needed to reach a point a little in advance of the flowing tide of mathematical progress will be a revelation to all those who have had no occasion to refer to the original work. This was well worth reproducing, for it is a magnificent example of the use of induction and interpolation as a method of research, a method of which Newton also proved himself to be a complete master. As a *tour de force* in this kind, this feat of Wallis is surely unsurpassed, and Newton may well have profited by the example.

Interesting details of the early history of the Royal Society and of the events which led up to its foundation are duly related. But Dr. Scott has two fatal disqualifications as a biographer of Wallis. He is prudishly shocked by the atmosphere of controversy, and he is not technically qualified to form first-hand critical judgments. By accepting everything which has been said to the detriment of Wallis, he has drawn a picture which must be grotesque. For it is utterly incompatible with the position held by Wallis in the Royal Society, which was composed in the main of kindly and gifted men like Wren.

Wallis criticized the Greek mathematicians on the ground that they wished to be admired rather than understood. This fully explains his attitude to Fermat. The resulting controversy was

anything but sterile, and both men may now be regarded as the founders of the theory of numbers. Continued fractions are mentioned only in connexion with Lord Brouncker; but Wallis was the chief founder of that theory also. In the chapter on the "Algebra" the references to Harriot and Descartes are dealt with at disproportionate length without altogether removing an element of mystery. In alluding to Harriot as "a very great man in his time" Wallis was guilty of no exaggeration, and he certainly left papers behind, whether Wallis had seen them or not; the "Praxis" was only published ten years after his death. Down to the time of Harriot, an equation was simply a means to an end, the answer to some problem which required in general a positive and often an integral solution. It was the Cartesian geometry which altered that situation. Wallis, with his sense of generality and of algebraic form, was among the first to see the equation from a mathematical point of view apart from any particular application. In doing so he seems to have confused his own development with the work of Harriot, to which he may well have owed some part of his inspiration. Why, in over-estimating that debt, he should have become increasingly hostile to Descartes is not clear. The only hint is that to Wallis a suspicion of deliberate obscurity was a veritable red rag.

As the work of Wallis on mechanics is probably less well known than that in the field of pure mathematics, a competent analysis of the "Mechanica" would have been valuable. Unfortunately, Dr. Scott is not equipped for the task, as is shown clearly (p. 121) in the matter of the centre of percussion and centre of oscillation, where any point at issue with Huygens is completely obscured. It is useless to pursue the subject of the development of dynamics from Galileo to Newton and the part of Wallis therein. With misguided and irritating pedantry the author always uses the name Galilei; has it become wrong to speak of Dante?

An instance of the injustice done to Wallis by lack of knowledge may be found in the disparagement of his astronomical knowledge because he accepted Flamsteed's parallax of Polaris. Naturally he was no expert, and it was not for the Savilian professor of geometry to suspect an error on the part of the Astronomer Royal. The gibe also appears in Miss Clerke's article in the "Dictionary of National Biography". The incident shows how in similar circumstances a great man, Bradley, made the discovery of aberration, while a lesser man, Flamsteed, merely made a mistake. But it belongs to the life of Flamsteed; so far as Wallis is concerned, it is practically irrelevant.

Another incident is mentioned by Miss Clerke, and it is to be regretted that the details are not recorded in this book, for it is perhaps the finest

scientific hoax ever perpetrated. Huygens announced the discovery of Titan by a cryptogram in 1655. But Wallis had anticipated this by a similar announcement so ingeniously constructed that after the event Huygens was led to believe that the satellite of Saturn had been observed in England at an earlier date. The true facts were disclosed in 1659. The deception may have been cruel, but it seems to have been effective in putting an end to a silly practice. It is a pity that Wallis was not equally successful in bringing to a close that other unmitigated nuisance, the challenge problem.

In an appendix a sort of "Who's Who" is given of the scientific men of the period. The value of a compilation of this kind depends entirely on its accuracy. Now Harriot, though a remarkable man certainly, did not live to the age of 120 years. He died in 1621, not 1681. This is a mere misprint. But the confusion between the works of Kepler can scarcely be explained in the same way. Nor is the list of contemporaries complete. Since the theory of equations plays so great a part in the text, the absence of Tschirnhausen can scarcely escape notice.

The specimen pages reproduced from Wallis and various authors of the period are of great interest. But in a work of this kind a complete bibliography is to be expected as a matter of course. It is emphatically not enough to copy out the contents of the Oxford collected edition (1693-99).

The author's industry is attested by the references given at the foot of nearly every page. The life of John Wallis is a fine subject but a very difficult one. It is not suited to the pen of one whose whole horizon is evidently bounded by the work of Newton.

(4) The name of F. X. Freiherr von Zach is chiefly known to astronomers as that of the founder and first editor (1800-7) of the *Monatliche Correspondenz*, a useful medium for the communication of astronomical intelligence. Strangely enough, there is an important link between him and one whose name has already obtruded itself in the preceding notices. For it was on a visit to Lord Egremont at Petworth House in 1784 that he discovered the scientific papers left by Thomas Harriot, and it is from his account in the *Berliner Jahrbuch* (1785, 1793) that the nature of Harriot's astronomical activity became known. This ranks Harriot as an astronomer in the same class with Galileo; and, be it remembered, this was one who had been to America and returned and written a remarkable book about it before the Armada. All things considered, the reputation of Harriot need depend little on a precise valuation of the merits of his "Praxis".

Father M. A. David was director of the Prague Observatory from 1800 until 1836, having been

connected with the institution for fifteen years previously. His first meeting with Zach took place at Karlsbad in 1789, the second and last at Gotha in 1801. From the correspondence which was carried on until 1805, when friendly relations were clearly broken off, sixty-two letters from Zach have been preserved at Prague and are now published. The nine additional letters of his successor Lindenau are of less interest. As David's replies have been lost, the value of the material lies chiefly in the light thrown on the character of Zach, who in that period of fourteen years shows himself as an admirable correspondent, keenly interested in all that was going on in the astronomical world, but chiefly in geodetic operations.

Born in 1754, Zach was educated at Paris, where he met Laplace and Lalande. In 1783 he was living in London, where he made contact with Maskelyne and Herschel and also the English instrument makers of the day. With the latter he had extensive dealings afterwards, both on his own account and for others. In 1786, under the Duke of Saxe-Gotha, he equipped a new observatory and directed it until the death of the Duke in 1804.

Of Zach's activity at that period there can be no doubt. But his voluminous correspondence with astronomers, his duties as editor and his active interest in geodetic operations must have interfered seriously with any astronomical work. It is therefore not altogether surprising to learn that

after his resignation the observatory was found to be in a deplorable state. Indeed, after the Duke's death, Zach disappears to all intents and purposes from the world of astronomy, though he still found occupation in editing a journal.

Had the Freiherr v. Zach been an indifferent musician or poet, instead of an indifferent astronomer, his later career would have provided material for a romantic biography. He attached himself as Hofmeister to the Dowager Duchess, the widow of his patron, and accompanied her in her travels in France and Italy until her death in 1827. According to one account he married the lady. Five years after the death of the Duchess, Zach fell a victim to cholera in Paris.

Zach's friend and successor, B. A. von Lindenau, did not remain permanently attached to astronomy, but embarked on a political career which earned for him a reputation in Saxony as a statesman and philanthropist. He died in 1864.

The present collection of Zach's letters show him to have been not only an admirable scientific correspondent but also a most efficient medium for the forwarding of astronomical literature and arranging for the supply of instruments. They abound in allusions to the astronomers living at the end of the eighteenth century and they convey much information about the equipment of observatories at that time and, more particularly, about portable instruments for use in the field. H. C. PLUMMER.

Petroleum Literature

(1) *The Principles and Practice of Lubrication: a Manual for Petroleum Technologists, Students, Engineers, Oil Salesmen, etc.* By Prof. Alfred W. Nash and Dr. A. R. Bowen. Second edition, revised. Pp. xi + 345 + 28 plates. (London: Chapman and Hall, Ltd., 1937.) 18s. net.

(2) *The Principles of Motor Fuel Preparation and Application* By Prof. Alfred W. Nash and Dr. Donald A. Howes. Vol. 1. Second edition, revised and enlarged. Pp. xiv + 628 + 15 plates. (London: Chapman and Hall, Ltd., 1938.) 36s. net.

(3) *The Chemistry of Petroleum Derivatives* By Carleton Ellis. Vol. 2. Pp. 1464. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1937.) £5 net.

THE oil industry is one of the most important of any, and it is in keeping with its rapid expansion that it has an ever-extending literature of the first rank which, perhaps more than any

other, is continually being revised and kept up to date. In Great Britain we are fortunate in that Prof. A. W. Nash of Birmingham is willing to devote a large portion of his time to making his knowledge available to his students and contemporaries.

(1 and 2) Prof. Nash's book on lubrication, which has now become an exact science, has been brought up to date in a second edition eight years after its first appearance. More recently the second edition of his "Motor Fuel" has appeared, in this instance after only four years. Even in this short space of time much has had to be added, in particular a section dealing with polymerization and pyrolysis. These processes have enabled superior grade petrols or gasolines, as they are termed in America, to be produced synthetically from both natural and cracked hydrocarbon gases, thereby adding to the total yield of motor-car fuel which can be obtained from a ton of crude oil and so contributing to the conservation of this material. Such high-grade fuels have a direct

connexion with the performance of the modern engine, particularly in aeroplanes at high speeds. Indeed, some of the more daring experts predict the advent of a day when crude oil is first cracked to gas and the fragments reunited in a controlled manner to form high-grade products.

(3) In the United States, Carleton Ellis is an equally prolific writer, and vol. 2 of his "Chemistry of Petroleum Derivatives" appears four years after vol. 1. It is very long and contains a wealth of information in fifty-four chapters. With the industry greedy to make use of his discoveries, the chemist has achieved much in this field and it

would make an interesting task, far too lengthy to undertake here, to contrast the state of knowledge relating to the hydrocarbons forty years ago and to-day. It is possible even to suggest that Mr. Henry Ford, when he made the automobile available to everyone, unknowingly inspired even more chemical research than engineering development. To-day this is going on faster than ever, partly because there is no knowing which particular line of work may become a major technical development in the near future.

Such a book as this saves hundreds of hours of valuable time to the worker, and in this way accelerates the tempo of new work.

Microchemistry

(1) Qualitative Analyse mit Hilfe von Tüpfelreaktionen:

Theoretische Grundlagen, Praktische Ausführung und Anwendung. Von Dr. Fritz Feigl. Dritte neu bearbeitete Auflage. Pp. xii + 554. (Leipzig: Akademische Verlagsgesellschaft, m.b.H., 1938.) 30 gold marks.

(2) An Introduction to Microchemical Methods: for Senior Students of Chemistry. By Dr. Cecil L. Wilson. Pp. xi + 196. (London: Methuen and Co., Ltd., 1938.) 7s. 6d. net.

(1) **T**HE popularity of spot methods of analysis is evident not only from the increasing number of text-books dealing with this section of microchemistry but, more particularly, from the fact that in the course of seven years three editions of Prof. Feigl's authoritative treatise have been called for, while, in addition, there have been English and Russian translations. To each edition subsequent to the first there have been made numerous additions, and this third German edition contains many new tests, some of which have not hitherto been published. The theoretical part of the book has also been enlarged, not only by the amplification of many of the original chapters, but also by the inclusion of chapters dealing with fluorescent analysis and spot tests, and the influence of substitution on solubility.

In the practical section, drop reactions are given for the first time for germanium, platinum, indium, gallium, lithium and caesium, and for hydrazoic acid, while the chapter on the systematic investigation of inorganic mixtures has been expanded by the inclusion of preliminary tests for the detection of anions. To the organic compounds and radicals

dealt with in the second edition (reviewed in *NATURE*, 136, 89; 1935), there have now been added schemes for the detection of formaldehyde, methyl alcohol, *p*-phenylenediamine, phosgene, aromatic *m*-nitro compounds, oximes and hydroxamic acids, acid amides and nitriles, pyrrole derivatives, and α -amino acids. A number of new applications of spot tests is also given.

In order that the size of the book should not be unduly increased, space has been saved by omitting the preparation of reagents and by mentioning only briefly those tests which are less sensitive or well known.

(2) This interesting, although somewhat ambitious text-book, is meant to serve as an introduction to microchemistry, and is intended primarily for senior students in chemistry. With the exception of quantitative organic analysis, it treats of all the usual sections of the new science, such as chemical microscopy, the use of the polarizing microscope, spot tests, inorganic qualitative and quantitative analysis, organic qualitative analysis, colorimetry, photomicrography, and spectroscopy. It is obvious that in such a small compass the author can be but briefly descriptive, that practically all theoretical treatment must be omitted, and that the number of examples provided must be limited. Nevertheless, enough is given to illustrate the various methods, and to enable the student to acquire sufficient confidence and skill to permit him to make effective use of more advanced text-books.

Although much is compressed into a little space, the monograph is clearly written, and is easy to read, while the text is effectively illustrated by numerous figures and photomicrographs.

G. R. DAVIES.

Vergleichende Morphologie der höheren Pflanzen
 Von Prof. Dr. Wilhelm Troll. Band 1: Vegetationsorgane. Teil 1, Lieferung 3. Pp. xii+509-955.
 (Berlin: Gebrüder Borntraeger, 1937.) 39.50 gold marks.

THE third "Lieferung" of the first part continues the large subject of branching in ferns and seed-plants. Axillary branching is discussed, as also the exceptions thereto, such as epiphyllous displacement of the lateral branch, and dichotomy in palms. Accessory or supernumerary axillary shoots and their independent origin from the meristem of the axil-tissue are described. The section on the structure of lateral shoots is replete with interesting and varied examples.

Following this is an engaging account of sub-cotyledonary shoot-formation, instances of which are given in *Linum*, *Linaria*, *Ocyclamen*, *Orobancha*, *Euphorbia*, etc. In the parasitic families of *Orobanchaceae*, *Balanophoraceae* and *Rafflesiaceae* hypocotyledonary and root-shoots entirely replace from the beginning the main shoot, which never exists at all in their life-history. There is a lengthy and well-illustrated chapter on the influence of symmetry conditions on branching—a very wide subject, and of far-reaching importance.

The next section deals with the orthotropic and plagiotropic growth of shoots.

A valuable and interesting section is that headed "Storage Shoots". It treats of (1) the origin and structure of rhizomes; (2) bulbs; (3) hypocotyledonary tubers and allied structures: amongst these are described the remarkable forms occurring in the *Dioscoreaceae*, some of which are rhizomes, others root tubers, and still others shoot tubers; and finally (4) rhizome and stolon tubers exemplified, for example, in *Stachys tuberifera*, *Trientalis europaea*, *Crepis bulbosa*, *Arum maculatum*, *Orcus*, etc.

Section 7 deals with twining and tendril-forming shoots; and no one could wish for a more thorough treatment of this subject.

The final section provides a most interesting and instructive account of the form-relationships of *stem-succulent* plants.

The whole "Lieferung" is splendidly illustrated with photographs and drawings. W. O. WORSDELL.

Handbuch der Anorganischen Chemie

In vier Bänden. Herausgegeben von Prof. Dr. R. Abegg, Dr. Fr. Auerbach und Dr. I. Koppel. Band 4, Abteilung 3: Die Elemente der achten Gruppe des periodischen Systems. Teil 2: Eisen und seine Verbindungen. A. Lieferung 3: Legierungen und Verbindungen des Eisens mit H, B, Si, P, As, Sb, Bi, S, Se, Te. Von Dr. I. Koppel. Pp. viii+559-723. (Leipzig: S. Hirzel, 1938.) 20 gold marks.

THE chemistry of such a widely used and technically important element as iron is so extensive that it is not surprising that the editors of this well-known "Handbuch" have found it necessary to divide the comprehensive study of iron and its compounds into more than one book.

It can be seen from the title that the volume under review constitutes the second part of this monograph on iron and includes the combinations of this element with some ten non-metals and metalloids. It possesses all the desirable features of comprehensiveness and simplicity in the arrangement of the subject matter, which have made Abegg justly popular among chemists. The thoroughness with which the literature has been covered may be gauged from the fact that there are references from 1718 up to the middle of 1937, and, what is more, they can be found without difficulty.

Workers on iron will find this book invaluable within the scope of the title, and it should be on the shelves of every reference library dealing with chemical or metallurgical topics. It is printed in clear type on good paper.

Beiträge zur Mineralogie von Japan
 Begründet von T. Wada. Neue Folge, II. Herausgegeben von T. Ito. Pp. xii+168+9 plates. (Tokyo, 1937.) n.p.

PROF. T. ITO, of the Mineralogical Institute of Tokyo, is continuing the excellent work begun by the late Prof. T. Wada by publishing the results of the investigation of the minerals and rocks of Japan and its dependencies. The present part is devoted to the composite sill which intrudes into the Tertiary formations near Kergan in north-eastern Korea. It is styled a sill, although the shape owing to the effect of the interposing rocks is more varied than is ordinarily understood by the term. The core consists of a syenitic rock, above and below which is a compact syenite-dolerite.

A full and careful description is given of the rocks and the various minerals composing or associated with them. The investigation includes the study of X-ray powder diagrams of goethite and of certain pyroxenes, the diagrams being reproduced on three of the plates. The frontispiece takes the form of a plate, on which are reproduced in colour a specimen of goethite in natural size and of specimens of goethite and aegirine as seen under the microscope.

The text is in Japanese, but the book can be understood without a knowledge of this language, since the crystal forms and angular measurements are expressed in the customary manner and a good abstract in English is incorporated at the end. The alternative title-page is still retained in German.

Die Chromatographische Adsorptions-methode:
 Grundlagen, Methodik, Anwendungen. Von Prof. Dr. L. Zechmeister und Dr. L. v. Cholnoky. Zweite wesentlich erweiterte Auflage. Pp. xiii+354. (Wien und Berlin: Julius Springer, 1938.) 19.80 gold marks.

IN twenty months this book, of which the first edition was reviewed in NATURE at some length (140, 48; 1937), has gained 125 pages—an increase of fifty per cent. This remarkable growth-rate is testimony not only to the importance of the subject, but also to the author's admirable exposition thereof. It should augur well for the success of the English edition now in preparation. A. L. B.

Recent Developments in Cyclotron Technique

By Dr. W. B. Mann, Imperial College, London

AT Berkeley, California, the first cyclotron to be built for the purpose of medical and biological research is nearing completion. In Great Britain it still remains a matter for debate as to whether the immediate expenditure on the construction of a medical cyclotron would be justified or whether it would, perhaps, be better policy to await the outcome of the research which has already been started in Berkeley.

The underlying principles of the cyclotron have already been adequately described in these columns by Prof. J. Chadwick (*NATURE*, 142, 630; 1938). It will therefore be the purpose of this article to try to enumerate some of the developments that have been made during the last few months.

Perhaps the most important of these developments has been the completion in Berkeley of an investigation into the possibility of using the very large currents circulating within the 'dees' of the cyclotron for the purpose of preparing artificially radioactive material. In the preparation of radioactive substances, either for therapeutic or for indicator purposes, it is important to obtain large yields. An increase in yield may be achieved in two ways: by using higher intensities, or, in the case of proton or deuteron bombardment, by the use of particles of higher energy.

In the latter case we are tacitly accepting the fact that the energies available are still considerably less than the energy corresponding to the top of the potential barrier of the bombarded nucleus, and that the yield is still rapidly increasing with increasing energy of the bombarding particle.

The purpose of the new cyclotron at Berkeley is to increase both the current and the energy of the emerging beam. With this cyclotron it is hoped to obtain deuterons with energies corresponding to accelerations in the neighbourhood of fifteen million electron volts. In the meantime, however, every effort is being made to increase the yields of radioactive products by using the large currents available within the 'dees' of the present cyclotron at Berkeley.

Prof. E. O. Lawrence had suspected the existence of large currents of circulating ions within the 'dees' and these suspicions were confirmed by the observations of R. R. Wilson, of the Radiation Laboratory, which were reported last August at the meeting at San Diego of the American Physical Society. It was found that in the case of deuterons, the ion current circulating within the 'dees' was of

the order of one milliamperere, the energies of the deuterons ranging from 6 to 9 million electron volts. Only some 10 per cent of the available current was, however, being withdrawn by the deflector and used in the target chamber.

A paper published by R. R. Wilson and M. D. Kamen last December describes the technique whereby these large currents of high-energy ions may be utilized in the preparation of radioactive phosphorus and iron. Previously, as has been described by F. N. D. Kurie, radioactive phosphorus had been prepared by bombardment of red phosphorus in an atmosphere of helium, the bombardment chamber being separated from the vacuum chamber of the cyclotron by means of a thin iron window, which was itself rendered radioactive by the deuterons passing through it. Thus both radioactive phosphorus for therapeutic purposes and radioactive iron for indicator experiments were produced simultaneously.

Wilson and Kamen have used instead iron phosphide for bombardment and have inserted this, mounted upon a water-cooled copper plate, between the 'dees', through the south window of the Berkeley cyclotron; the design and disposition of the Berkeley cyclotron having become something of a prototype, no further explanation with regard to the point of the compass is, perhaps, necessary. They found that they were able to obtain currents of incident deuterons of 150–200 microamperes, and at the same time the beam drawn by the deflector from the 'dees' and arriving in the target chamber was decreased by only 10 per cent. By inserting the target farther between the 'dees', incident ion currents of more than six hundred microamperes were obtained.

Using this technique, Wilson and Kamen have succeeded in obtaining ten millicuries of radioactive phosphorus in the course of a day.

A further advantage of the use of internal targets is derived from the fact that the ion current density is higher within the 'dees', and thus for a given yield it is necessary to expose a much smaller area of target than in the case of bombardment in the target chamber. Thus the ratio of radioactive to inactive phosphorus is enhanced, a definite advantage for therapeutic purposes where it may not be desirable to administer large quantities of inactive phosphorus. Wilson and Kamen are confident that specimens of several millicuries per milligram of phosphorus can easily be prepared.

The possibility of using neutron irradiation for the treatment of cancer has been one which has long attracted the attention of Prof. Lawrence, and two years ago, in collaboration with his brother, Dr. John Lawrence, and Mr. P. C. Aebersold, he published the results of a comparative study of the effects of X-rays and neutrons upon healthy and malignant tissue. From these it appeared that, for a given lethal dose with respect to normal healthy tissue, neutrons were quite as effective as X-rays in destroying malignant cells and indeed might even be more efficacious to the extent of some 20-30 per cent. These experiments were carried out on mice, using transplanted sarcoma tumours. The results were sufficiently encouraging for experiments to be planned on a clinical scale, and the new cyclotron was designed with this in view.

Before such experiments could be carried out, however, it would be necessary to obtain a collimated beam of fast neutrons which could be directed upon that locality which it was desired to irradiate. The satisfactory solution of this problem has been reported by Aebersold and Prof. Gladys A. Anslow at the New York meeting of the American Physical Society last February. Essentially, the fast neutron beam was obtained by means of an air channel through a water tank, the depth of water being sufficient to reduce the velocities of the neutrons and also appreciably to absorb them. A certain intensity of unabsorbed slow neutrons will, however, not be detrimental, since the biological action of neutrons is chiefly by reason of the heavy ionization produced by the proton recoils from fast neutrons. In order to eliminate gamma-radiation originating in both the water tank and the source, Aebersold and Anslow surrounded their channel and covered the outside walls of the water tank with lead and filtered the beam of fast neutrons through a slab of the same material. With the beam so obtained clinical treatment has already begun in Berkeley.

Further recent developments in cyclotron technique include an important contribution by L. W. Alvarez who, very ingeniously, by modulation of the cyclotron beam, has been able to produce monochromatic beams of neutrons of thermal energies. The method is essentially similar to that which has been developed independently by G. E. F. Fertel, P. B. Moon, G. P. Thomson and C. E. Wynn-Williams, and which was the subject of a recent letter in *NATURE* (142, 829; 1938). Bursts of neutrons were produced, in the former case by modulation of the radio-frequency input to the cyclotron, and in the latter by modulation of the current in the ion source of a 300 kv. deuteron discharge tube. The resolution which has been obtained by Alvarez is not, however, so sharp

as in the experiments with the discharge tube, a difference which can probably be ascribed to the fact that, in the case of the cyclotron, instead of a short sharp pulse of voltage being applied to the plates of the oscillator, modulation was effected by the use of 60-cycle A.C. after half-wave rectification. Under these conditions Alvarez reports that the cyclotron beam was incident upon the target for 25-30 per cent of each cycle, whereas in the case of the experiments of Fertel, Moon, Thomson and Wynn-Williams, the duration of the neutron pulse was limited to only 10 per cent of the cycle.

Alvarez has, however, quite adequately demonstrated the potentialities of his method, and any increase in resolution is probably merely a matter of experimental refinement if, and when, it may be required.

A question which has aroused some interest, although it has as yet little practical significance, is the difficulty which will arise when the energies of the ions produced in the cyclotron shall be so great as to cause a breakdown in the resonance condition, due to the relativistic increase in mass of the ions at velocities comparable with that of light. A deuteron having an energy of fifteen million electron volts or an alpha-particle having twice that energy will be travelling with velocities of a little more than a tenth of the velocity of light. The consequent increase in mass of about one per cent, due to relativity, will cause an increase in the time taken for a particle to describe the semi-circular path within the 'dees'. It will therefore tend to lag behind the electric field and will be lost from the beam.

By effecting a suitable increase in the magnetic field at large radii, the path of the ion can be decreased to such an extent that it will arrive in phase with the electric field, but such a magnetic field would necessarily have a defocusing effect upon the beam. In a recent paper, L. H. Thomas has suggested that the magnetic field should be made, not only to increase with radius, but also to vary periodically along the path of the ion. This latter variation in the magnetic field introduces a further focusing effect which will partially counteract the defocusing effect due to the increase of magnetic field at large radii, necessary to compensate for the relativistic increase in mass of the ions. Thomas shows that by this expedient it will be possible to attain to energies where the relativity effect is already appreciable.

In deciding between the relative merits of radium, X-rays and a cyclotron for medical purposes, there is a natural tendency to count the cost and to calculate possible yields of radioactive materials in terms of interest on capital expended. Already sources of radioactive sodium have been prepared

in Berkeley with a strength of several hundred millicuries using the ordinary technique of bombardment with deuterons in the target chamber; radioactive sodium, in the process of decaying to magnesium in the ground state, emits a gamma-ray of such energy as may dispose of the need for radium for some purposes. This, with the results of the investigations into the yields using internal targets, and the possibilities of neutron irradiation of malignant tissue, should be an added stimulus to those who are in favour of the immediate construction of a cyclotron for medical purposes in Great Britain, believing that active research alone, with the most recent techniques available, is the necessary preliminary to any further progress in the treatment of cancer.

There are now some twenty-six cyclotrons, either operating or under construction, in various parts of the world. At Berkeley there are two cyclotrons, one belonging to each of these two categories. In addition, cyclotrons are running, or

have been running, at the following places: Ann Arbor, Michigan; Cambridge; Copenhagen; Ithaca, New York (Cornell); Leningrad; Princeton; New York (Columbia); Rochester, New York; Swarthmore, Pennsylvania (The Bartol Foundation of the Franklin Institute); Tokyo; Urbana, Illinois.

Cyclotrons are also under construction at Birmingham; Bloomington, Indiana; Cambridge, Massachusetts (Harvard University and Massachusetts Institute of Technology); Chicago; Columbus, Ohio; Lafayette, Indiana (Purdue); Liverpool; Montreal (McGill); New Haven, Connecticut (Yale); Paris; Seattle, Washington; Stockholm.

The conclusion of this article on the cyclotron would, indeed, be inappropriate without a tribute to Prof. Ernest Lawrence, through whose imagination and experimental skill this valuable tool has been placed in the hands of the experimental physicist.

North Rona: a North Atlantic Island*

By Dr. F. Fraser Darling

MAN has such little interest in Rona that this island of less than half a square mile has disappeared from many maps of Scotland. It lies about forty-five miles north-east of the Butt of Lewis and north-west of Cape Wrath. The island is completely rockbound, the cliffs varying from a few feet to 355 feet in height. The continual Atlantic swell makes landing difficult and often impossible.

Rona is a northern outpost of the Hebridean hornblende gneiss intersected by several veins of pegmatite. Botanically, the island is distinct from the Hebrides. The northern end of Lewis is a vast peat bog which grows a characteristic herbage complex dominated by heather (*Calluna*). But there is no peat on Rona. The rock is covered with a thin layer of soil held together with a good turf of Yorkshire fog (*Holcus*), bents (*Agrostis*), sheeps' fescue (*Festuca*). Sedges (*Carex*) are rare on Rona, occurring only to the west of the ancient village site, where the turf has been cut for fuel hundreds of years ago. There are no permanent pools of fresh water on Rona. A well for seepage has been chiselled in the solid rock at the edge of the cliff in Poll Heallair on the south side of the island and it holds about ten gallons.

The drier rocky places are covered with a wealth of sea pink (*Statice*) and buckhorn plantain (*Plantago*); the cliff edges, heavily manured by the summer population of birds, grow luxuriant sprays of scurvy grass (*Cochlearia*), some sheep sorrel (*Rumex*) and mayweed (*Matricaria*). The village area with its lazy beds grows wild white clover (*Trifolium*) on the dry banks of conserved soil, and in the immediate vicinity of the ancient dwellings, silverweed (*Potentilla*) almost crowds out everything else. There is no bracken, fern or spleenwort, and few of those flowers which make the northern lands gay in May and June.

The whole of Rona is washed by salt spray in winter gales, but the northern peninsula of Fianuis is often impassable under a continuous driven cloud. Only plants with a high tolerance of salt can grow there—annual poa grass (*Poa*), sea pink, sea milkwort (*Glaur*) and chickweed (*Cerastium*).

So far as we know, St. Ronan was the first human inhabitant of Rona, in the eighth century A.D. He moved to Rona from Eoropaiddh at the north end of Lewis and adopted the name of the island as his own. Thus we gather that Rona, *ron-y*, has been the island of seals for a very long period. The cell of St. Ronan still remains in a fair state of preservation, and I have done some

* Substance of a Friday evening discourse delivered at the Royal Institution on January 20.

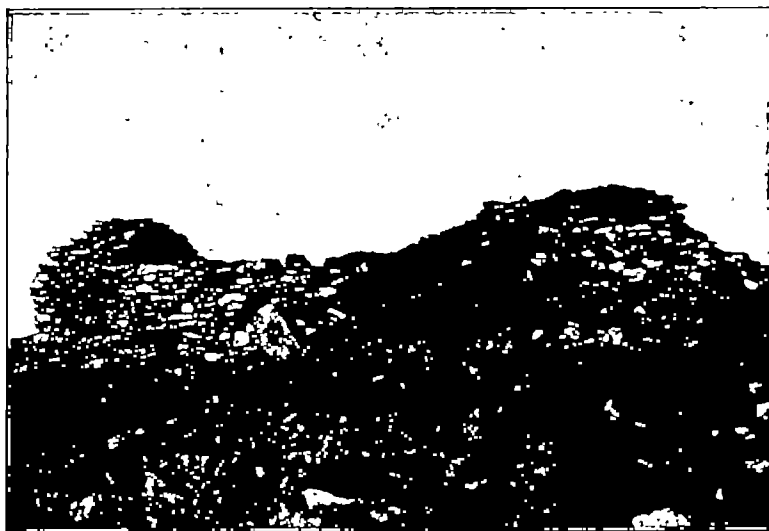


FIG. 1. CHAPEL (LEFT) AND CELL OF ST. ROMAN (RIGHT) SHOWING RESTORATION OF SOUTH WALL.

excavation and slight restoration (Fig. 1). The east and west walls of the cell inside are almost perpendicular, but the longer north and south walls slope inwards rapidly, and at a height of more than 11 ft. are 18 in. apart. Rectangular slabs of gneiss are placed across the top to finish the roof. The length and breadth of the cell at floor-level are 11 ft. 6 in. and 8 ft. Earth and stones were banked high round the outside of the north, east and south walls so that the building was practically underground.

The outside west wall became the east inside wall of a chapel which was built some time after Ronan's cell. This building, also in dry-stone but of poorer workmanship, is 14 ft. 8 in. by 8 ft. 3 in. and forms in effect a nave to the cell as chancel, though it is doubtful whether the two buildings were used conjointly as such. A block of masonry was laid bare on each side of the doorway into the cell and at the foot of these piers, which were taken to be the supports for the wooden altar in the later chapel (described by Martin Martin in 1703), a rough paving was found leading into the cell. The paving of the cell has been completely cleared at the eastern end, revealing an altar of well-built masonry 2 ft. 6 in. high, 3 ft. broad and 2 ft. 3 in. deep. A polished stone, rather smaller than a man's fist, was found at the foot of this altar and it appears to be of the same rock as Iona green marble, a rock entirely foreign to North Rona.

The first written mention of Rona and its people was made in 1549 by Sir Donald Monro, High Dean of the Isles, and later we read from Martin Martin of the life of the five families: "They covet no wealth, being fully content and satisfied

with food and raiment; though at the same time they are very precise in the matter of property among themselves; . . . they take their surnames from the colour of the sky, rain-bow and clouds". A plague of rats came ashore from a wrecked ship between 1680 and 1690 and ate up the whole sustenance of the people, who then starved to death. The half-underground dwellings remain and it is evident they were entered by low and devious passages which would baffle the wind, which is an all-important factor in life on Rona. Several quern stones were found about these dwellings and two fragments of stone vessels.

Rona is an important sea-bird station. The guillemot population is approximately 12,500 pairs; kittiwakes are equally numerous and the puffins are countless. There



Fig. 2.

BRIDLED GUILLEMOT WITH PLAIN MATE.
13.2 per cent of common guillemots on North Rona are bridled.

are about 750 pairs of razorbills and 600 pairs of fulmar petrels. A population of at least 500 pairs of great black-backed gulls is predatory on the puffins. Storm petrels are numerous, and Rona is one of the three British breeding stations of Leach's fork-tailed petrels. Arctic terns and black guillemots also breed on the island. There is a resident flock of 300-400 starlings. Many interesting migrants visit Rona on their spring and autumn passage—flocks of white wagtails, of waders such as knots, sanderlings, dunlins and redshanks. Turnstones may be resident. There are such occasional visitors as the

corn is now largely fed to the cattle in the straw.

The annual association of the seals with the land for reproductive purposes is their time of greatest danger, and the social system of the animals has become finely adapted for lessening this danger of the sea's edge. The seals are migrating to the island throughout August, but on arrival they do not come farther ashore than outlying skerries and ledges at the foot of the cliffs. Behaviour alters early in September, when mature bulls come on to the main mass of the island, as far as 300 yards inland, and lie quiet and alone



Fig. 3.

ATLANTIC GREY SEALS ON A LEDGE AT THE EDGE OF THE SURF.

green sandpiper, spotted redshank, short-eared owl, buzzard, hen harrier, woodcock and great snipe. Although the island has a good turf, neither grey lag nor barnacle geese winter there.

North Rona is the headquarters of the Atlantic grey seal, *Halichoerus gryphus* (Fig. 3). Protection by law has helped the species to recover from the low numbers brought about by the careless hunting in the nineteenth century. There is also the fact that the advent of rubber for sea boots and paraffin for light have made it unnecessary for the Hebridean to use sealskin and blubber. Crofters' cattle are now better fed, and no longer receive seal oil in the winter since threshing of the peoples' own oats has declined and the

by small pools of brackish water. Bulls in adjacent territories make no attempt to impinge on each other's ground, but throughout the breeding season there is a traffic of bulls coming up from a neutral reservoir at the sea's edge, and these challenge the bulls in possession. The winner stays and the loser returns to the neutral ground, where all challenging behaviour is laid aside.

Cows come ashore about a week later than the bulls and, by the cows' freedom to move where they will, it appears that the territories of the bulls are most decidedly entities of space and not of numbers of cows within that space. The matings take place 11-14 days after the birth of the calves, so the bulls have been ashore then at least three

weeks without any cows having been in season. The maiden cows and a few old cows without calves collect on the surf-ringed skerry of Loba Sgeir and mate there with young bulls. It was exceptionally interesting to observe that all these animals lay cheek by jowl without any apparent expression of territorial behaviour. The young stock does not come inland.

After the breeding season a large proportion of the adult stock gathered on Loba Sgeir and lay quiet there until they had moulted their coats. They leave Rona then to feed about the Hebridean coasts until the next season.

The Atlantic grey seal calf is thin when born but puts on fat at a very rapid rate. Its fluffy white coat begins to be shed at a fortnight old

and it is then that lactation in the cow rapidly declines and maternal care ceases. The calves face starvation until they reach the sea, and from a cliff-bound island that journey is a perilous one.

The occupation of the northern peninsula of Rona by the seals affects the vegetative complex and creates a favourable environment for Chironomid larvae. Thus the island is a fruitful port of call for migrant birds and a place of immense consequence to many others. In any attempt to conserve our country's wild life we should not forget the little islands, for they have a value as sanctuaries far beyond that which their size would indicate. Rona, where man has failed to survive, is one of the great cities of this earth.

Scientific Approach to Milk Policy

MANY members of the British Association for the Advancement of Science have been feeling during the past three or four years that more efficient machinery should be devised by the Association for the consideration of the effects on society of scientific developments and discoveries, and for the application of scientific methods to social ends. At the Cambridge meeting of the Association in August last, it was decided to constitute a new Division of the Association to be concerned with social and international relations of science, and Sir Richard Gregory was elected the first chairman. It was later decided that the Division should hold meetings, at times intermediate between those of the normal annual meetings of the Association, at different centres in Great Britain and elsewhere.

The Nutrition Sub-Committee of the new Division has been the first to get off the mark, and, at the University of Reading on March 28, held a one-day conference on milk, in its nutritional and allied aspects. It is a commonplace that the handling of the milk question is the most awkward problem in any long-range policy concerned with improvement either in general health or in agriculture, and the boldness of the young Division in firmly grasping this important domestic nettle at its first meeting is a good augury for its future activities. In view of the trying weather, the attendance (about 180 were present at the main session) cannot be regarded as other than satisfactory.

The day began with a visit of the more weather-resistant members to the National Institute for Research in Dairying at Shinfield near Reading.

Here the party was shown, by the Director and staff, experimental work on various *ad hoc* dairy industry questions, and also on some of the more fundamental problems of dairy science. Amongst the investigations described were those on the protein requirements of dairy cattle, on new methods for the pasteurization of milk, on the effect of various types of commercial processing on the nutritive value of milk, on the causes of low compositional quality in milk, and on the hormonal control of lactation. The new chemical and physiological laboratories now rapidly approaching completion, and the completely rebuilt dairy machinery testing centre were inspected, and the memorial library and the recently founded Imperial Bureau of Dairy Science visited.

After lunching at the University, members met for the afternoon session in the Great Hall, where the Vice-Chancellor (Sir Franklin Sibly) welcomed the Association on behalf of the University. The chair was taken by Sir Richard Gregory, who introduced the three principal speakers, Dr. Harriette Chick, Prof. J. C. Drummond and Dr. A. W. Scott. The papers given by these three dove-tailed so closely into one another that it is more convenient in this brief report to deal with them together.

The factual basis for the emphasis which has been laid on the importance of milk in the national dietary was re-described, and the food value of milk products, for example skim milk, was discussed. Despite its food value, milk is rather an awkward material to handle and distribute, and a potentially dangerous material for the consumer if it is not properly produced and processed. Whilst Great

Britain lingers rather far behind several other countries (such as Sweden, Switzerland, Norway, the United States), in liquid milk consumption per head, yet when dairy products such as butter, cheese, cream, dried milk, etc., are taken into account at their liquid milk equivalent, our consumption of liquid milk plus milk products puts us in a high position on the list, the consumption having increased from 322 kgm. per head per year in 1925-29, and 403 kgm. in 1930-31, to 548 kgm. in 1934. The dietetic value of milk is practically unaltered by properly controlled commercial pasteurization, and little affected even by sterilization and drying. This recent conclusion is the result of carefully controlled feeding and other experiments carried out at the National Institute for Research in Dairying and at the Rowett Institute, and also in elementary schools in England during the past four years, under the auspices of the Milk Nutrition Committee (chairman, Lord Astor). These findings and those obtained by other responsible investigators have finally disposed of the fallacy that commercial methods of pasteurization seriously damage the food value of milk. Kon has shown that one of the most labile constituents of milk, vitamin C, is, in milk, actually more sensitive to light than to heat, though milk is, in any event, a poor source of this vitamin. In view of the potential danger of drinking raw milk, exemplified from the health records of past years, which show how much ill-health is directly traceable to an infected milk supply, it was stated that no good scientific reason exists why the pasteurization of all milk for liquid consumption should not now be enforced.

The implications of such a policy were dealt with in some detail. A very large proportion of the milk supply of Great Britain is already heat-treated, but frequently inefficiently heat-treated, so that disease organisms are not completely destroyed, though the keeping quality of the milk may be improved. One of the advantages of compulsory pasteurization would be that supervision of commercial heat-treatment could be made much more efficient than at present, particularly now that the phosphatase test is available. Objections to compulsory pasteurization on the grounds that it would lessen the stimulus to the eradication of disease in dairy herds, or that it would cause farmers to relax their efforts towards clean milk production, or that it would put the whole industry in the hands of the large distributing combines, were stated to be without foundation. With reference to this last objection the control of the industry is now, in fact, in the hands of the largest possible combines—the producers' marketing boards.

Following the principal speakers, there was a short discussion. One of the most important

points in favour of compulsory pasteurization was made during the discussion—namely, that it would actually help the producer by increasing public confidence, and the confidence of medical men (who in matters of nutrition are frequently the mentors of the public) in the safety of the milk supply. A rather loosely worded resolution was passed by the divisional meeting, for consideration by the Council of the British Association, recommending that pasteurization of all milk to be sold in their areas should be enforced by all authorities dealing with a population of 20,000 or above.

It would perhaps be an exaggeration to say that this resolution is battering at an open door. It is no secret that the big producers' organizations in Great Britain are not opposed to compulsory pasteurization at least as applied to the large municipal areas, with a stipulation that a supply of raw tuberculin-tested milk should be available for those individuals who really prefer raw milk. The Government too, in 1938, accepted the principle of compulsory pasteurization and had incorporated it, with certain safeguards, in the very comprehensive and well-thought-out Milk Industry Bill, which was withdrawn a few months ago. That the withdrawal was on account of the compulsory pasteurization clauses seems highly unlikely.

Quite apart from new legislation, however, a suggestion, admittedly not novel, was made informally after the meeting which, if put into action, might greatly ameliorate the risk, from the consumer's point of view, of milk-borne disease. Heavy penalties could presumably be exacted at common law from any retailer who had sold milk which could be proved to have caused disease in the consumer; if this were done in one or two cases, it is not unreasonable to suppose that raw milk distributors themselves would feel disinclined to continue to risk not merely the consumer's health, but also their own reputation, trade and pocket, by selling unsafe milk in the future.

During the evening session, the chair was taken by Sir Daniel Hall, and two papers, one by Mr. James Mackintosh on milk production, and the other by Mr. John Cripps on milk distribution and costs were given. The main problem of increased production in Great Britain to meet a steadily increasing demand for liquid milk was stated to be, at least in the early stages of this demand, that of increasing the winter supply, which in November, December, and January is at present very close to the minimum required to cover the needs of the liquid trade.

It would be possible to even out supplies during the year by arranging for more cows to calve in autumn. Again, far better yields per cow than those obtained at present are possible in many herds by making use of knowledge already available

on feeding and management, and on methods of breeding. In urban distribution, it was pointed out that the consumer is suffering under a surfeit of retailers, many of whom could be dispensed with, and of 'services' many of which are quite superfluous with properly processed milk. If surplus retailers and these costly but unnecessary services could be dispensed with, consumer prices could be reduced. But without monopoly in some form or another, it is not easy to see how a stable scheme for effective and minimum-cost distribution could be brought about. It was suggested that, instead of further verbal discussion of hypothetical alternatives, some experiments on different types

of monopoly control, for example, municipal, co-operative, public utility, private firm, ought to be tried out under careful supervision in limited areas. But this type of experiment cannot take place without legislation.

From the events of this most interesting day, one point emerges very clearly. This Division of the British Association by its very nature cannot proceed far without becoming involved, and involved very deeply, in politics and in active social planning. While this is well understood by the officers of the Division, it seemed to be somewhat of a revelation to several of those others who attended the Reading meeting.

Obituary Notices

Miss Dorothea F. M. Pertz

DORA PERTZ, who died on March 6, a few days before reaching her eightieth birthday, was born in 1859 into a cosmopolitan, intellectual milieu, for which it would be difficult to-day to find a parallel. Her father was Dr. G. H. Pertz, a scholar of world-wide repute, and Royal Librarian in Berlin. His first wife was a brilliant Englishwoman, who counted Simondi and Lafayette among her friends. His second wife, Dora's mother, also an Englishwoman, was one of a remarkable group of sisters, the six daughters of Leonard Horner, a prominent early member of the Geological Society, and twice its president. He was evidently a man of unusual breadth of view, for though he was born at so remote a date as 1785, he was sufficiently open-minded to commend Darwin's speculations in his last address to the Geological Society in 1861. Horner's eldest daughter was married to Sir Charles Lyell, and his second daughter to Sir Charles J. F. Bunbury, a botanist, who, under Lyell's influence, turned his attention to fossil plants.

Among the Horners, scientific enthusiasm was by no means confined to the man. Dora Pertz's grandmother helped her husband with his rock collections, and when the meetings of the Geological Society were first thrown open to women visitors, Dora's aunts, Lady Lyell and her sisters, were constant in their attendance, though otherwise few women cared to avail themselves of this privilege. Katharine Horner, who married Lyell's brother, and eventually became the biographer of her father and her brothers-in-law, was a botanist. She published in 1870 "A Geographical Handbook of Ferns"—a highly technical catalogue dealing with the distribution of this group. Of Sir Charles Lyell, in his Harley Street period, Dora had certain childish recollections, especially of occasions when he would call a hansom cab and carry off his two small nieces for rapturous visits to the Zoo. Love of animals was throughout Dora's life a ruling passion, and her youthful memory of

visiting the Darwins at Down, centred in the joy of being allowed to caress the nose of the horse on which Charles Darwin was riding, in his cloak and broad-brimmed hat.

When her father died, Dora Pertz went with her mother and sister to live in Florence, but, after some years in Italy, the family urge towards science brought her to England in 1882, in order to enter Newnham College. Having taken honours in the Natural Sciences Tripos, she continued to work at Cambridge, doing research in plant physiology under the direction of Francis Darwin, who was then a member of the staff of the Botany School. Dora Pertz co-operated in much of his work, and also produced several independent papers. The best known of their joint memoirs is probably that "On the Artificial Production of Rhythm in Plants", published in the *Annals of Botany* of 1892. She also did some genetical work in the days when that study was just beginning at Cambridge, and collaborated with William Bateson in a paper on inheritance in *Veronica*.

After Sir Francis Darwin's retirement, Dora Pertz continued for a time to make observations; but she came to recognize that the plant physiology of the twentieth century was developing on lines widely divergent from those on which she had been educated, and that it demanded a grasp of mathematics, physics, and chemistry, which she did not possess. With characteristic clear-sightedness as to her own limitations, she desisted from attempting to do research for which her equipment was inadequate, and she sought for some other means through which she could be of use to botany. Fortunately, Dr. F. F. Blackman was able to enlist her services in cataloguing pamphlets, and in making an elaborate index of the papers of plant physiological interest in the numerous early volumes of the *Biochemische Zeitschrift* and the *Zeitschrift der physiologischen Chemie*. She completed the index up to the year 1935; the magnitude of the task may be judged

from the fact that in the *Biochemische Zeitschrift* alone she had to deal with 268 volumes. A letter of appreciation of this work from the members of the staff of the Sub-Department of Plant Physiology gave her special pleasure in her last illness. Concurrently with the work on the index, she found scope for her considerable powers of draughtsmanship in making all the illustrations for a long series of papers on floral anatomy published by her friend Miss E. R. Saunders, between the years 1923 and 1936.

Over a very long period—indeed until the failure of her health brought all activities to a close—Dora Pertz was content to give her time with complete steadiness and regularity to indexing and drawing, though these somewhat mechanical occupations could not, in the nature of things, have for her the compelling charm of her own chosen work. In her absence of personal ambition, and the disinterestedness of her desire to be serviceable to botany, Dora Pertz was true to the family tradition handed on to her by Horner, Lyell and Bunbury; she was one with them in pursuing science simply for the love of it, and in being—in the basic sense of that much mishandled word—an amateur. AGNES ARBER.

Dr. Moses Gaster

WE regret to record the death of Dr. Moses Gaster, the distinguished Jewish scholar, historian, and folklorist, formerly Chief Rabbi, which took place suddenly on March 5 at the age of eighty-two years.

Moses Gaster was born in Bucharest on September 16, 1856. He was the son of the Chevalier A. E. Gaster, and a member of a family which for long had been settled in Rumania. He graduated at the University of Bucharest and received the degree of Ph.D. from the University of Leipzig and the rabbinical diploma from the Jewish Rabbinical Seminary at Breslau. On his return to Bucharest in 1880, after a period of literary activity, he became lecturer on Rumanian language and literature at the University of Bucharest and inspector-general of schools, holding in addition other public offices; but his activities in connexion with the settlement of Jews in Palestine led to his inclusion among the Jews expelled from Rumania at this time at the instance of Russia. Dr. Gaster then settled in England, where his work as Ilchester lecturer in Greco-Slavonic languages in the University of Oxford rapidly secured him a place in the front ranks of scholarship.

Dr. Gaster was the author of a large number of works on Jewish historical subjects, as well as in the more advanced Hebrew and Rabbinical studies. As a folklorist he inevitably came to be regarded as the first authority in Great Britain on the folk-lore of Rumania; but his interest in folk-lore studies was by no means confined to either his country of origin or to his special field of Jewish scholarship. His wise counsel and ready ability in suggestion were ever at the service of his fellow workers. Among his publications may be mentioned as of special interest to students of folk-lore and comparative religion "Rumanian Bird and Beast Stories", "Studies and

Texts in Folklore, Magic, Medieval Romance, Hebrew Apocrypha, and Samaritan Archaeology", "The Samaritans", embodying the Schweich Lectures of 1925, and "The Sword of Moses" an early Jewish magical work which had been lost for a thousand years until discovered and published by him.

On the cancellation of his order of expulsion Dr Gaster paid several visits to Rumania and for a report on the English educational system, published as a Rumanian State paper, and other services he received the Rumanian Order of Merit of the First Class.

Dr. Antoine Bécclère

DR. ANTOINE LOUIS GUSTAVE BÉCLÈRE, the pioneer of medical radiology in France, died at the age of eighty-two years on February 24 in Paris, where he was born on March 17, 1856, the son of a general practitioner, and received his medical education.

Béclère qualified in 1882 with a thesis on the contagion of measles and at first took a keen interest in other infectious diseases, especially smallpox—for which in collaboration with Chambon and Ménard he introduced treatment by convalescent serum—vaccinia and syphilis. Shortly after the discovery of X-rays in 1895 he became engrossed in the study of radiodiagnosis and radiotherapy, and at his own expense fitted up a radiological laboratory at the Hôpital Tenon in 1898 and started a course of free instruction in medical radiology which he resumed in 1899 after his transfer to the Hôpital Saint Antoine and continued until his retirement in 1921.

During the Great War, Béclère was director of a radiological centre at the Val de Grâce military hospital. In addition to numerous communications to medical societies and journals, he was the author of works on "Röntgen Rays in the Diagnosis of Tuberculosis" (1899), "Röntgen Rays in the Diagnosis of Non-Tuberculous Diseases of the Chest", several articles in the treatise of medical radiology edited by Prof. Bouchard (1904), and "Röntgen Rays in the Diagnosis of Internal Diseases" (1904).

Besides being Commander of the Legion of Honour, Béclère received many well-merited distinctions. In 1928 he was elected president of the Académie de Médecine, of which he had been made a member in 1908. He was also one of the first members of the recently resuscitated Académie de Chirurgie. In 1931 he was president of the third International Congress of Radiology held in Paris, and the same year he was elected an honorary fellow of the Royal Society of Medicine. On attaining his eightieth birthday in 1936 his pupils, colleagues and friends dedicated to him a jubilee volume in which his contributions not only to radiology but also to paediatrics, experimental medicine, neurology, endocrinology, diseases of the chest, diseases of the abdomen and gynaecology formed the subjects of appreciation by well-known specialists. The journal *Strahlentherapie* also devoted a *Festschrift* to him on the same occasion. During the last years of his life, he resumed his study of vaccinia and syphilis.

J. D. ROLLESTON.

News and Views

National Service Committee for Scientific Research

THE Central Register Advisory Council of the Ministry of Labour has appointed the following Committee for Scientific Research: A. V. Hill (chairman); C. G. Darwin (mathematics); E. V. Appleton (physics); J. C. Philip (chemistry); R. V. Southwell (engineering sciences); E. B. Bailey (geology); V. H. Blackman (botany); D. M. S. Watson (zoology); A. V. Hill (physiology); W. W. C. Topley (pathology); F. C. Bartlett (psychology); Director of Scientific Research, Admiralty; Director of Scientific Research, War Office; Director of Scientific Research, Air Ministry; Department of Scientific and Industrial Research; Medical Research Council; Agricultural Research Council. Ten sub-committees for the consideration of the several subjects have been co-opted.

Broadcasting by Telephone

THE Postmaster-General announced in the House of Commons on March 30, that the Post Office is to proceed immediately with the introduction of a system of distributing broadcasting programmes over the line telephone network. This service will be additional to that of the existing relay companies, the licences of which will also be extended for a further period of ten years to December 31, 1949. The new telephone broadcasting service will be operated on the so-called 'wired wireless' or carrier-current system, which is already in use to some extent in Great Britain and other countries for ordinary line telephony; a radio frequency carrier current, with the appropriate programme modulation, will be transmitted over the telephone lines, and a complete wireless receiving set will be used at the subscriber's end of the line. Three or four alternative broadcast programmes will be provided, the selection to be carried out by adjusting the receiver, and it will be possible to use the telephone simultaneously with the reception of a broadcast programme. The new service will be restricted at first to telephone subscribers, and the question of its extension to non-subscribers will be deferred pending experience of its working. From the point of view of national defence, the new service will have the advantage over the existing broadcasting system of reduced liability to interruption or interference; it is not intended, however, that any restriction shall be placed upon the wireless broadcasting programme service at the present time. The existing relay companies transmit merely the audio frequency currents over a special line network to loud-speakers on the subscribers' premises, and the service is usually limited to a choice between two programmes provided from the relay exchange. The new licences issued to these companies will require that these exchanges shall be connected to a B.B.C. station by wire, and that in time of emergency they shall transmit any special announcements ordered by the local A.R.P. or police authorities.

H.M. Aircraft-Carrier *Ark Royal*

THE annual session of the Institution of Naval Architects, was held in the Royal Society of Arts during March 29-31. Lord Stonehaven, the president of the Institution, reviewed the events of the last year in his opening address. Sir Stanley Goodall, Director of Naval Construction for the Admiralty, then read an interesting paper describing H.M.S. *Ark Royal*, the first ship to be designed exclusively as an aircraft carrier. As it is not the function of this type of ship to fight a gun duel, its armament consists mainly of aeroplanes. The ship carries a few guns capable of both high angle and low angle fire. She has a heavily armoured deck, side-armour adequate against medium guns, and improved underwater protection. 103,000 horse-power on three shafts gave her a speed in trials of 31½ knots and special attention had been given to rapid manoeuvring. The auxiliary machinery is both electric and hydraulic. Special aircraft fittings include two catapults at the fore end of the flying deck, arresting wires at the after end for aircraft landing on it, hydraulically operated wind screens which fold down flat when necessary and three two-story lifts which take aircraft with their wings folded. Electric welding was used extensively in her construction, and this lessened her weight by 500 tons. In the discussion which followed the paper Sir George Preece, engineer-in-chief to the Navy, said that owing to the necessity for rapid manoeuvring it was found necessary to have two engineers of the watch, one for general control and one for direct supervision. The large rudder immediately abaft the centre propeller was invaluable when turning at rest. In the last cruise, 1,400 aircraft landings on deck had been made without a scratch. 'Landing on' had proved safer than driving a car on an English road.

Emergency Medical Arrangements for War-Time

PREPARATIONS for dealing with casualties in the event of war are now well advanced. The Ministry of Health has issued circulars to local and other authorities under the Air-Raid Precautions Act, 1937, indicating the organization of emergency ambulance services, and of first-aid posts (Circulars 1787 and 1789. H.M. Stationery Office. 2d. and 3d. net, respectively). An emergency Hospitals Scheme for London has also been prepared. This scheme is based on the affiliation of certain casualty hospitals in the more vulnerable areas to others in outer areas. In London this affiliation is arranged in ten sectors radiating from the centre. Each of these sectors contains voluntary and municipal hospitals of widely differing types, including the great teaching hospitals, local authority institutions, mental hospitals, specialized hospitals, cottage hospitals, and others. It is proposed that the casualty hospitals near the centre of each sector should be used so far as possible for immediate treatment only, and that the injured

should be transferred at the earliest opportunity from the centre to affiliated casualty base hospitals in the outer areas.

The Palaeontographical Society

At the annual meeting of the Palaeontographical Society held in the rooms of the Geological Society on March 31, the Council reported that the Society's ninety-first annual volume had been issued during the past year. This volume contains the first part of a new monograph on the Carboniferous Rugose Corals of Scotland by Dr. Dorothy Hill. Largely based on the extensive and oft-quoted material studied by James Thomson and afterwards disorganized by the fire in the Kilmarnock Museum in 1909, this monograph introduces considerable simplification in systematic nomenclature. Further instalments of the monographs on Cambrian trilobites by Mr. P. Lake and on corallian ammonites by Dr. W. J. Arkell are also included in this volume. The work of the Society in publishing illustrations and descriptions of fossils collected in Great Britain has been materially assisted by an allotment of £100, from the Government Publication Grant administered by the Royal Society, towards the issue of the monograph on corallian ammonites. Other donations mentioned in the report include sums of money received from the Colston Research Fund of the University of Bristol and from Miss Mary S. Johnston. Monographs which are also in progress include Pleistocene Mammalia (Prof. S. H. Reynolds), Cretaceous Belemnites (Prof. H. H. Swinnerton), Gault Ammonoidea (Dr. L. F. Spath), Great Oolite Brachiopoda (Dr. Helen Muir-Wood), Dendroid Graptolites (Dr. O. M. B. Bulman) and Palaeozoic Asterozoa (Dr. W. K. Spencer). The following officers were elected for the ensuing year: *President*, Sir A. Smith Woodward; *Treasurer*, W. E. F. Macmillan; *Secretary*, Dr. C. J. Stubblefield.

Mayan Chronology: New Evidence

A JOINT expedition of the Smithsonian Institution, Washington, and the National Geographic Society, which is engaged in the excavation of a site at Tres Zapotes, in the State of Vera Cruz, southern Mexico (according to a communication issued by Science Service, Washington), has discovered a date monument which, it is anticipated, will settle a much-debated question of the authentic age of the reputedly earliest known dated Mayan object, and at the same time determine how and when the ancient Maya first spread over Central America. The site at Tres Zapotes, it is to be noted, is at least one hundred miles west of what had hitherto been believed to be the Mayan zone. Reports of the early results of excavation indicate that the site at Tres Zapotes is early; but the dating of the recently discovered monument is in the so-called 'short' style, which has generally been regarded as a late invention. Apart from its intrinsic interest, the question whether this style of dating was or was not in use in the early period of Mayan civilization is of importance in its bearing on the age of the famous jade statuette of a priest now in the National Museum, Washington.

This statuette bears a dating equivalent, on the Spinden correlation, to May 16, 98 B.C., and if this be taken at its face value, the statuette is the oldest known dated Mayan object. The date, however, is written according to the 'short' system, and question, therefore, has been raised whether the dating is contemporary, or was added in a later period, or whether, indeed, the statuette itself may not be an archaistic piece. Dr. Matthew W. Stirling, who is in charge of the excavation, has summoned a conference of archaeologists to be held on the site, to discuss whether they confirm his conclusion that the newly discovered monument is 'early'.

Eoliths

A COMMUNICATION from Mr. A. S. Barnes traverses the arguments put forward by Mr. J. Reid Moir for the human origin of the pre-Crag implement (see *NATURE* of January 28, p. 151) and deals *seriatim* with the characters upon which he relies. The problem of the differences between natural and human flaking is discussed by Mr. Barnes at length in the current issue of the *American Anthropologist* (41, 1, 1939, p. 99). He there maintains that the arguments for the human origin of pre-Crag implements are for the most part purely subjective, while it has been shown that purely natural forces are able to produce flaking similar to that on eoliths, and further, that the flaking on eoliths differs from that on human work. Although attempts have been made to formulate objective differences between the flake detached by man and those detached by natural agencies, such as 'resolved flakes' and flakes with certain other characteristics, these effects, Mr. Barnes holds, are found on flake fractures by fortuitous pressure as well as by man. After recapitulating the factors operating in natural and artificial fracture, Mr. Barnes goes on to suggest that a criterion of human workmanship, readily measurable and common to both classes of flaking, natural and artificial, is to be found in the angle platform-scar, which he defines as the dihedral scar formed by the intersection of the surface on which the blow has been struck, or pressure applied, and the surface of the scar left by the flake removed. As the result of an investigation of a large number of specimens by this method it has been found that an industry, or supposed industry, may be regarded as of human origin if not more than 25 per cent of the angles platform-scar are obtuse, that is, 90° and over. None of the eoliths examined by Mr. Barnes complies with this criterion, and, he maintains, cannot therefore be considered to be of human origin.

Encouraging Inventions

THE Paris International Trade Fair will be held during May 13-20. An interesting feature is the Inventions Competition (*Concours d'Inventions*), which is open and free to every inventor. An invention of any type may be entered. It may take the form of a new apparatus or device or it may be an improvement which can be incorporated in existing machinery or material. There is a strict

limitation that the invention must not have been exhibited for any other competition. Each competitor must also attach to his entry form a copy of his patent specification, or, if the invention be not patented, a notice setting forth its aims and functions and, when possible, a résumé of its technical qualifications. If possible, actual models (in working order) are to be submitted, but if this cannot be done, permission may be obtained for their presentation by means of a plan. The jury decides whether the plan submitted is sufficiently explicit in itself to convey to experts, and to the public, a clear representation of the functions and operation of the invention. The total area allotted to each exhibit will as a rule not exceed one square metre, but by special application to the committee larger models may be exhibited. All inventions entered for the competition are displayed in a special hall for the duration of the Fair and should be forwarded so as to arrive not later than May 6, addressed Foire de Paris, Concours d'Inventions, Porte de Versailles, Paris 15. The exhibits are classified under many headings, including engineering, medical apparatus, domestic economy, games, travel and camping, office equipment, publicity and education. Competitors whose inventions are not patented may apply for a certificate of guarantee affording protection in France for a period of twelve months from the opening date of the Fair. Entry forms can be obtained at the London Office of the Foire de Paris, 17 Tothill Street, Westminster, S.W.1, and must be completed by March 31.

Combustible Material in Electric Power Stations

EARLY in this century, after a fire at Bristol, rubber-covered cables for switchboard work were rarely used. The recent inquiry on the fire at the Kingston Power Station should accelerate the demand for the use of non-combustible materials alone in main power stations. It was stated in evidence that about 850 gallons of inflammable oil and about 14,000 lb. of solid compound fed the flames. Fires due to oil have been perhaps more numerous in America and Germany than in Great Britain; but recent events show the necessity of getting control of a fire in a power station at the earliest possible moment. The modern oil circuit-breaker (switch) has proved very trustworthy in practice. At its rated capacity it will clear any electric faults with certainty; but in very exceptional circumstances it may fail. The chiefs of supply stations are now paying great attention to the problem of oil-less circuit breakers. Several foreign makers have for the last few years been successfully producing oil-less breakers, particularly the A.E.G. Co. in Berlin, the Brown-Boveri Co. and the Oerlikon Co. in Switzerland. The A.E.G. Co. manufactures a special breaker called a chemical resin breaker for service in unattended substations where the air-blast type could not receive adequate supervision and maintenance. A very profitable and urgent line of inquiry for the industrial research worker would be to try to discover non-combustible liquids and solids of high insulating value for transformers, switches and electric wires. Some

fairly satisfactory liquids and compounds have been found, but their cost at present is far too high for use in bulk. It is all a matter of finance. Textile glass has recently been invented. It seems probable that as a wrapping for electric wires it will have a great future.

Agricultural Research and the Farmer

A BROADSHEET "Bringing Science to the Farm" issued by P.E.P. (Political and Economic Planning) directs attention to defects in the present system of putting the results of agricultural research at the disposal of the farmer. Some of the difficulties are familiar in other attempts at the popularisation of scientific discoveries, notably the superimposition of lecturing on research. Not only does such work impede actual research, but also research ability is by no means invariably linked to lecturing ability, and poor exposition may retard rather than help the spread of agricultural knowledge. The broadsheet urges a thorough overhaul of the provincial advisory service, which is not only seriously understaffed but has lagged behind the rapid diversification and specialization of the sciences concerned. Inadequate arrangements exist for liaison between the provincial advisers and research institutes not situated at their centre, or within their province as well as between the research institute and the farmer. The efficiency of the advisory service moreover depends primarily on the rateable value of the county and is controlled by the county agricultural committees, which cannot be expected to have the same scientific outlook and aims as the research and provincial advisory workers. County organisers do not always refer to the provincial advisers' problems which are beyond their own capacity, and the county organiser is often laden with many other duties besides advisory work. The broadsheet criticizes the annual reports of the research stations from the point of view of propaganda and also the manner of distribution of the official leaflets for farmers issued by the Ministry of Agriculture as well as the meagre use made of films, and lays special stress on the place of the educational services as the fundamental link between research and practice.

Colloquium on Sex Hormones

IN June 1937 a colloquium on sex hormones was held in Paris under the auspices of La Fondation Singer-Polignac. This colloquium was attended by men of science from France, Denmark, the United States, Canada, Great Britain, etc. The meeting lasted ten days, morning and afternoon sessions being held for the reading of papers on most days. The wide international representation of active investigators led to great interest being taken in the papers and to vigorous discussion. The papers presented, together with summaries of the discussions, were afterwards published in one volume for private circulation. They have now been republished in five numbers, each containing five papers, in the series of "Actualités Scientifiques et Industrielles" (Paris: Hermann et Cie). The first number appears under the general title "Les Propriétés des Hormones Sexuelles". The second number deals with "Ovula-

tion, Menstruation, Gestation". The third contains papers dealing with the pituitary. The fourth is entitled "Régulations générales. Influence des facteurs nerveux et externes"; and the fifth number contains papers on a variety of subjects such as pathology, toxicity, antihormones and cancer. The final publication of this material concludes the record of the colloquium, which will be long remembered by those taking part as a particularly happy and profitable occasion upon which La Fondation Singer-Polignac should be most heartily congratulated.

Lake District Roads

THE main object of the Friends of the Lake District is to have the Lake District made a National Park; but they insist on the necessity of guarding against the present tendency to undue development of motor-roads and motor-transport which would ruin the beauty and solitude of the district. The theme is developed at length in a pamphlet entitled "A Road Policy for the Lake District" published by the Friends of the Lake District, Ambleside. The essential Lake District is within a radius of some fifteen miles from the Langdale Pikes: this is the area that needs to be protected. There should be good motor-road access to this area and around it, but there should be no increase in the two or three good routes which go through this area. Moreover, in order to preserve the amenities, which give the Lake District much of its claim to preservation as a park, the width of roads should not be increased and through fast traffic thereby encouraged, dead-end roads which end in a cul-de-sac should not be made available for through traffic, and certain by-roads should be closed entirely to motor-traffic. The pamphlet discusses these matters at length as well as the good and bad examples of road widening that have already been carried out. Above all, it advocates a policy that suits the requirements and amenities of the district rather than a standardized national policy which has little or no relation to local requirements.

Insurance Against Natural Calamities

THIS is a matter which has received a considerable amount of attention from time to time, and here and there premiums against such risk have been accepted, but in general, however, such risks are not taken by companies except for abnormally high premiums, for the simple reason that the place, time and destructive energy of the phenomena cannot be foretold, nor do they occur with any regularity. The problem has been examined by H. Lenz-Stauffer (*Revue pour l'étude des calamités*, 1, No. 3; 1938). The first international conference on this topic, held in Paris on September 18-17, 1937, expressed the hope that research would be made into the problem of the application of the principles of insurance to natural calamities, an application considered until the present time not capable of realization. The author considers the problem from three different angles with regard to the Union Internationale de Secours: (1) with the Union as the insurer against the risk; (2) with the Union as the

insured party against the risk; (3) with the Union encouraging in a general manner insurance against such calamities and contributing to its realization. The article may be commended to those concerned with insurance against damage by earthquakes, tornadoes and the like.

Earthquakes Recorded at Tokyo

WE have received the seismometrical report of the Earthquake Research Institute, Tokyo Imperial University, 1938, parts 1-2 (Jan. 1-June 30, 1938). This includes a first list of twelve stations attached to the Institute together with their latitude and longitude co-ordinates to the nearest second of arc, and their distances in kilometres from Tokyo. Following this is a table of twenty-two earthquakes sensible in Tokyo during the period under consideration. It would be an improvement if the headings to the columns in this table were given in English as well as in Japanese. Next is a map on a square of approximately 3° edge having Tokyo at the centre, showing the distribution of the epicentres. It is notable that these are elongated in a direction north-east-south-west, and otherwise fairly uniformly distributed. Eight are submarine and off the north-east coast of the main island of Japan. Finally there are twelve reproductions of seismograms from the Tokyo (Hongo) station for the shocks of February 7, May 23 and June 6, six being normal and six acceleration seismograph diagrams, all very well reproduced. The publication provides valuable data for seismological studies.

The Smithsonian Institution

THE report of the Secretary of the Smithsonian Institution for the year ended June 30, 1938, refers to the completion in June of two full years of the Smithsonian radio programme in co-operation with the United States Office of Education (Publication 3489. Pp. viii+117. Washington, D.C.: Government Printing Office, 1938). These educational broadcasts have covered the various fields of the Institution's activities—science, invention, history and art—and have been widely popular. An outstanding accession to the National Museum has been a collection of molluscs obtained through the Francis Lee Chamberlain fund, which numbered more than a million specimens. Numerous specimens were brought back for the National Zoological Park by the National Geographic Society-Smithsonian Expedition to the East Indies. The Bureau of American Ethnology dispatched an expedition to South America to make extensive studies of the Indian tribes of the western part of that continent. The Division of Radiation and Organisms has developed an improved method for measuring plant growth substances concerned in the bending of plants towards the light, as well as a new automatic apparatus for measuring and recording photosynthesis continually, and an apparatus for the determination of chlorophyll. The Smithsonian solar observing station on Mount St. Katherine in Egypt was abandoned, and construction of a new station on Burro Mountain, near Tyrone, New

Mexico, was begun. The Astrophysical Observatory has undertaken the re-computation of all solar-constant values from 1923 to the present time.

Academy of Sciences of the U.S.S.R.

At a plenary session of the Academy of Sciences of the U.S.S.R. recently held in Moscow the following officers were elected: *President*, V. L. Komarov; *Vice-Presidents*, O. J. Schmidt, I. M. Gubkin, E. A. Chudakov, A. A. Bogomolets, A. J. Vishinsky, T. D. Lysenko, V. N. Obruchev, A. E. Fersman. The secretaries of the eight newly constituted departments of the Academy, elected at a previous session of the Academy, become *ex-officio* members of the Presidium. They are: Department of Economics and Law, E. S. Varga; Department of Technical Sciences, V. P. Nikitin; Department of History and Philosophy, A. M. Deborin; Department of Geology and Geography, P. I. Stepanov; Department of Biology, L. A. Orbeli; Department of Physico-Mathematical Sciences, A. N. Kolmogorov; Department of Languages and Literature, I. I. Meshchani-nov; Department of Chemistry, A. N. Bakht.

Scholarships in Electrical Engineering

APPLICATIONS, which must be received not later than April 15, are invited for the following scholarships awarded by the Institution of Electrical Engineers: *Duddell Scholarship* (£150 per annum, tenable for three years), open to British subjects less than nineteen years of age on July 1, 1939, who wish to take up a whole-time day course in electrical engineering; *Ferranti Scholarship* (£250 per annum, tenable for two years), open to British subjects less than twenty-six years of age on July 1, 1939, who are students or graduates of the Institution and have been such for not less than two years, who desire to carry out whole-time research or postgraduate work of an electrical engineering nature; *Swan Memorial Scholarship* (£120, for one year), open to British subjects less than twenty-seven years of age on July 1, 1939, who have completed a recognized course in electrical engineering or science of at least three years, and who desire to carry out whole-time research or postgraduate work of an electrical engineering nature; *Silvanus Thompson Scholarship* (£100 per annum and tuition fees, tenable for two years) for works employees who are the sons of parents of limited means, open to British subjects less than twenty-two years of age on July 1, 1939; the successful candidate will be required to make up a whole-time day course in electrical engineering at an approved university or technical college. Further information can be obtained from the Secretary, Institution of Electrical Engineers, Savoy Place, London, W.C.2.

Announcements

PROF. JOSEPH H. HILDEBRAND, professor of chemistry in the University of California, has been awarded the Nichols Medal of the New York Section of the American Chemical Society.

M. BERNARD LYOT, of the Meudon Observatory, has been elected a member of the Section of Astronomy of the Paris Academy of Sciences in succession to the late A. de La Baume Pluvinel.

DR. J. M. STAGG has been appointed superintendent of Kew Observatory, Richmond, in succession to Dr. F. J. W. Whipple, who retired on March 31.

THE Masters Memorial Lectures of the Royal Horticultural Society will be delivered in the Society's New Hall in Greycoat Street, Westminster, on April 18 and 19 at 3.30 p.m. by Dr. J. C. Willis, on "How Plants have found their Homes".

At a meeting of the Microchemical Club on March 11 the following officers were elected: *Hon. Treasurer*, Dr. L. H. N. Cooper; *Hon. Secretary*, Mr. W. F. Stephenson; *Hon. Librarian*, Miss I. Hadfield; *Members of Committee*, Miss M. Corner and Mr. J. R. P. O'Brien.

THE American Social Hygiene Association has awarded the 1939 William Freeman Snow Medal to Dr. Thomas Parran, Surgeon-General, United States Public Health Service, "for his great contribution to the health and happiness of the American People through his persistent efforts against syphilis and the conditions which favour its spread".

AN informal conference on "Internal Strains in Solids" will be held during July 11-13 at the H. H. Wills Physical Laboratory, University of Bristol, under the joint auspices of the Physical Society and the University of Bristol. The Conference is open to all members of universities or research institutions. Further information can be obtained from Prof. N. F. Mott, H. H. Wills Physical Laboratory, The University, Royal Fort, Bristol 8.

THE thirty-seventh annual meeting of the South African Association for the Advancement of Science will be held in East London during July 3-8, under the presidency of Prof. G. H. Stanley. The British Association Medal for 1938 will be awarded to Miss Jean Murray, of the Division of Plant Industry, Pretoria, for her paper entitled "An Investigation of the Inter-relationship of Vegetation, Soils and Termites". A symposium on "The Need for the Investigation and Conservation of Human Resources in South Africa" is being organized by Dr. E. G. Malherbe, director of the National Bureau of Education and Social Research, Pretoria. Further information can be obtained from the assistant general secretary, Mr. H. A. G. Jeffreys, P. O. Box 6894, Johannesburg.

In the ninth report of the Committee for Atomic Weights of the International Union of Chemistry, the only change proposed is the atomic weight of phosphorus, which is now taken as 30.98.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 605.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The Time Involved in the Process of Nuclear Fission

BOHR¹ has discussed the process of nuclear fission in uranium and thorium under neutron bombardment on the assumption that a neutron is first captured by the nucleus and that later the energy of excitation of the compound nucleus is concentrated in motion of some special type which leads to deformation and ultimately to division of the system. From this point of view, it is of interest to try to obtain an estimate of the life-time of the compound nucleus before fission, and Green and Alvarez² have reported upon experiments with a modulated beam of neutrons produced in the Berkeley cyclotron which show that this life-time must be smaller than 3×10^{-12} sec. I have recently obtained evidence of an asymmetry in the spatial distribution of the fission fragments, in the case of uranium bombarded by fast neutrons, from which a limiting time very much smaller than this may be deduced. On the basis of considerations given below, it would in fact appear that the mean life of the intermediate nucleus cannot be longer than about 5×10^{-13} sec. in this case.

In essence, the experiments consisted in collecting the fission products from a 'thick' layer of uranium bombarded by neutrons, in thin sheets of polythene, when different thicknesses of absorbing material were interposed between the uranium and the collector and different orientations were adopted with respect to the stream of neutrons from the lithium target. (Lithium bombarded by deuterons, 100 μ a. at 800 kv., was used as source of fast neutrons in these experiments.) When the active products were collected in the forwards direction with respect to the neutron beam, and aluminium was used as absorbing material, an experiment was first made to see whether the normal 'thick layer absorption curve' was obtained. This was found to be the case; the amount of activity collected on the polythene sheet appeared to vary accurately as the square of the remaining range of the particles, when a small residual effect, ascribed to ²⁴Mg and ²³Na recoiling from the aluminium itself, was allowed for. A single range of 3.80 mgm./cm.² was deduced from these results. An absorption curve for the fission products projected in the backwards direction was then taken and compared with the first. Within the accuracy of the experiment (about 5 per cent) both the range of the particles and the total yield of the active products were the same as in the forwards direction.

A more sensitive test for asymmetry was next applied. A 'sandwich' was made of a thick layer of uranium between gold foils each 6.74 mgm./cm.² thick, and the activities collected on equal polythene sheets, placed in contact with the gold on either side, were compared after the composite system had been irradiated with neutrons. The general activity was reduced to one eighth of that from an uncovered

layer of uranium, and 10 ± 3 per cent more was obtained on the forwards collector than on the other. When a 'sandwich' was made with gold foils 7.13 mgm./cm.² thick, 19 ± 3 per cent more activity was obtained forwards than backwards.

An asymmetry of the type observed shows that, after capture of the neutron, fission of the nucleus usually occurs before the original momentum of the system has been lost. On the existing data concerning the ranges of the heavy radioactive recoil atoms, an estimate of this time may be made. Remembering that the momentum of a 14-million electron volt neutron is roughly the same as that of the least energetic of the α -particles from the natural radio-elements, and that in the present instance the path of the compound nucleus is in solid uranium, a value of 2×10^{-13} sec. is obtained. A time of the same order of magnitude will be required even for the compound nuclei formed by the capture of neutrons of much less energy. Taking all things into consideration, therefore, 5×10^{-13} sec. seems a safe upper limit to the lifetime of these compound nuclei.

Having drawn the main conclusions from the qualitative observation that more activity is collected, through a given thickness of absorber, in the direction of neutron motion than in the reverse direction, it is interesting to try to calculate the magnitude of the asymmetry to be expected on the assumptions which have been made. If a neutron of mass m and energy E is captured into a compound nucleus of mass $2M$, and if this then breaks up with the release of energy $2Q$, in the simplest case, when the break-up is into fragments of equal mass, the relative energy difference, $\Delta Q/Q$, between forwards and backwards fragments, is $2(mE/MQ)$. With $M = 120m$ and $Q = 7E$, $\Delta Q/Q = 0.07$. On any reasonable assumptions, the relative difference in range, $\Delta R/R$, for heavy atoms of the energy in question, will be of the same order of magnitude. This difference, of course, refers to the actual range; when an absorber is used, the relative difference in remaining range is correspondingly greater. With an absorber which reduces the activity collected from a thick layer to only 9 per cent of the total activity without absorber, theoretically a remaining range of 30 per cent of the full range is to be expected. In such a case the relative difference in remaining range between forwards and backwards fragments is about 25 per cent, with the figures quoted, and roughly 60 per cent more activity is to be expected on the 'forwards' collector than on the other. Even taking count of the smaller difference which would be contributed by fission products formed by capture of neutrons of smaller energy, a 30 or 40 per cent asymmetry should result. It is not easy to reduce this figure to the 10-20 per cent which is all that is observed. However, at this stage, the discrepancy is not important.

The experiments which have been described were made possible by the co-operation of members of the Cavendish High Voltage Laboratory, to whom I wish to express my thanks.

Cavendish Laboratory,
Cambridge.
March 30.

N. FRATHER.

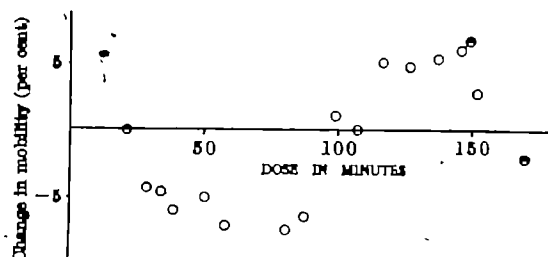
¹ *NATURE*, 142, 330 (1939); *Phys. Rev.*, 55, 418 (1939).

² *Phys. Rev.*, 55, 417 (1939).

An Effect of Gamma Radiation on Egg Albumin

It has previously been shown that the electrophoretic mobility of particles of inorganic sols and suspensions can be influenced by small doses of X- and gamma-radiation. The mobility does not vary monotonically with the dose but exhibits a series of maxima and minima^{1,2}.

A similar effect has now been observed with egg albumin. The technique employed was that of Freundlich and Abramson³, who have shown that the mobility of quartz particles covered with protein is equal to that of the protein itself. Samples of albumin in dilute acetate buffer solutions were exposed to increasing doses of gamma radiation, the irradiated solutions added to a quartz suspension, and the velocity of the composite particles under the influence of an electric field was determined with the ultra-microscope. Care was taken that sufficient protein was present to coat the quartz completely, and the buffer was maintained at the same strength in the initial and final solutions.



The results of a typical series of experiments are given in the accompanying graph, in which the percentage change of mobility is plotted against the time of exposure. A significant effect can already be observed after an exposure of 30 minutes, and as in the case of the inorganic sols, the curve relating the dose with the change of mobility passes through a minimum and a maximum. The probable error of a single velocity determination was found to be 0.5 per cent. The rate of irradiation as estimated from the amount and disposition of the radium employed was rather less than 3 rontgens per minute. Experiments are in progress to determine it with greater precision.

It is interesting to note that if unirradiated protein is added to a quartz suspension and the solution is then irradiated, the mobility of the composite particles remains unchanged over the range of doses investigated.

Department of Physics,
University of Reading.
March 6.

J. A. CROWTHER.
H. LIEBMANN.

¹ Crowther, J. A., and Liebmann, H., *NATURE*, 140, 28 (1937).

² Crowther, J. A., Liebmann, H., and Jones, R., *Phil. Mag.*, 26, 120 (1938).

³ Freundlich, H., and Abramson, H. A., *J. phys. Chem.*, 123, 51 (1923).

A Positive Beam in Cathode Ray Tubes

DURING the course of work on behalf of the Radio Research Board of the Department of Scientific and Industrial Research, certain phenomena have been observed in high vacuum cathode ray tubes of a commercial type.

The electrode system of this type of tube consists of an indirectly heated cathode, surrounded by a cylindrical electrode to control the electron quantity; an accelerating anode; a focusing anode; a final gun anode; and the two pairs of deflecting plates, each being connected separately. The fluorescent screen (blue, with short delay) is at a considerably lower potential than the gun anode, so that when electrons are projected from the gun with velocities corresponding to about eleven hundred volts or less, they slow up completely before reaching the screen, reverse their direction of travel, and finally return towards the gun. Under these latter conditions, when there is no fluorescent spot on the screen due to the electron beam, a faint, slightly more greenish spot has been observed, which can be brought to a comparatively sharp focus by reducing the potential on the electron focusing anode. Furthermore, the brilliance of this spot can be controlled by the electron quantity control electrode in the same manner as the electron beam.

This new spot first appears when the gun potential is about five hundred volts positive, increasing in brilliance up to a gun potential of about eleven hundred volts, above which it becomes unstable. With a further increase of potential the electron beam also reaches the screen, but also in a very unstable condition, wandering over the screen at random. During this condition, the newly observed spot is also present, in close proximity to the electron spot. Finally, when the potential is raised to about twelve hundred and fifty volts, the electron beam becomes stable and the new spot disappears. It is found that the screen has been badly damaged in the region of the spot, and it is thought that this damage may be due to bombardment by heavy particles moving relatively slowly.

Experiments made with electrostatic and magnetic deflecting fields indicate that the new spot observed under the above conditions is caused by a beam of positive ions. It has been further noticed that there is a very considerable external negative electrostatic charge on the glass of the tube in the region of the spot. This charge is sufficient to block the grid of an amplifying valve when a lead from the grid end of its high impedance input circuit is moved into contact with the glass in the region of the spot. Experiments made with an electrometer triode also show that there is a concentration of charge on the inner wall of the cathode ray tube having a positive potential of several hundred volts. It is a significant fact, when the nature of the beam is considered, that the electron beam produces no indication on the electrometer valve.

Considering the phenomena, especially the manner in which brilliance and focus are affected by the electron beam controls, it would appear that the production of positive ions is a secondary effect from the primary electron stream, possibly due to the slowing up of the beam and the slight trace of residual gas in the tube, although the tubes in question are of the hard or high vacuum type.

To sum up, it appears that positive ions can be generated in some types of cathode ray tubes having

high vacua, and that these ions can travel towards the screen, causing bad damage with attendant loss of fluorescence. This effect should be especially noticeable in cathode ray tube systems employing mixed electrostatic and magnetic scanning, where a line will appear across the screen after some use, owing to the fact that the ion beam is not appreciably deflected by the magnetic field.

Thanks are due to the Department of Scientific and Industrial Research and the Medical Research Council for permission to publish this note.

JAN FORMAN.

Ultra-Short Wave Laboratory,
London Hospital Medical College, E.1.
Feb. 22.

Surface Structures of Possibly Atomic Dimensions using Autoelectronic or 'Field' Emission from Fine Metal Points

WE have set out to study the contamination of metal surfaces, using the field emission from fine points to give large-scale patterns representing the angular distribution of electron emission.

The general technique adopted is similar to that described by Müller^{1,2}, but we have found that with the wide-angle beams obtained a spherical bulb is desirable. The patterns which we have obtained from clean tungsten are so well defined that we feel it may be of general interest to describe the results so far obtained.

A fine tungsten point is mounted on a thick filament in the centre of a spherical bulb, one half of which is coated with fluorescent material. The anode consists of a carbon film on the other half of the bulb.

After suitable exhaust treatment, the filament is dimmed to room temperature or a little above, and a voltage of the order of 10 kv. is applied to the anode. An electron pattern of the emitting point is then obtained on the screen.

In our experiments the points have been different from those of Müller, being formed by electrolytic etching of fine wires of diameter 0.05 mm. The solid angle subtended by the pattern on the screen is considerably wider than Müller shows, and contains more pattern elements.

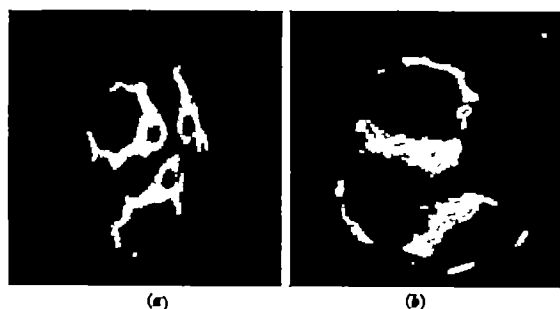


Fig. 1.
PATTERN FROM CLEAN TUNGSTEN

In Fig. 1(a) is shown a photograph of a typical pattern on the screen. The symmetry of the pattern will be at once apparent, and the dark spaces can be identified, as Müller has done, as corresponding to the directions of the normals to the main lattice planes in the crystal. It is noteworthy that, except when the surface is heavily contaminated, there appears to be no luminosity in these areas.

In the case under consideration, the crystal has a cubic structure, and the centres of the large octagons correspond to the (100) planes. The small well-defined circles forming triangles are the (211) planes, and the centre of the main rectangle corresponds to the (110) plane. The fainter ones either side of the (110) are the (221) planes. The centres of the triangles corresponding to the (111) planes are not fully dark.

From the emission-voltage characteristics, the radius of the point and the size of the emitting area can be approximately estimated, using the Fowler-Nordheim formula^{3,4}. For the point shown in Fig. 1(a) the radius is 1.5×10^{-4} cm., and the emitting area is 2.5×10^{-11} cm.². Optical measurement indicated that the point radius was 5×10^{-4} cm.

In Fig. 1(b), we show the pattern obtained with a somewhat larger point. (A rough measure of the size is given by the voltage necessary to obtain the pattern.) It will be observed that the pattern is basically the same as in Fig. 1(a), but that the dark spaces are surrounded by multiple lines. The bright parts of the pattern are made up of small twinkling spots in rows forming the multiple lines, shown in Fig. 1(b). From the number of spots present, and the emitting area, these spots must correspond with areas of atomic dimensions. Their agitation is quite clearly a function of temperature.

Using thoriated tungsten points, we have found that the basic tungsten pattern can be obtained. The surface can then be covered with a monatomic layer of thorium. The patterns obtained give some idea of the way the surface becomes covered.

It seems to us that the technique described offers an extremely simple method for the study of metallic surfaces and the contamination of such surfaces. For example, the arrival and removal of gas ions can be clearly observed.

We hope to publish our detailed results in the near future.

M. BENJAMIN.

R. O. JENKINS.

Research Laboratories,
General Electric Company, Ltd.,
Wembley.
Feb. 16.

¹ Müller, H. W., *Z. Phys.*, 106, No. 9-10 (1937).

² Müller, H. W., *Z. Phys.*, 108, No. 9-10 (1938).

³ Gossling, B. S., see Nordheim, *Phys. Z.*, 30, 189 (1929).

⁴ Stein, Gossling, Fowler, *Proc. Roy. Soc., A*, 124, 696 (1929).

Magnetic Evidence regarding the State of Manganese in Glasses

MUCH controversy centres around the role of manganese as a colorant of glass. Mellor¹ states that manganese colours alkaline glasses pink to violet under oxidizing conditions. According to Thorpe², the full colour is only developed when manganese is in a fully oxidized condition (Mn^{IV}). In Fuwa's³ opinion, the manganic oxide is responsible for the pink colour, and colourless manganese in glasses is bivalent.

Notable contributions on the subject have been made by Bancroft and Nugent⁴, Solomin⁵, Childs and co-workers⁶, Turner and Weyl⁷, Springer⁸, Hoffman⁹ and others. According to Sir Herbert Jackson¹⁰, none of the evidence is conclusive. An attempt has been made by us to clarify the issues by the aid of

magnetic susceptibility measurements of the manganese glasses. Borax and phosphate glasses have been chosen to start with on account of their availability in the pure state and the simplicity of their preparation.

The melts were made in an electric furnace. The colour conditions could be determined at any time by removing a small bead on a platinum wire. The melt could be made coloured or colourless at will. It was decolorized with tartaric acid and it regained its full colour on prolonged heating in air. Manganese was estimated by the 'bismuthate method'. The magnetic measurements were made on a balance of the Gouy type.

In the case of the decolorized samples, the experimental value of χ was found to be 268.3×10^{-4} . This compares well with the theoretical value 269.3×10^{-4} for divalent manganese, showing that manganese in the decolorized product is in the divalent state.

It was found that in the case of the coloured samples the susceptibility for manganese ion had a value intermediate between those required for divalent and trivalent manganese on the well-known Stoner and Van Vleck formula.

On exposure to ultra-violet light from a quartz mercury vapour lamp with a Wood filter, it was found that the decolorized glass gave an orange-red fluorescence resembling that obtained in the case of the anhydrous manganese halides, thereby lending further support to the view that manganese is divalent in this case¹¹. The coloured sample did not exhibit this type of fluorescence.

Phosphate glass prepared from microcosmic salt was also similarly treated. The coloured product was non-fluorescent while the decolorized sample fluoresced with an orange-red glow, indicating divalency of manganese in the reduced glass. The phosphate glasses are being examined by the magnetic method, and the preliminary results indicate complications arising from the probable polymerization of the manganese salts formed.

It is interesting to recall here that the name pyro-lusite has been derived from $\pi\lambda\phi$, fire, and $\lambda\omega\epsilon$, I wash, owing to the use of this material by the ancients for the removal of colour from glass tinged by iron.

The controversial mechanism of this change is amenable to a satisfactory treatment by the methods described above. Full details of these studies will be communicated shortly in papers to be published jointly with Messrs. Brahm Prakash, B. D. Khosla and Abdul Hamid.

S. S. BHATTAGAR.

University Chemical Laboratories,
University of the Punjab,
Lahore.

¹ Mellor, "A Comprehensive Treatise on Inorganic and Theoretical Chemistry", 6, 533 (1936).

² Thorpe, "Dictionary of Applied Chemistry", 2, 721 (1912); 3, 586 (1923).

³ Fuwa, *J. Japan Ceramic Assoc.*, 208, 80-97 (1933).

⁴ Bancroft and Nugent, *J. Phys. Chem.*, 33, 481 (1929).

⁵ Solomon, N. V., *Keram. i Staklo*, 8, No. 2, 28-30 (1932).

⁶ Childs and co-workers, *J. Soc. Glass Tech.*, 15, 172-81 (1931).

⁷ Turner, W. M. S., and Weyl, W., *J. Soc. Glass Tech.*, 19, 206-16 (1936).

⁸ Springer, L., *Glastechnik*, 61, 611 (1931); *J. Soc. Glass Tech.*, 15, 246A (1931); "Ceramic varnishes, emulsions", 251-3 (1933).

⁹ Hoffman, J., *Glass*, 12, 419-20, 423, 433 (1936).

¹⁰ Jackson, Sir Herbert, *NATURE*, 130, 303 (1927).

¹¹ Randall, J. T., *Trans. Faraday Soc.*, 28, 12 (1932).

Jahn-Teller Theorem and the Arrangement of Water Molecules around Paramagnetic Ions in Aqueous Solutions

It is well known from X-ray studies that in many of the highly hydrated salts of the iron and the rare earth groups the cation is surrounded by an octahedron of water molecules. This distribution fits well with the observed magnetic properties of these salts; first, it gives an electric field of predominantly cubic symmetry about the central cation, as required by the magnetic data, and secondly, it gives the potential of the electric field the proper sign demanded by the magnetic data. The magnetic data, however, further require (1) that the field, though predominantly cubic in symmetry, should deviate from it considerably, since the cation in these crystals exhibits, in general, a strong magnetic anisotropy, and (2) that for a given cation the magnitude and the asymmetry of the electric field about it should be nearly the same in the different hydrated salts containing the ion, since the magnetic anisotropy of the ion is found to be of the same order of magnitude in all these salts. These requirements will be satisfied in a simple manner if the octahedron, instead of being regular, deviates from it slightly—a small deviation is permitted by the available X-ray data—and the deviation is determined by the nature of the cation in the centre. This arrangement appears very probable in view of the important theoretical result obtained recently by Jahn and Teller¹, namely, that if the electronic state of the central ion is degenerate, the system will be stable only if there is enough asymmetry in the system to remove the degeneracy (except, of course, the special two-fold degeneracy of Kramers). This minimum asymmetry required for stability supplies then the mechanism by which the cation can in a manner determine the geometry of distribution of the water molecules around it.

Such an asymmetric arrangement of the water molecules about the cation seems to persist even in the aqueous solutions of these salts. Freed and his collaborators² have found in the observed multiplicity of the absorption lines of the rare earth ions in aqueous solutions evidence for asymmetric electric fields, nearly the same as in the corresponding hydrated crystals. A comparison of the magnetic behaviour of some of the paramagnetic ions, both of the rare earth and the iron groups, in aqueous solutions, with the ideal free-ion behaviour on one side, and with the behaviour of the ions in the hydrated crystals on the other, also leads to the same conclusion.

The large magnetic double-refraction exhibited by aqueous solutions of these salts³ follows as a natural result. Owing to the asymmetry in the distribution of the water molecules about the paramagnetic ion, and the consequent asymmetry of the electric field about the ion, the group as a whole will be magnetically anisotropic, and will tend to orient in the magnetic field. Since the group will also be optically anisotropic, the solution will exhibit double-refraction. Now these anisotropies, according to the views presented here, should depend indirectly on the incipient degeneracy of the electronic state of the central paramagnetic ion, and in particular on the orbital degeneracy. The observation by Chinchalkar⁴ that the double refraction depends on the orbital angular momentum of the paramagnetic ion, and that in particular the double refraction is almost

nothing when the ion is in the S -state, (for example, Gd^{+++}) is significant. Indeed, from the known magnetic anisotropy of the group in the crystal state, and its birefringence, a rough estimate can be made of the magnetic double refraction of the solution, and it is found to be of the right order of magnitude.

K. S. KRISHNAN.

Indian Association for the
Cultivation of Science,
Calcutta.
Feb. 15.

¹ *Proc. Roy. Soc., A*, 161, 220 (1937), 164, 117 (1938)

² *J. Chem. Phys.*, 6, 297 and 654 (1938).

³ Raman, C. V., and Chinnabkar, S. W., *NATURE*, 123, 758 (1931); Haenny, C., *O.R.*, 123, 931 (1931); 123, 219 (1932).

⁴ *Phil. Mag.*, 20, 886 (1935).

A Comprehensive Fundamental Electrical Formula

DR. C. V. DRYSDALE has pointed out that his formula¹ can be applied to the calculation of what are usually called 'electromagnetic forces'; and it then becomes an expression (in vector notation) for the generally accepted principle called the Biot-Savart law. But the experiments to which I referred in *NATURE* of August 7, 1937, have shown that the Biot-Savart law sometimes indicates only a small fraction of the actual force, and have therefore shown the serious incorrectness of the more general formula proposed by Dr. Drysdale.

The accuracy of my experimental results was verified by finding that they were all in close agreement with the formula given in Maxwell's Art. 583. When applied to the case shown in Fig. 2 of my above-mentioned communication to *NATURE*, this formula becomes

$$F = \frac{1}{2} i^2 dL/dy,$$

where F is the force that acts in the vertically downward direction on $MBON$, while this part of the circuit moves through the distance dy in that direction, which movement increases the inductance by the amount dL . The value of dL/dy can be found by differentiating the well-known expression for the inductance of a rectangular circuit. Maxwell's formula says that the vertical force exerted on $MBON$ by $MADN$ and on $MADN$ by $MBON$, is $8.74 i^2$, whereas Drysdale's formula says that the force exerted on $MBON$ by $MADN$ is $0.43 i^2$, and that the force exerted on $MADN$ by $MBON$ is $0.17 i^2$, this last being less than one-fiftieth of the actual force. Here it will be seen that Drysdale's formula contradicts, to a very serious extent, both Maxwell's formula and Newton's laws of motion.

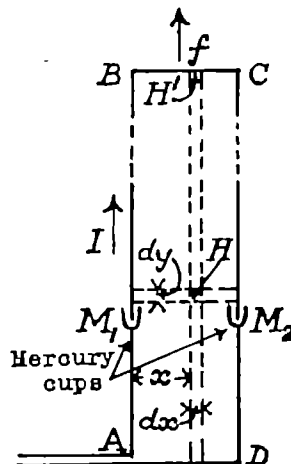
W. F. DUNTON.

46 Grosvenor Road,
Birmingham, 20.
Jan. 30.

¹ *NATURE*, 140, 945 (1938).

MR. DUNTON's measurements do not in any way affect the validity either of my equation, the Biot-Savart law, Faraday's law of electromagnetic induction, or the magnetic flux-cutting equation. His error lies in assuming that it is only the magnetic field of the lower fixed portion M_1ADM_2 of the accompanying circuit which produces a force on the conductor BC ; whereas the only part of the magnetic field produced by the whole circuit which does not

produce a force on BC is that due to BC itself. If for simplicity we consider a very long narrow rectangular loop of breadth b and conductor radius a , the magnetic



force at any distance x from AB and remote from BC or AD is $H = 2I/x + 2I/(b-x)$, and hence if the length of the loop is increased by the amount dy

$$\frac{\partial L}{\partial y} = 2 \int_0^b \{1/x + 1/(b-x)\} dx,$$

neglecting the internal magnetic field in the conductors. But the magnetic force at a corresponding point on BC is $H' = H/2$, and the force on BC or on AD is therefore

$$f = I \int_0^b H' dx = I^2 \int_0^b \{1/x + 1/(b-x)\} dx = \frac{1}{2} I^2 \frac{\partial L}{\partial y},$$

which is Maxwell's formula, with which Mr. Dunton's measurements agreed. He ought actually to have observed a somewhat greater force due to the pressure on the ends of the conductors caused by the constricting effect of the current in the mercury (the 'pinch phenomenon' of Carl Hering), which is covered by the same argument; but the above is sufficient to show that his supposed discrepancy has no foundation.

C. V. DRYSDALE.

Frequency Interpretations in Probability

If he were consistent, de Moivre would not have accepted $5/12$ as the probability in Dr. Jeffrey's problem. (Two boxes, one containing 1 white and 2 black balls, the other 1 white and 1 black. Choose a box; then draw a ball; what is the probability of drawing white? *NATURE*, Feb. 11.) For, according to his definition, the statement that the probability is $5/12$ must mean that there are $12n$ different possible cases, of which $5n$ are favourable, n being an integer. That simply is not true.

The 'modern' who affirms $5/12$ must hold that probability means something other than the ratio of favourable to possible cases. When the cases are sums of 'equally possible' elements, then the probability happens to be that ratio, but not otherwise. De Moivre's definition, or Laplace's modification of it, is not wrong; it is merely unduly limited; it tells us nothing about probability except in a limited class of problems.

The question is then what is the general meaning of probability, and why, in this limited class, does it happen to be measured by the ratio? The question can be answered in accordance either with Dr. Deming's view or Dr. Jeffrey's. My object is not to answer the question, but to point out that an answer is required.

NORMAN CAMPBELL.

21 Carlton Hill,
St. John's Wood,
N.W.8.
Feb. 12.

Use of the Termination *-tron* in Physics

IN the invention of names in physics, there appear to be two schools of philological thought as to the meaning of the termination *-tron*. According to one school, it is derived from a Greek word signifying an instrument, as illustrated by *cyclotron* or *thyatron*, whereas according to the other it signifies an elementary particle, as in *positron* and now *mesotron*. The decision as to which is the better meaning is in no way helped by reference to authority, for the ancients appear to have been wholly ignorant of the use of the word in either sense, or indeed in any sense at all. It is perhaps none the worse for that, but it does seem an unnecessary confusion to introduce, out of all possible combinations of letters, exactly the same four to represent a new machine or a new particle. If the termination is to be accepted for both, it is indeed rather hard to think of anything in modern physics to which it might not be applied.

Discoverers are of course free to name their inventions as they please, but there would be, to say the least, a convenience if the chosen name terminated with something expressing the category to which its possessor belongs, so that *-tron* should be restricted to signify either an instrument or a particle, but not both. The names *thyatron* and *cyclotron* have already got into wide use, so that it would seem almost impossible to change them without confusion. On the other hand, *positron* and *mesotron* are household words in the mouths of comparatively few, and to rename them would not cause such widespread trouble. The situation is unavoidably complicated of course by the *electron* and *neutron*, but the division of these as *elec-tron* and *neu-tron* is one which the most illiterate would scarcely make, and *-on* taken by itself—why not for example *poson* and *negon*?—seems the most natural ending for a particle.

C. G. DARWIN.

National Physical Laboratory,
Teddington.
Mar. 23.

Growth-controlling Hormonal Substances of the Hypophysis

STUDYING the substances which accelerate or inhibit the growth of plants, and which are present in different extracts of particular organs of animal body, we have found that the acetonic extract of the anterior lobe of the hypophysis accelerates the growth of plants, while the same extract of the posterior lobe of the hypophysis inhibits their growth.

Later, we experimented with various extracts of organs influencing the growth of animals. These experiments were performed upon young animals of the same breed (rabbits, guinea pigs), and especially upon young rats of about 30 gm. in weight. We

have found in the acetonic extract of the anterior lobe of hypophysis a substance which accelerates the growth of normal young animals compared with controls under the same conditions. This substance is not identical with the somatotrophic hormone of Evans because its physical and chemical properties (freedom from albumin, resistance to boiling, reduced sensibility to alkali, etc.) are different. Compared with the controls of the same breed, the normal size of the animals under treatment is attained under the influence of the substance in a shorter time. The action was evident after two or three injections of the extract.

The acetonic extract of the posterior lobe of hypophysis was found to have an opposite result. After two or three subcutaneous injections of the extract, the growth of the animals became so much inhibited that two or three months later the weight of the treated animals was only slightly increased compared with controls. The treated animals presented quite a normal appearance not only in their behaviour but also in their appetite. The anatomical examination of the animals which were killed has shown no pathological changes in the organs, which were of an inferior average weight compared with the organs of the controls.

There exist, therefore, in the hypophysis not only the somatotrophic growth hormone discovered by Evans, but also other growth-controlling substances, namely, in the anterior lobe a growth-stimulating, and in the posterior lobe a growth-inhibiting substance. We suggest that the substance inhibiting the growth of animals and of plants in the posterior lobe of the hypophysis be named 'amioins'.

BERNARD LUSTIG.

Pearson Foundation.

HENRY K. WACHTEL.

Radium Institute,
Cracow.
Feb. 18.

Pentose Nucleotides in the Cytoplasm of Growing Tissues

INTEREST in the nucleic acid metabolism of mitosis has in general tended to centre on the nucleus. More recently evidence has been obtained showing an interplay between the nucleic acid metabolism of the nucleus and that of the cytoplasm¹. Studying the ultra-violet absorption spectra of the cytoplasm of growing tissues, we have found them all to exhibit the maximum around 2600 Å., characteristic of the cyclic nitrogenous bases present in the nucleic acids. In contrast, the homologous mature tissues exhibit a different absorption similar to that of the proteins.

The cells from rapidly growing yeast cultures have already² been shown to differ from the cells of the senescent cultures in containing a much higher concentration of the substances absorbing maximally at 2600 Å. An estimate of the total absorbing substances, calculated as yeast nucleic acid, agrees well in order of magnitude with Baumann's data³ for the yield on the extraction of yeast nucleic acid from yeast.

In the tissues of the plant embryo, prepared as they are for rapid growth and division, it has long been known that yeast nucleic acid was present^{4,5}. The absorption spectrum of cells from the rye embryo shows a maximum at 2600 Å., with an additional absorption indicating a high concentration of proteins. Here Behrens⁶ has shown that yeast nucleic acid can be extracted from the cytoplasm of the cell itself.

In the eggs and embryos of animals, pentose nucleic acids have already been demonstrated for the sea urchin¹, chick² and fish³. The absorption spectrum of the *Drosophila* egg cytoplasm agrees well with that of a nucleic acid¹. Moreover, the imaginal disks of the *Drosophila* larva, which are dividing rapidly while the larval cells merely increase in size, have a strongly absorbing cytoplasm the absorption spectrum of which has a maximum at 2600 Å. In the mid-gut of the larva, where the imaginal cells are present in small nests among the larval cells, it is easy to compare the absorption spectra of the two types (Fig. 1). The functional gut cell of the larva has a much lower concentration of absorbing materials, and the shape of the absorption curve is more like that of proteins.

The system of apical growth in the root of plants is another case in point. We have studied the *Allium* root-tip, finding in the zone where mitoses are occurring, cells with a high concentration of absorbing materials the absorption spectrum of which is of the nucleic acid type. Towards the base the cells which will no longer divide have the absorption spectrum of a protein with cyclic amino acids (Fig. 2).

The absorbing substances are probably pentose nucleotides. In the cases of yeast and the rye embryo, yeast nucleic acid has been extracted. In the *Drosophila* and the *Allium* material a strong orcin reaction for pentoses has been obtained in the same tissues, which on micro-incineration show a plentiful residue of ashes that give a positive test for phosphorus. That the pentose, phosphorus and ultra-violet absorbing substances mentioned above occur in the same tissues gives support for the assumption of the presence of nucleotides.

It seems likely that a high concentration of nucleic acids is the basis of the generally noted basophilia of embryonic tissues. Those here discussed are strongly basophilic, in correlation with the high ultra-violet

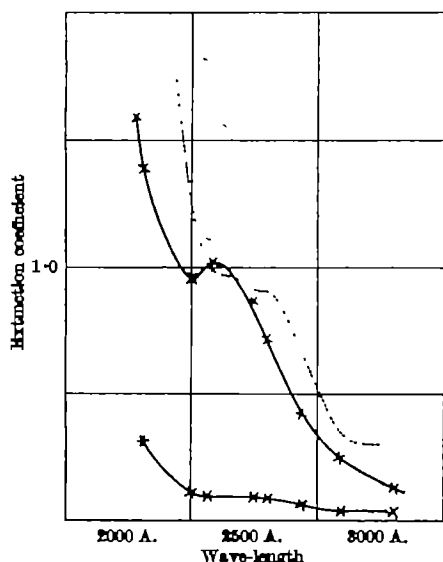


Fig. 1.

A COMPARISON OF THE ULTRA-VIOLET ABSORPTION SPECTRUM OF THE MATURE LARVAL GUT CELL (LOWER CURVE) WITH THAT OF A CELL FROM THE IMAGINAL DISKS OF THE MIDGUT (UPPER CONTINUOUS CURVE). IN THE DOTTED CURVE THE VALUES OF THE LOWER CURVE ARE MULTIPLIED BY THE FACTOR 10 TO PERMIT A COMPARISON OF SHAPES.

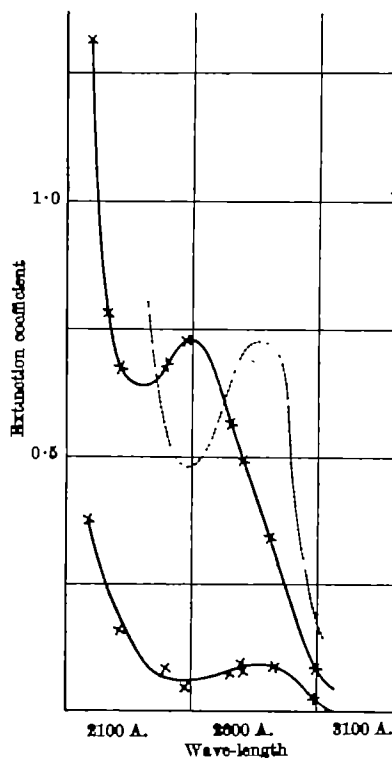


Fig. 2.

THE ULTRA-VIOLET ABSORPTION SPECTRA OF THE CYTOPLASM OF A CELL FROM THE GROWTH ZONE (UPPER CURVE) AND FROM THE BASE (LOWER CURVE). THE DOTTED CURVE HAS THE SAME MEANING AS IN FIG. 1, BUT THE VALUES OF THE LOWER CURVE ARE MULTIPLIED BY 8 IN THIS CASE.

absorption. The presence of pentose nucleotides in high concentrations in rapidly dividing tissues is probably thus a general phenomenon.

T. CASPERSSON.

JACK SCHULTZ.

(International Fellow of the Rockefeller Foundation.)

Department of Chemistry,
Caroline Institute,
Stockholm.

Feb. 21.

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The Enzyme System Transferring the Amino-Group of Aspartic Acid

I HAVE, in recent communications^{1,2}, described a method for the preparation of a purified enzyme from muscle tissue, catalysing the reversible transfer of amino nitrogen from glutamic acid to monocarboxylic α -ketoacids³. The enzyme preparation is inactive with regard to the *Umaminierung*, or 'trans-amination' of aspartic acid, whereas this process is readily effected

by the original muscle pulp⁴. I have since been successful in obtaining from muscle tissue, by means of a modified purification scheme to be described in detail elsewhere, enzyme preparations catalysing the transamination of aspartic acid at a considerable rate in the presence of a thermostable activator, or coenzyme, contained in tissue extracts.

This enzyme preparation still contains the enzyme of glutamic acid trans-amination, but from vegetable materials preparations can be obtained that are active only with regard to aspartic acid while completely indifferent to glutamic acid. The aspartic enzyme differs from the glutamic enzyme in that it is more readily extracted from tissues by aqueous solvents, and also in its higher lability. The glutamic enzyme appears to contain an active group similar to the coenzyme of aspartic enzyme, but less readily dissociable. The chemical nature of the active thermostable constituent is under investigation in this laboratory.

M. G. KRITZMANN.

Laboratory of Oxidation-Reduction
Processes,
Department of Metabolic Research,
Vienn, Moscow.
Feb. 15.

¹ Kritzmann, *Biochimica (Moscow)*, 3, 593 (1938).

² *C.R. Acad. Sci. U.R.S.S.*, 11, No. 1-2, 72 (1938).

³ Braunstein and Kritzmann, *Enzymologia*, 2, 129 (1937).

⁴ Karyagina, *Biochimica*, 4, No. 2 (1939) (in the Press).

Purification of Uricase

URICASE is an enzyme which catalyses the oxidation of uric acid. It was reported recently by Davidson¹ that he had been able to obtain a preparation of uricase about a thousand times more active than the acetone powder of liver which was used as a starting material. Several purified preparations showed, according to him, a high and fairly constant iron content ranging from 0.15 to 0.20 per cent, which he regards as evidence in favour of the view that iron is a constituent of uricase.

Using a modified method of purification, I have been able to obtain preparations 1,000-1,400 times more active than the acetone powder of pig's liver used as initial material. My preparations are completely colourless, insoluble in water and only sparingly soluble in alkaline buffer solutions. The iron content of these preparations as determined on samples up to 16 mgm. of dry weight, is only 0.02 per cent.

Their catalytic activity is poisoned reversibly by potassium cyanide but not by hydrogen sulphide, α -dipyridyl, pyrophosphate or diethyldithiocarbamate.

The lack of proportionality between iron content and activity in preparations obtained with different methods and the very low iron content (0.02 per cent) in highly purified enzyme preparations make it very improbable that iron is a constituent of uricase.

An account of the purification and properties of the purified enzyme will be given elsewhere.

C. G. HOLMBERG.

Molteno Institute,
University of Cambridge.
March 3.

¹ Davidson, J. N., *NATURE*, 141, 790 (1938). *Biochem. J.*, 32, 1286 (1938).

Marrubiin, a Diterpenoid Lactone

ACCORDING to Gordin¹, marrubiin, the optically active bitter principle of *Marrubium vulgare*, is a lactone, $C_{21}H_{32}O_4$, m.p. 154.5°-155.5°, which on hydrolysis yields marrubic acid, $C_{21}H_{32}O_5$, m.p. 173°-174°, forming an ethyl ester, m.p. 87°.

In the course of an investigation on the constitution of this compound, which has m.p. 158°, we have found that the analytical results and molecular weight determinations given by marrubiin and a number of its derivatives are in agreement with the formula $C_{21}H_{32}O_4$ for the lactone which on hydrolysis gives rise to a monobasic acid $C_{21}H_{32}O_5$, m.p. 197° (methyl ester, m.p. 85°; ethyl ester, m.p. 88°). Hydrogenation of marrubiin and marrubic acid gave the corresponding tetrahydro-derivatives, m.p. 132° and m.p. 187° (ethyl ester, m.p. 95°) respectively, which like the parent compounds are interconvertible.

Determination of active hydrogen indicates that marrubiin contains one hydroxyl group and, since the compound does not appear to form acyl derivatives under the usual conditions, this is in all probability a tertiary alcoholic group; the fourth oxygen atom is present in an oxide system. Marrubiin, which is readily resinified by warm mineral acids and by hot formic acid, gives rise on oxidation with potassium permanganate to a neutral compound, m.p. 211°, and a lactone, m.p. 161° (acid, m.p. 208°), which is also formed along with a liquid acid by the action of ozone, whilst dehydrogenation with selenium furnishes a comparatively good yield of 1:2:5-trimethylnaphthalene (agathaline). It is concluded that marrubiin is a hydroxyditerpene lactone of the manoyl oxide type.

FREDA HOLLIS.

Dept. of Organic Chemistry,
University,
Liverpool.
March 3.

J. H. RICHARDS.
A. ROBERTSON.

¹ Gordin, *J. Amer. Chem. Soc.*, 39, 255 (1906).

Effect on Bacteria of Continued Cultivation in Lecithin Broth

THE pathogenic properties of bacteria (typhi, dysenteriae, coli) are slowly reduced by daily subcultures (about a hundred) on bouillon containing between 0.2 per cent and 4 per cent colloidal lecithin¹. For the sake of brevity these will be designated as *L*-bacteria and normal organisms as *N*-bacteria.

Particularly interesting results were obtained with *B. typhi murium*, which after four hundred subcultures required 10,000 times the original dosage to produce a fatal effect when injected intraperitoneally into mice (1,000 and 10,000,000 living bacteria, respectively). Neither fifty subsequent subcultures on ordinary media nor twelve animal passages induced a return of the pathogenic properties. The agglutinability of the *L*-bacteria with immune serum produced by the corresponding *N*-bacteria was not measurably lessened, nor was their ability to produce H and O agglutinins in affected animals.

The duration and intensity of the immunity resulting from intraperitoneal administration of *L*-strains were equal to the results observed in surviving animals infected with *N*-strains, and the results were better than those obtained by the injection of 10-100 times as many *N*-bacteria killed at 60° C.

Groups of pregnant mice which received ten oral doses (0.5 c.c. daily) of a 24-hour living broth culture of an *L*-strain of *B. typhi murium* gave birth as normally as untreated controls. A similar group of mice treated at the same time with equal numbers of *N*-bacteria showed 100 per cent mortality.

Three months later, the mice which had been fed *L*-strains were given orally large numbers of *N*-bacteria; the resulting mortality was 15 per cent, whereas controls which had been immunized at the same time with large numbers of heat-killed *N*-bacteria showed a mortality of 80 per cent.

A certain degree of attenuation in virulence was also noticed after passage of *N*-bacteria on ordinary media. After four hundred passages of *B. typhi murium*, the lethal dose was fifty times that of the initial culture. However, in most such cases a few animal passages sufficed to bring the pathogenicity of the strain back to its original degree.

In animals inoculated with *L*-strains the bacteria disappeared from the blood stream and organs within a few weeks and sometimes within as short a time as 48 hours. Animals which had recovered from sub-lethal doses of *N*-strains generally remained carriers for many months.

All the *L*-strains also showed a diminished production of endotoxins. This effect is irreversible in the case of *B. typhi murium*, even after fifty passages on ordinary media; other members of the typhi-coli-dysenteriae group, however, recovered their endotoxicity.

BARUCH S. LEVIN.
LEO OLITSKI.

Department of Hygiene and Bacteriology,
Hebrew University,
Jerusalem.
Feb. 21.

¹ *O.R.*, 205, 1261 (1937).

Points from Foregoing Letters

FROM an observed asymmetry in the spatial distribution of the explosion fragments from uranium bombarded by fast neutrons, N. Feather concludes that less than 5×10^{-12} sec. must elapse between the capture of a neutron by the nucleus and the break-up of the system into two heavy fragments. Previously, more direct methods of investigation had indicated that this time must be less than 0.003 sec.

J. A. Crowther and H. Liebmann show that the electrophoretic mobility of egg albumin alternately decreases and increases when exposed to increasing doses of gamma-radiation.

The occurrence in certain circumstances of a beam of positive ions in high vacuum cathode ray tubes of a commercial type is described by J. Forman. It appears to be a secondary effect due to residual gas and causes damage to the fluorescent screen.

Patterns of the emission from fine metal points under autolectronic conditions can be identified, according to M. Benjamin and R. O. Jenkins, as corresponding to the main planes in the crystal lattice. The patterns obtained are made up of twinkling spots which are of possibly atomic dimensions. The technique described lends itself to the study of surface structure and surface contamination.

S. S. Bhatnagar finds that in borax glasses of manganese, the manganese ions in the decolorized variety have an experimental value of magnetic susceptibility equal to 268.3×10^{-6} , which compares well with the theoretical value of 269.3×10^{-6} for divalent manganese. The coloured variety shows a value intermediate between the divalent and trivalent manganese.

On the basis of magnetic and other evidence, K. S. Krishnan concludes that the octahedra of water molecules surrounding the cation in many of the salts of the iron and the rare earth groups, are asymmetric, the degree of asymmetry being determined by the electronic state of the cation in the centre; this arrangement persists in water solutions.

W. F. Duntun argues that the "comprehensive fundamental electrical formula" proposed by C. V. Drysdale, when applied to the calculation of electro-

magnetic forces, will sometimes give results that are inconsistent with Newton's laws of motion, and are very different from the results given by Maxwell's energy method of calculation. In reply, Drysdale points out that the force on a straight conductor depends upon the magnetic field induced by the whole of the remainder of the circuit, and that the proper application of the flux-cutting principle or of the Biot-Savart law gives the same value for the force as that given by the Maxwellian formula.

B. Lustig and H. K. Wachtel state that they have extracted with acetone a growth-stimulating hormone from the anterior lobe of the hypophysis and a growth-inhibiting hormone from the posterior lobe.

Measuring the ultra-violet absorption spectra of the cytoplasm in cells of the rye embryo, the *Allium* root-tip and the *Drosophila* imaginal disks, T. Caspersen and J. Schultz find the absorption band characteristic of the cyclic nitrogenous bases in the nucleic acids. These ultra-violet absorbing substances are present as pentose nucleotides in high concentrations in rapidly dividing tissues.

The enzyme effecting the reversible transfer of amino nitrogen from aspartic acid to different α -ketoacids has been prepared from animal and vegetable tissues by M. G. Kritsmann. The enzyme is associated with a thermostable co-enzyme.

C. G. Holmberg states that the very low iron content (0.02 per cent) in highly purified preparations of uricase makes it improbable that iron is a constituent of this enzyme.

Marrubium, which is the bitter principle of *Marrubium vulgare*, is an unsaturated lactone of the diterpene series, according to A. Robertson and his co-workers, having the empirical formula $C_{18}H_{22}O_4$ and containing a tertiary hydroxyl group and an oxide linking. A number of derivatives have been obtained, including agathaline, which is formed by dehydrogenation with selenium.

B. S. Levin and L. Olitski find that bacteria of the typhi-coli-dysenteriae group, which had been subjected to daily passages in lecithin bouillon, showed a markedly lower pathogenicity than controls grown in ordinary bouillon.

Research Items

Mangarevan Ethnology

THE RANGI HIBOA (Dr. Peter H. Buck) has recently reported on the results of his ethnological observations on the Mangarevan expedition organized by the Museum in 1934, when he spent seventy days on Mangareva (*Bull.* 157, Bernice P. Bishop Museum, Honolulu). The Mangareva (Gambier) Islands lie in latitude $20^{\circ} 20' S.$ and longitude $134^{\circ} 45' W.$, 900 miles from Tahiti, and 1,450 miles from Easter Island, the eastern extremity of Polynesia. The group consists of four islands, which are the unsubmerged peaks of extinct volcanoes, without permanent streams and with only a few springs. The population is much mixed, and only a few families of full-blooded Mangarevans remain. It is probable that at no time did the population exceed more than a few thousand. It was kept within food-producing capacity by emigrations resulting from inter-group struggles for cultivable land and cannibalism. Their speech is a dialect of Polynesian, resembling that of Cook Islands, Tuamotu, and New Zealand. The culture of Mangareva is fundamentally based on the early culture that prevailed in the Society Islands before dispersion took place to Hawaii in the north and New Zealand in the south. The earliest settlers evidently drifted in from the Tuamotus in small groups, bringing no cultivable food plants, and in insufficient numbers to establish an organized system of social classes. They were a simple fisher folk. Later immigrations about A.D. 1300, in the form of organized expeditions, brought food plants from some volcanic group such as the Marquesas, or the Society Islands. They introduced the worship of Tu, the mare, and a highly organized social system. The major gods of the Society Islands are present, and the form of worship and temple follow those of Central Polynesia. The pattern of social organization is orthodox Polynesian, while the material culture has an early Polynesian pattern. Mangarevan culture was thus an offshoot of Central Polynesian culture, which reached the islands by way of the Marquesas.

Propagation of Vaccinia in Chick Embryos

METHODS of cultivating viruses on the embryonic membranes of the developing chick within its egg-shell, which have been devised during the last few years, have been applied to the cultivation of the vaccinia virus, and Lieut.-Colonel W. D. H. Stevenson and Dr. G. G. Butler have recently reported upon their extensive studies of this subject (*Ministry of Health: Repts. on Pub. Health and Med. Subjects*, No. 87. London: H.M. Stationery Office. 4s. net). Glycerinated calf lymph, which is usually employed for vaccination, is prepared by inoculating the skin of calves, collecting the vaccinal material and mixing it, after grinding, with glycerin, water and a small amount of preservative. However carefully prepared, the material contains numbers of extraneous micro-organisms, which are reduced by treatment and storage to a number considered safe. The vaccinia grows well in the egg, and the material so obtained can be used for vaccination. Fertile hens' eggs are used; these are inoculated by a special technique, the eggs are opened on the fourth day of incubation, and the material is

then collected. By adopting certain precautions, it is possible to obtain a lymph free from the extraneous micro-organisms which are so troublesome in ordinary calf lymph. It is suggested that in the future chick membrane lymph may replace calf lymph. Full details of the technique are given in this report, which also contains a critical discussion of the whole subject.

Acetylcholine Formation in Tissues

B. B. DICKSHIT (*Quart. J. Exp. Physiol.*, 28, 243; 1938) studied the formation of acetylcholine in the different tissues of dogs by suspending the tissues in warm eserinized Locke's solution and oxygenating for five hours. The brain cortex, basal ganglia, spinal cord, sympathetic ganglia, auricle, urinary bladder, gastro-intestinal tract and pancreas were found to possess the property of forming acetylcholine. Although all parts of the gastro-intestinal tract could form acetylcholine, the largest quantities were formed by the small intestine in which the nerve plexuses are chiefly responsible. The writers suggest that acetylcholine formation is a specialized function of the nerve cells.

Birds of Nanking

IN the difficulties which beset China at present it is surprising and gratifying to find that publication of scientific papers seems to continue without break. An account of the passerine birds of Nanking and its vicinity has appeared as one of the contributions from the Biological Laboratory of the Science Society of China (*Zool. Series*, 12, No. 9, Shanghai, 1938). It is a guide to a passerine avifauna of 112 species and subspecies, amongst which the finches (with 22 forms) predominate, and the wrens, goldcrests and orioles are each represented by only one species. Analytical keys to the characters of families, species and subspecies, as well as many illustrations of distinctive head-markings, aid in identification. The author, L. T. Chong, has compiled the list from collections which have been accumulating in the museum of the Biological Laboratory since 1925, so that it is possible that additions may still have to be made; but to a Western reader it is remarkable that where so many Western species of birds are represented, there should be such a dearth of subspecies familiar in Great Britain.

Tomato 'Rogues'

GROWERS of tomatoes are often troubled by the appearance of abnormal plants or 'rogues', which are of dwarf habit, have extensive lateral shoot development, with unusual leaf shape, and give low yield. M. B. Crane, of the John Innes Horticultural Institute, has investigated the genetics of these aberrant tomatoes (*Gard. Chron.*, Feb. 11 and 18, 1939). Grafting experiments have shown that the rogue condition is not pathological, and it is probable that unstable genes, which could either determine normal, or mutate to form rogues, are present in the plants concerned. Rogue plants frequently develop normal growth, and it has been found that seeds harvested from trusses at various heights on such a plant, yield varying proportions of rogues. The more general question as to any effect of position of the truss

upon normal genes has been investigated by experiments on a cross between the varieties Kondine Red and Blaby. No differing proportions of characters in the offspring could, however, be associated with varying positions of the trusses in these normal conditions. The control of rogues would appear to be easy, if sufficient care be taken to eliminate abnormal plants during the first potting, and to save seed only from tomato plants which are fully normal.

Mosaic Disease of Cassava

A VIRUS disease which causes a mosaic-like mottling of the leaves of cassava (*Manihot utilisima*) has been known in East Africa since 1894, and there has been an increasing recognition of the serious nature of the disease. H. H. Storey and R. F. W. Nichols, of the East African Agricultural Research Station, Amani, have recently made detailed studies of the malady and its transmission (*Ann. App. Biol.*, 24, No. 4, 790-806; Nov. 1938). Symptoms exhibit wide variation, owing to varietal reactions of the host, and also to differences in strains of the virus. Two groups of strains have been recorded, one giving mild, and the other severe, symptoms. Cassava mosaic has not been transmitted to a healthy plant by mechanical means; but it can pass across a graft union, and has an insect vector, a species of *Bemisia*. The latter can only inoculate a plant through an immature leaf, a fact which should be useful in experiments upon movement of the virus. It has been found already that the virus does not pass out of the inoculated leaf until after eight days. It then moves quickly to the base of the stem, and slowly into the side branches. The presence of a mild strain of the virus does not confer any resistance against the more severe kind.

The Centromere

C. D. DARLINGTON (*J. Genetics*, 37, 341; 1939) finds in *Fritillaria kamschatkensis* that chromosomes lag on the first metaphase plate of meiosis due to failure of bivalent formation, and more frequently as the result of bivalents being crowded off the plate. In about 1,000 first anaphases, 109 lagging chromosomes were found. Of these laggards, 107 showed transverse divisions of the centromere. It is suggested that chromosomes with terminal attachments, chromosomes with similar ends as in the extra chromosome of secondary trisomics and attached X-chromosomes of *Drosophila* may result from this type of division of the centromere. The structure of the centromere is discussed.

Effect of Colchicine on Allium

A. LEVAN (*Hereditas*, 24, 471; 1938: 25, 9; 1939) has studied cytologically the effect of colchicine on mitosis and meiosis in *Allium*. In both types of cell-division the spindle apparatus is more or less put out of action. In mitosis the normal division at the attachment constrictions is considerably delayed. Consequently the two daughter chromosomes are held together, to be included in one nucleus. In meiosis, a similar delay of division occurs, chiasma formation and contraction are reduced, leading to an increased number of chromosomes in the daughter nuclei. In two further papers, by Levan (*Hereditas*, 25, 109; 1939), and J. Rasmussen and A. Levan (*Hereditas*, 25, 97; 1939), the practical aspects of colchicine treatment are pointed out. The proportion of tetraploid shoots from a treated diploid plant depends on the comparative viability of

diploid and tetraploid cells. Tetraploid shoots are much commoner in *Petunia* than in sugar beet for this reason.

Paper from Australian Timbers

A SHORT time ago, an arrangement was made by which the Division of Forest Products in Australia commenced to work in co-operation with the paper industry. The Division of Forest Products is under the Council for Scientific and Industrial Research, and the latter has just issued Pamphlet No. 86 under the title "A Study of the Pulping Properties of three Trees of *Eucalyptus sieberiana*, using the Sulphate Process". This species was selected because of its potential importance at the time the work was planned. The report was prepared by J. C. Cavanagh, H. E. Dadswell, A. W. Mackney, and Miss T. M. Reynolds, and acknowledgments are made to Australian Paper Manufacturers, Ltd., for their financial assistance during the period when the work was being done and prior to the association of other companies with the Division. Thanks are, it is said, also due to the company for the active assistance of its officers in carrying out the evaluations, etc., and also in discussing the problems as they arose. Three trees of *E. sieberiana* (silver-top ash), which is found in favourable quantity and size in the southern coastal districts of New South Wales, were investigated. The object of the work was to study the variability in the yield and the quality of the pulp that could be expected from different parts of one tree and from different trees. Samples of the 'truewood' and the 'heart' of the butt, centre, and top sections of the merchantable bole were accordingly tested. In general, it was found that satisfactory pulps could be obtained from all these samples. The investigation is said to have yielded valuable data, considering the small number of trees handled.

Densities of D₂O—H₂O Mixtures

LONGSWORTH, in 1937, found that at 25° mixtures of D₂O and H₂O are ideal from the point of view of volume changes on mixing. Since the publication of his paper, the density of pure heavy water has been found by Tronstad and Brun to be $d_{25}^{25} = 1.10750$ instead of 1.10790 found by Selwood, Taylor, Hipple and Bleakney and used by Longworth. More recently, Tronstad has given the value 1.10764. This necessitates a recalculation of Longworth's data. E. Swift (*J. Amer. Chem. Soc.*, 61, 198; 1939) has made experiments on the densities of mixtures of heavy water and ordinary water at 5° and 25°, and finds that from the point of view of density these mixtures form ideal solutions at both temperatures. The constants used in Longworth's equation were found to reproduce the results, the only change being that for the specific gravity of pure deuterium oxide. If ΔS is the density difference referred to pure protium oxide (taken as 15 p.p.m. lighter than tap water) then the mol fraction (N) of D₂O in a mixture at 25° is given by the equation $N = 9.257 \Delta S / (1 - 0.033 \Delta S)$.

Non-Stoichiometric Oxides of Chromium

IN addition to the well-known oxides CrO₃ and Cr₂O₃, a large number of oxides of chromium have been reported, including a dioxide CrO₂. A Cameron, E. H. Harbard and A. King (*J. Chem. Soc.*, 55; 1939) have now shown that CrO₂ decomposes thermally in two stages with the formation of two non-stoichiometric oxide ranges: (a) CrO_{1.4}—CrO_{1.1},

and (b) $\text{CrO}_{1.7}\text{--CrO}_{1.8}$. Many oxides previously reported lie in one or other of these ranges. The methods claimed to give the dioxide were examined and it was shown that (i) the product of low temperature decomposition of ammonium dichromate contains nitrogen; (ii) the oxide formed by heating CrO_3 in oxygen is in the non-stoichiometric range (a); (iii) the oxide formed by the action of CrO_3 on chromic hydroxide lies in range (b). The recent work of Moles and González which claimed to have substantiated the individuality of chromium dioxide is thus, apparently, invalid.

Recording Sound by means of Films

SOUND-FILM recording is now a large and important industry. Even in the earliest days of cinematography attempts were made to develop sound-recording on metal and photographic films, but it was not until practical forms of thermionic amplifiers were developed that recording became of more than scientific interest. On February 20 Mr. D. W. Boston read to the London Students' Section of the Institution of Electrical Engineers a paper on the art of sound-film recording. To record sound on film the main requirements are a lightproof box provided with means for driving the film at constant speed and some means of producing a beam of light, so that it falls on the face of the film, and which can be modulated at audio-frequency. As the film runs past the beam of light it produces a trace which when developed appears as a band the width and darkness of which varies according to the method of light modulation employed. This trace is known as the 'sound-track' and depends on the shape of the oscillogram of the recorded sound wave. The lightproof box and associated apparatus is called a 'sound camera'. For reproduction the film speed must be the same as when recording. A beam of light similar to that used in recording, but unmodulated, falls on the sound track and the light passing through the film is modulated by the recorded wave form. The light now falls on photo-electric cells giving rise to audio-frequency currents which can be amplified and fed to loud-speakers. Sound tracks are of two types, variable density and variable area. The first of these types is produced by a light beam of constant width but variable density. A light beam modulated in this way is produced by a glow lamp with a suitable current passing through it. As a rule this method gives insufficient light, so now some form of mechanical light valve is used. If the sound-track of the reproducer is opaque, there is very little background noise, but if it is clear, noise will arise due to dirt, grain and scratches interrupting the light. Recent developments in sound recording are mainly due to methods of getting rid of this noise.

The Metadyne in Electric Traction

THE 'metadyne' is a new form of electric machine utilizing the principles on which both the dynamo and the motor work. The currents in some of the windings of the armature tend to produce rotation in one direction and the currents in others tend to produce rotation in the opposite direction, the object in view being to get rapid acceleration when starting and rapid retardation when stopping. The great advantage of the metadyne is that when going at speed it can be pulled up rapidly by utilizing some of its own kinetic energy of motion without drawing on electric power from the electric supply line as,

for example, when a mechanical brake is applied. Used in traction when trains are frequently starting and stopping, this leads to a considerable economy in the cost of the power expended. The metadyne was invented a few years ago, and developed in a number of devices applicable in practice for various purposes by J. M. Pestarini, now of the University of Turin. In a paper read to the Institution of Electrical Engineers on February 23 by G. H. Fletcher and A. Tustin, its application to electric traction on suburban railways was specially considered. After preliminary experiments, the London Passenger Transport Board placed an order for fifty-eight metadyne equipments with Metro-Vickers, all of which are now in constant service. It was found that at 3 m.p.h. per second (average) the speed was too high to permit of full braking being obtained on the 'motored' axles as the limit of adhesion of the wheels was exceeded. It was found necessary to apply air-brakes to the 'non-motored' axles at the same time as 'regeneration' was applied to the motored axles. During normal braking, approximately two thirds of the total braking effort is applied through regeneration and one third by air brakes. The metadyne principle was first applied to the Diesel electric shunting engines on the Paris-Orléans line and was most successful.

Corrosion of Underground Cables

MODERN telephone systems utilize extensive networks of bare lead-sheathed cables drawn into earthenware conduits, and although lead is one of the least corrodible of metals, as witnessed by the fact that many lead roofs exist which are five centuries old, and that the Romans employed lead water pipes some of which are said to be in use to-day, yet the replacement of corroded telephone cables costs the Post Office £50,000 per annum. In a paper read to the Institution of Electrical Engineers on March 8 by W. G. Radley and C. E. Richards, of the Post Office Engineering Research Station, it is stated that laboratory examination of samples of corroded sheathing, together with chemical analysis of the corrosion products and soil waters enable definite conclusions to be reached as to whether there has been electrolytic stimulation by stray currents or not. Useful information has been obtained from apparatus recording the sheath current at two points a short distance apart and accurate determination of the small potential difference existing between a sheath and its immediate surroundings. Localities exist, chiefly in certain provincial cities, where corrosion due to tramway stray currents is very rapid. There are also areas in rural districts, chiefly in south-east England, where the soil water is so rapidly corrosive to lead that it is now the normal practice to install these cables with some form of protective covering. The non-metallic cable sheath which has been discussed for a number of years does not yet seem to be within the realms of early possibility. Advantages are to be gained from the liberal application of a suitable cable lubricant. Considerable increase in the life of Post Office cables subjected to chemical corrosion has resulted from the addition of a silicate inhibitor to the petroleum jelly used as a lubricant. The success that has been attained has in nearly every case been due to the formation of a local 'electrolysis committee' for considering all the underground services—gas, water, electric light, telephones, etc., within the area.

The Enzyme System of Trans-Amination, its Mode of Action and Biological Significance

By Prof. A. E. Braunstein, The A. M. Gorky All-Union Institute of Experimental Medicine, Moscow

THE reversible transfer of amino groups between aminodicarboxylic acids and α -ketoacids, or 'trans-amination', reported in a series of papers by me and my associates¹, is of almost universal occurrence in biological objects. It is readily effected by most animal tissues², and also, as shown in this laboratory³ and independently by Virtanen⁴ and Euler *et al.*⁵, by vegetable tissues and micro-organisms. Trans-amination is effected by a special group of intracellular enzymes, for which the name *aminopherases* is suggested (in preference to the clumsy although more precise term aminotransportases). As trans-amination involves intermolecular oxidoreduction, the aminopherases should be classed among the deamolases. They differ in mode of action and in many properties from the formerly known enzymes of amino acid metabolism, including the *L*- and *D*-deaminases and specific glutamic and aspartic dehydrogenases.

The process of trans-amination can only take place with the participation of a dicarboxylic α -amino or α -ketoacid, functioning either as a stoichiometrical reaction partner (donator or acceptor of amino groups) or as a catalyst, or intermediate carrier of amino nitrogen, rendering possible the enzymatic shift of NH_2 -groups from amino- to ketomonicarboxylic acids. In the latter case, that is, in the presence of low concentrations of the dicarboxylic carriers, trans-amination is competitively inhibited by saturated dicarboxylic acids (oxalic, malonic, glutaric, adipic acid)⁶. All experimental data point to the special role in trans-amination of the two acidic groups in the dicarboxylic acid molecule. However, it is the peculiar electrostatic configuration, or polarity, of such a molecule, rather than the particular behaviour due to the presence of two carboxyl groups, that determines the availability of the substrate molecule for trans-amination. This is evidenced by the fact that α -amino acids similar in electrostatic structure to aspartic or glutamic acid but bearing, instead of the second carboxyl group, some other acidic substituent group (for example, phosphoserine, cysteic acid⁷ and homocysteic acid⁸), are adequate substrates for trans-amination, like the aminodicarboxylic acids. The formation of aminopherase-substrate symplexes evidently depends upon affinity of the enzyme to the two electronegative acidic groups of the substrate—most likely, due to the presence in the enzyme molecule of two electropositive basic groups forming a 'haptophoric' centre. Hence the inhibitory effect of simple dicarboxylic acids, displacing the amino- or ketodicarboxylic acids from the haptophoric centre. It follows that the substrates of trans-amination belong to two different types, namely:

(a) 'Primary' or 'active' substrates—those exhibiting direct affinity to the enzyme and capable of reacting with mono- or dicarboxylic partners alike. This type includes the natural amino- and ketodicarboxylic

acids (and some related acids, like mesoxalic, oxyoxosuccinic and α -ketoadipic acid⁹), as well as other dibasic acids such as phosphoserine, cysteic and homocysteic acid.

(b) 'Secondary' or 'passive' substrates—all monocarboxylic α -amino and α -ketoacids lacking direct affinity to the aminopherases and trans-aminated only as partners of the primary dicarboxylic substrates or with their intermediation in the case of catalysed trans-amination. The availability of secondary substrates depends upon the presence of a keto or free amino group in the α -position to a free carboxyl. β - or γ -amino or ketoacids, simple amines, aldehydes, ketones or hydroxyketones are inadequate; di- and tripeptides are not trans-aminated unless hydrolysed by contaminating peptidases.

There exist several aminopherases differing in specificity with respect to primary substrates. Two such individual enzymes have been obtained in cell-free solution, and purified to some extent, in this laboratory by Mrs. M. Kritzmann¹. One of these enzymes catalyses the shift of amino nitrogen from glutamic or to ketoglutaric acid; the other—more readily extractable from tissues and more labile—effects trans-aminations involving aspartic, resp. oxaloacetic acid. We propose the names *glutamic aminopherase* and *aspartic aminopherase* for the respective enzymes. (Preliminary experimental data indicate that our enzyme preparations react with some further primary substrates besides their natural ones: thus, glutamic aminopherase transfers amino nitrogen to mesoxalic and α -ketoadipic acid, whereas the specificity of the aspartic enzyme extends only to oxyoxosuccinic acid; phosphoserine, cysteic and homocysteic acid, while adequate as primary substrates in experiments with muscle pulp, are only secondary substrates for purified preparations of both aminopherases¹⁰). The aminopherases are optically selective: only the natural *L*-forms of the amino acids act as NH_2 -donators with aminopherase solutions, and the amino acids formed as reaction products also belong to the *L*-series (in whole muscle pulp a slight transformation of *D*-amino acids has been observed in some cases, but evidence on this point is not conclusive)¹¹.

The presence of aminopherases in most types of living cells suggests that they play an important part in nitrogenous metabolism, especially in the many tissues devoid of the enzymes required for direct formation and breakdown of aminomonicarboxylic acids (for example, muscle, brain, plant tissues). Several enzyme systems of wide distribution in various living tissues are known at the present, specifically and reversibly catalysing the synthesis and deamination of aminodicarboxylic acids (aspartases I and II, Virtanen's oxaloacetic oxime system⁴, glutamic and aspartic dehydrogenases). In association with such enzyme systems the aminopherases provide an adequate mechanism for the synthesis and

deamination of all amino acids in tissues containing no universal amino-oxhydrases. Ever since the first publications on trans-amination, I have pointed out the possible role of trans-amination in the synthesis of aminoacids in vegetable organisms, where the aminodicarboxylic acids apparently belong to the first organic products of nitrogen assimilation³. Recently, Virtanen⁴ and Euler, Adler *et al.*⁵ have reported experimental evidence supporting, though not conclusively proving, the role of the trans-amination mechanism in amino acid synthesis.

We wish to point out that the properties of *l*-deaminase (Krebs, Bernheim) indicate the complex nature of this enzyme and suggest that oxidative deamination of the *l*-amino acids is also probably due to the co-operation of aminopherases, glutamic or aspartic dehydrogenase and catalytic amounts of the respective dicarboxylic acids. Experimental verification of this hypothesis is in progress. If such be the case, it would follow that the dicarboxylic amino- and α -ketoacids function as intermediate carriers not only in the interconversion of amino acids by trans-amination, but also in their synthesis

from ammonia and deamination, thus forming a transition channel between mineral and organic nitrogen.

Summary.—The results of recent investigations concerning the transfer of amino-groups between amino- and ketoacids are discussed. These investigations led to the discovery of a new group of intracellular enzymes, termed aminopherases. A survey is given of the range of specificity and mode of action of these enzymes. The biological significance of the aminopherases and of the dicarboxylic amino- and ketoacids is discussed with a view to their probable role as key substances in the biological formation and breakdown of amino acids.

¹ Braumstein, A. B., Kritsmann, M. G., *Biozymologia*, **2**, 129 (1937). *Biokhimiya* (Moscow), **2**, 242, 860 (1937); **3**, 590, 693 (1938); **4**, No. 2 (1939).

² Kritsmann, M., *Biozymologia*, **5**, 44 (1938). *Biokhimiya*, **3**, 28 (1938).

³ Virtanen and Laine, *NATURE*, **141**, 748 (1938).

⁴ Euler, H., Adler, H., *et al.*, *Z. physiol. Chem.*, **254**, 61; **255**, 14, 27.

⁵ Braumstein, A. B., (unpublished data).

⁶ Bychkov, S. M., *Biokhimiya* (1939, in the Press).

⁷ Kritsmann, M. G., *O.R. (Doklady) Acad. Sci. U.R.S.S.*, **91**, 42 (1938). *NATURE* (this issue, p. 603).

⁸ *Biokhimiya*, **2**, 257 (1937).

The Atmosphere as a Raw Material*

IN the middle of the seventeenth century, the phlogiston theory was generally accepted. Scientific study of the atmosphere only began in the last quarter of that century, and within fifty years of Stahl's formulation of the theory, it had been displaced, and oxygen had been recognized, isolated and identified. In little more than a century, the composition of air was known to 1 per cent, and not very long afterwards, Ramsay completed the story with his discovery of the inert constituents. At the present time, gases which are only present to the extent of one drop in 130 gallons are articles of everyday commerce.

Although use is now being made of the atmosphere as a raw material of industry, our demands are as yet quite unlikely to affect the stock appreciably. England and Scotland have twenty or more factories taking the oxygen from 20 million cubic feet daily, but this large amount ceases to seem dangerous when we remember that the population of those countries uses 600 million cubic feet daily in the ordinary course of respiration; animals add their demands to this figure, and the total is again vastly increased by the supply required for the daily combustion of wood, coal and petrol. The case is in marked contrast to that of coal. Mankind is continuously oxidizing carbon, and yet rapidly diminishing the amount of the only agent—vegetation—that can renew his exhalations to a useful atmosphere. The energy from sunlight received in a growing season by an acre of land is equivalent to that obtained by the combustion of 245 tons of anthracite. If 25 bushels of corn are reaped from the acre, they return energy equivalent to only 0.3 tons of anthracite. Nor is the prospect from water power very favourable. It is estimated that the hydro-electric power available

from the whole rainfall of America is about equal to the present power production from coal.

So far as the production of carbon dioxide by human beings is concerned, it is interesting to calculate that a man exhales about 3 lb. per day; a eucalyptus tree of the mountain ash type, 200 feet high and weighing 24 tons, is capable of breaking down about one third of this amount and returning the oxygen to the atmosphere. It is clear therefore that the tendency to replace vegetation of this type by buildings, or even by cereal crops, carries with it a potential danger to the oxygen supply.

It was about the year 1885 that man began to abstract oxygen from the air for its own sake, when the barium oxide process was first used commercially. At first, much of the oxygen was used for therapy, and for the limelight. Now that this is replaced by electric light, about 98 per cent of the oxygen prepared is used in engineering, either for metallurgical, fabricating, or cutting purposes. Of course, the oxygen is no longer extracted by chemical processes, but by liquefaction and subsequent rectification, in plants that can make 4,000 gallons an hour for days on end. The fractional distillation of liquid air depends for its success on the heat exchange tray devised by Kuhni, and known as a 'foam plate'. In it, a disk is built up in a true spiral, with about 10,000 holes to the square inch.

Turning now to the inert gases, argon is present to the extent of about 1 per cent, but was only detected in 1894 by Ramsay and Rayleigh. It is now separated directly in a state of comparative purity from commercial oxygen distilling apparatus. At the present time, about 10 million cubic feet are used annually to fill the 1,000 million electric lamps produced in the same time. Neon exists only to the extent of 1 part in 55,000, but its characteristic spectrum has led to the use of thousands of litres annually in 'neon lights' so widely used in advertising signs.

*Substance of the presidential address delivered to Section B (Chemistry) of the Australian and New Zealand Association for the Advancement of Science, by Russell Grimwade, O.B.E., on January 12, 1939.

Helium, present to the extent of one part in 245,000, or 50 tons in the atmosphere above each square mile of the earth's surface, is the lightest unflammable gas, and is thus of especial use in lighter-than-air craft. For this purpose it is collected from the gases of certain bore-holes in the United States, where it is present to the extent of 1-2 per cent. It is of particular value medically in that an artificial atmosphere of helium and oxygen can prevent Caisson disease or 'the bends', a malady, due to the solubility of nitrogen in human blood serum, to which divers and others working under increased pressure are subject. Krypton, occurring only to the extent of 1 part in a million, and xenon, only one tenth as abundant, are not used very extensively as yet, but the fact that they increase the efficiency of an electric lamp filament by 10 and 20 per cent respectively, suggests that they will eventually be in common use.

The remaining constituent of the atmosphere, nitrogen, constitutes 81 per cent of its volume. From about 1830, nitrogen was chiefly obtained from the caliche deposits in Chile, and the rate of extraction was so fast that in 1898 Crookes predicted a world famine in nitrogen, and therefore in agricultural products, at no very distant date. Within a very

few years, the situation was changed by the establishment of the first plant for the production of nitric acid from atmospheric nitrogen. That first process, depending on the electric arc, has now been superseded, first by the cyanamide process, and then by the Haber process, in which the immediate product is ammonia, instead of oxides of nitrogen. It is of interest to note that the arc process, with the production of oxides, is the one used by Nature herself as the main agency for restoring nitrogen to the earth's surface for agricultural needs; her arc is the lightning flash. In 1937 there were 145 plants operating on the Haber process, producing nearly 4 million tons of fixed nitrogen, an amount which, though large in itself, is only the amount to be found above 1/5 square mile of the earth's surface. In any event, the nitrogen withdrawn from the air almost all ultimately finds its way back again, through the agency of living matter.

From the consideration of these matters, we are eventually reminded that the balance of Nature is the only basis of man's existence. It will demand control over vegetation which has been lacking ever since the inception of the industrial period, and it is to chemists that the world should look for a lead.

Factor Analysis in Psychology

AT the general meeting of the British Psychological Society, held this year at the University of Reading, a symposium on factor analysis attracted on April 1 the largest number of members present for several years at any meeting of the Society.

Opening the symposium, Prof. Godfrey Thomson said that many sets of factors are mathematically available, and principles have to be adopted for deciding between them. These have included: (1) the universal desire to use few common factors; (2) reproducing the whole variance; (3) reproducing the correlations; (4) insistence on a general factor; (5) rotating to psychological significance; (6) requiring 'simple structure'; (7) requiring invariance of analysis; (8) requiring reciprocity of persons and tests. The second loses least information, but conflicts with (5) and (7). The third principle is used by both the Spearman and Thurstone schools; the former proceeds step by step, the latter by a simultaneous analysis. The Spearman school safeguards psychological significance at each step, and insists on a general factor. The Thurstone plan rotates the factors into 'simple structure' and holds that psychological significance will ensue. 'Simple structure' seems to rule out a general factor, and Thurstone finds no g in Spearman's own g -tests. Both methods result in large specific factors, and have more factors than tests, so that the factors cannot be accurately estimated. The last principle (8) is put forward by Burt, who analyses covariances. His reciprocity is only obtained, however, after removal of a factor composed of the average.

Prof. Spearman's paper, read by Mr. Maxwell Garnett, directed attention to the disappearance of the general factor in Thurstone's 'Primary Mental Abilities'. A set of correlations, he said, can be factorized in many ways, the choice being regulated

by statistical simplicity and psychological interest. The theory of two factors uses a method which draws all the correlations from one factor. Statistically simple, it affords psychologically the basis for the concepts of general ability. Hotelling, Kelley and Burt, in securing that the weights of factors are heaped up in order of calculation, generate negative loadings which contradict experience. Alexander and Thurstone, in rejecting negative loadings, decrease without eliminating the indeterminateness. Thurstone in addition maximizes the number of zeros. It is this which banishes the general factor, for weights which fall below a certain minimum are ascribed to error and counted as zero. Moreover the number of Thurstone's factors creates suspicion.

Correlations alone fail to determine factors completely: other grounds are needed. In the special case of one single factor we have the cogent ground of parsimony; in all other cases to find adequate grounds is difficult.

Prof. Burt emphasized that the components obtained by factorizing a correlation table describe an analysis of the relations between minds and their environments. Whether a factor has meaning depends on the appropriateness of the experimental design as much as on the validity of the analysis. Factor analysis should, if possible, be based on covariances rather than on correlations. Variance varies objectively, and depends primarily on the complexity of the process measured. When the errors are sufficiently small, all analyses reveal a series of factors whose contributory variances are roughly 50, 12, 5 . . . per cent of the total. This may be explained by regarding factor analysis as a process of successive averaging. Concerning the 'sampling theory', he said that an effective test integrates a wide variety rather than samples a large number of co-ordinations.

Accepting Prof. Thomson's equation, it can be shown that the sum of the test-measurements operates as the general factor in his hierarchies. If we assume that intelligence depends on the number and systematic arrangement of the unorganized synapses of cortical neurones, this interpretation appears equally plausible from a physiological point of view. He reiterated his belief in the reciprocity principle and his opinion that the bipolar factors obtained by correlating tests and persons respectively are essentially identical.

Dr. W. Stephenson said that Prof. Thomson would appear to take tests for granted and to seek to identify the qualities of persons tested with selected factor axes. It seemed to him that tests should have something to say about the axes to be selected, and that we should define axes at the outset on psychological grounds. Mathematical theorems would then be used to see whether these axes are consistent with facts.

There is a great deal of equivocality in the use of the word 'ability' in factor analysis, and he proposed a definition which relates abilities to what he called *non-fractional* factors for cognitive activity, a *non-fractional* factor being a kind of compound of the 'fractional' factors usually discussed.

A general discussion followed the papers. In summing up, Prof. Godfrey Thomson said that as Thurstone was not present he thought he ought to say something on behalf of the idea of 'simple structure'. Recently he had heard Prof. P. A. M. Dirac support the thesis that when he found a hypothesis or solution of great mathematical beauty he could have considerable confidence that it would correspond to something real in physical Nature. Something of the same sort, Prof. Thomson imagined, was behind Thurstone's faith in 'simple structure'.

On the other hand he felt that Prof. Spearman would have been justified in putting up a more fundamental defence of g than he had. For the blemishes criticized in Thurstone's work could be removed by care, and Thurstone might still attain 'simple structure' in chosen batteries. The real defence of g was surely that it had proved to be useful.

University Events

ABERDEEN.—On March 29, the honorary degree of LL.D. was conferred on the following among others: Prof. J. Gray, professor of zoology in the University of Cambridge; Dr. J. McIntosh, director of the Bland-Sutton Institute of Pathology, Middlesex Hospital.

The ordinary degree of D.Sc. was conferred on Dr. J. S. McPetrie for a thesis entitled "Studies in the Production and Propagation of Radio Waves".

CAMBRIDGE.—Dr. O. M. Solandt, of Trinity Hall, has been appointed University lecturer in mammalian physiology.

N. B. Slater, of Gonville and Caius College, has been appointed second junior observer at the Solar Physics Observatory.

Sir Edward Mellanby, of Emmanuel College, secretary of the Medical Research Council, will deliver the Rede Lecture at 5 p.m. on April 28, the subject of which will be "Some Social and Economic Implications of the Recent Advances in Medical Science".

Science News a Century Ago

The Royal Society

At a meeting of the Royal Society on April 11, 1839, James Finlay Weir-Johnston (1798-1855), the agricultural chemist, read a paper "On a New Equi-atomic Compound of Bicyanide with Bin oxide of Mercury". In the paper he gave an account of the properties of "a salt, obtained by agitating, with red oxide of mercury, a small portion of hydrocyanic acid, and which he found to be distinguished from the bicyanide of mercury by its sparing solubility in cold water, by the alkaline reaction exhibited by its solution (a property which indicates an excess of mercury) and by its susceptibility of detonation by heat, depending on this excess being in the state of an oxide and on the carbon of the cyanogen it contains, and the presence of which is shown by the disengagement of hydrochloric acid gas when acted on by hydrosulphuric and hydrochloric acid".

At the same meeting Felix Savart (1791-1841), the successor of Ampère at the Collège de France, Macedoine Melloni (1798-1854) the Italian physicist, and Lambert Adolphe Jacques Quételet (1796-1874), the Belgian astronomer and statistician, were elected foreign members.

Lacaille's Astronomical Observations at the Cape

On April 12, 1839, the concluding part of Thomas Maclear's paper "On the Position of Lacaille's Stations at the Cape of Good Hope" was read. The lapse of 85 years since Lacaille's visit had obliterated all local evidence of the French astronomer's operations, and the fact that he had been there at all was only kept alive by the inquiries of Captain Everest in 1821. Having by inquiries found the house Lacaille resided in, Maclear measured the position of the house relative to the Royal Observatory by triangulation. He then proceeded to discover the exact site of Lacaille's northern station at Klyp-Fonteyn. With the assistance of a party from the Royal Engineers he made excavations of various ruins and so unearthed the foundation of the granary used by Lacaille.

Geology in Russia

"Some idea of the activity of the Russians in pursuit of science, but especially that of geology," said the *Athenaeum* of April 12, 1839, may be gathered from the following statements. "The Inspector in Chief of Mines, the Count Cancrini, has for several years obtained his Imperial Majesty's permission to make geological and mineralogical researches in various parts of the vast empire, and a scientific committee has been established to superintend the publication of a work entitled 'Annals of the Russian Mines'. M. Parrot, Professor at the University of Dorpat, was ordered by the Russian government to explore Armenia and Transcaucasia. . . . M. Kupffer has determined the height of the Elbrous, the culminating point of the Caucasian chain, and is at this moment making meteorological and magnetic observations throughout the Empire. Baron de Humboldt and M. Rose have traversed the northern mountains, M. de Pasch has described the chalk formations in the south of Poland, M. Pander those of the neighbourhood of St. Petersburg. . . . M. de Semanoff, principal engineer of mines, has described the geological formation of the northern part of the Altai Mountains."

Societies and Academies

London

Royal Society (*Proc.*, A, 170, 1-144; 1939).

I. LANGMUIR: Molecular layers. (Pilgrim Trust Lecture).

T. SVEDBERG and others: The protein molecule (Discussion).

W. E. GARNER and A. J. HAM: Combustion of methane.

E. E. SOHNLEDER, C. F. GOODRICH and R. J. LYTHGOM: Spectral variation of the photosensitivity of visual purple.

W. G. PENNY and G. J. KYNCH: Magnetic susceptibility and related properties of rare-earth crystals.

J. J. BICKERMAN: Formation and structure of multilayers.

Paris

Academy of Sciences (*C.R.*, 208, 685-776, March 6, 1939).

E. ESCLANGON: Dynamometric forces and field forces.

H. VINCENT: Pathogenic characteristics of the micro-organisms of gas gangrene; fundamental principles of anti-gangrene serotherapy.

C. BENDICKS: Remarks on the generation of parallelopipeds of n dimensions.

S. BERGMANN: Approximation of functions satisfying a linear equation with partial derivatives.

F. ROGER: A classification of extremals.

E. HALPHEN: Convergence of estimations.

G. PÓLYA: Integral interrupted series which are not extensible.

G. VALIRON: Riemann surfaces defined by certain integral functions.

M. ZORN: Abstract theory of analytical functions.

H. CARTAN: Solution of Carleman's problem for a closed finite integral.

J. DUFRÉNOY: Meromorphic functions in an angle.

A. OUDART: Problem of wakes; validity of solutions.

J. K. DE FÉRET: Spectrum of homogeneous turbulence.

M. LUNTZ: Isotropy of turbulent movements and the distribution of energy between translation and rotation.

L. SACHMANN: Singularities in the study of a model wing.

H. FARR: Gaps in the asteroid ring considered as resonance phenomena.

H. MINCHY: An anomaly of the solar period. 1923-33. This period showed 5-6 years of increasing activity followed by 4-5 years of decreasing activity; generally the period of decrease is greater. (The same phenomena occurred in 1723-33 and 1823-33, confirming the author's previous suggestion of a 100-year cycle of 9 periods of 11.1 years.)

J. LAGRULA: New measurements of the intensity of gravity in the Departments of Algiers and Constantine.

F. CARBENAY: High-frequency telephony along triphase power transport lines.

G. FOIX: Constant paramagnetism of tetravalent cerium and of other ions having the same number of electrons as the rare gases.

P. LAMBERT and J. LECOMTE: Absorption of acrolein in the infra-red spectrum.

C. MAGNAN: Disruption of the nuclei of elements lighter than uranium, under neutron bombardment. Positive effects were obtained with gold, tungsten and titanium.

J. THIBAUD and A. MOUSSA: Disruption of uranium nuclei under the action of neutrons, and the liberation of energy which results. Chemical separations suggest that an isotope of bromine is formed.

A. BOUTARIC and Mlle. S. THÉVENET: Viscosity of arsenic sulphide sols and Einstein's formula.

W. S. REICH: Separation of oces by chromatography of their coloured esters.

E. DARMOIS, Y. DOUCET and Mlle. M. MURGIER: Cryoscopy of molybdic acid in aqueous solution.

G. DÉJARDIN: Red bands of cyanogen in the spectrum of the night sky.

R. GRANDMONTAGNE: Remarks on the variation of colour of the night sky. During 1938, radiation at the beginning of the red, 5850-6800 Å., was particularly weak from March to August.

S. MAELOUM: Analysis of the components of the Euphrates in Syria.

J. BOURCART: Origin of the silts of the maritime Seine.

B. RAJČEVIĆ: Salinity of the waters of the Seine between Amfreville and Honfleur.

C. FRANÇOIS-BOUF: Variations of salinity, during a day in September, of the waters of the maritime Aulne at Trégarvan.

R. LAMT: Conditions of illumination of some algae living in the grottoes and littoral defiles of the Falkland Islands.

L. GAILLEN: Hypophysectomy and the sexual cycle of *Rana temporaria* L.

P. MINIER and C. BLANCPAIN: Quantitative determination of the antineuritic vitamin in natural media; new technique.

P. BOQUET: The role of copper in the attenuation of viper venom (*Vipera aspis*) by hydrogen peroxide.

Mlle. R. SCHOEN: Transmission of the Nicolas and Favre malady by nasal instillation in the white mouse.

A. STAUB: Vaccination against swine fever.

Dublin

Royal Dublin Society, February 21.

A. G. G. LEONARD and BRIDGET McVERRY: Atmospheric pollution in Dublin during the year 1938. Measurements of atmospheric pollution including suspended impurity and estimations of sulphur dioxide have been carried out continuously near the centre of Dublin for the year 1938, and are compared with records published for English cities for 1937.

O. ROBERTS and S. A. STYLES: An apparent connexion between the presence of colloids and the osmotic pressures in conifer leaves. There is good agreement between the osmotic pressures of conifer leaves as determined by the plasmolytic and cryoscopic methods when the leaves in question are colloid-free. In conifer leaves which contain mucilaginous colloids and have slimy or viscous saps, there is a wide disparity between the results by the two methods. The cryoscopic results agree with the others in the literature, but the plasmolytic osmotic pressures are always very much higher.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

HEAD OF THE ENGINEERING DEPARTMENT, Luton Technical College—The Principal (April 15).

PRINCIPAL of the Bengal Engineering College, Shibpur, Calcutta—The High Commissioner for India, India House, Aldwych, London, W.C.2 (April 17).

LECTURER IN PHYSICS in the Battersea Polytechnic, London, S.W.11—The Principal (April 21).

JUNIOR SCIENTIFIC OFFICERS in the Electricity, Metrology, Engineering and Aerodynamics Departments of the National Physical Laboratory, Teddington, Middlesex—The Director (April 24).

LECTURER IN THE HYGIENE AND PUBLIC HEALTH DEPARTMENT of the Battersea Polytechnic, London, S.W.11—The Principal (April 29).

PRINCIPAL of the Beaufort Institute, S.B.11—The Education Officer (T.I.), County Hall, S.B.1 (May 1).

ASSISTANT DEMONSTRATOR IN PHYSICS (Woman) in the Royal Holloway College, Englefield Green, Surrey—The Principal (May 1).

JUNIOR RESEARCH PHYSICIST for the National Research Council of Canada, Ottawa—The Secretary-Treasurer (May 15).

UNIVERSITY READER IN MECHANICAL ENGINEERING in the Imperial College of Science and Technology—The Academic Registrar, University of London, Senate House, W.C.1 (May 17).

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Reports of the Progress of Applied Chemistry. Issued by the Society of Chemical Industry. Vol. 23, 1938. Pp. 861. (London: Society of Chemical Industry.) 7s. 6d.; to non-Members, 12s. 6d. [103]

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1835 (3064): Aircraft Blade Vibration. By J. Morris. Pp. 80. 4s. net. No. 1836 (3453): Elevator-fuselage flutter. By G. A. Naylor. Pp. 8. 1s. 3d. net. No. 1838 (3140 and 3363): The Calculation of the Profile Drag of Aerofoils. By H. B. Squire and A. D. Young. Pp. 27. 4s. net. No. 1841 (3803): Hydraulic Operator for Remote Balance Control. By Dr. A. B. Halliday and O. H. Burge. Pp. 4+1 plate. 1s. net. (London: H.M. Stationery Office.) [103]

Imperial College of Science and Technology: Department of Chemical Technology. Report, 1937-1938. Pp. 24+4 plates. (London: Imperial College of Science.) [113]

Ministry of Health. Report of the Committee of Inquiry into the Anti-Tuberculosis Service in Wales and Monmouthshire. Pp. 201. (London: H.M. Stationery Office.) 4s. 6d. net. [113]

Philosophical Transactions of the Royal Society of London. Series A: Mathematical and Physical Sciences. No. 784, Vol. 237: Electromagnetic Induction in Non-uniform Conductors, and the Determination of the Conductivity of the Earth from Terrestrial Magnetic Variations. By B. N. Lahiri and A. T. Prue. Pp. 509-540. 4s. No. 785, Vol. 237: The Accurate Analysis of Gaseous Mixtures. By B. Lambert and D. J. Burgess. Pp. 541-560. 8s. 6d. No. 786, Vol. 238: The Refraction and Dispersion of Air for the Visible Spectrum. By H. Barrell and J. H. Seares, Jr. Pp. 1-64. 8s. No. 787, Vol. 238: An Absolute Determination of the Acceleration due to Gravity. By J. B. Clark. Pp. 65-124. 7s. (London: Cambridge University Press.) [133]

Department of Scientific and Industrial Research. Methods for the Detection of Toxic Gases in Industry. Leaflet No. 5: Nitrous Fumes. Pp. iv+9. (London: H.M. Stationery Office.) 3d. net. [133]

Bacon Development Board. Bulletin No. 4: Selected Abstracts on Pig Production, 1938. Pp. 59. (London: Bacon Development Board.) 2s. 6d. [153]

Ministry of Health. Report on the Work of the Central Midwives Board for the Year ended 31st March 1938. Pp. 20. (London: H.M. Stationery Office.) 4d. net. [153]

Hull Museum Publications. No. 199: Early Lighting Appliances. By T. Sheppard. Pp. 16. No. 200: Catalogue of the Railway Museum (Paragon Station, Hull). By T. Sheppard. Pp. 32. 2d. No. 201: Hull Museums and Advertising. By T. Sheppard. Pp. 12. (Hull: Hull Museum.) [173]

Bacon Development Board. Bulletin No. 2: Substitutes for Cereals in Pig-Keeping. Revised edition. Pp. 70. (London: Bacon Development Board.) 2s. 6d. [173]

Department of Scientific and Industrial Research: Forest Products Research. Bulletin No. 14: Moisture Content Determination. By R. A. G. Knight. Second edition. Pp. iv+22+2 plates. (London: H.M. Stationery Office.) 9d. net. [203]

Other Countries

Foudat I University. Bulletin of the Faculty of Science, No. 18: Binding of Water in relation to Drought Resistance, by Dr. Ahmed Mohamed Mighid; Two New Cyanophytes from the Red Sea, by Prof. B. Frémy and A. H. Nasr. Pp. 34+2 plates. (Oairo: Foudat I University.) [93]

Estudos sobre Electreos. Pelos B. Gross e P. S. Rocha. Pp. 61+2 plates. (Rio de Janeiro: Instituto Nacional de Tecnologia.) [93]

Geographical Index to the Memoirs, Vols. 1-54, Records 1-66, of the Geological Survey of India and General Reports of the Director for the Years 1897 to 1908. By T. H. D. La Touche. Pp. xvi+576. (Calcutta: Geological Survey of India.) 6.12 rupees, 11s. [93]

Zoological Series of the Field Museum of Natural History. Vol. 24, No. 1: New Central American Frogs of the Genus *Hypobombus*. By Karl P. Schmidt. Pp. 6. 10 cents. Vol. 24, No. 2: A New Lizard from Mexico, with a note on the Genus *Morone*. By Karl P. Schmidt. Pp. 7-10. 10 cents. Vol. 24, No. 3: A New Australian Lizard, with a Note on *Menidia*. By Hobart M. Smith. Pp. 11-14. 10 cents. Vol. 24, No. 4: Notes on Mexican Reptiles and Amphibians. By Hobart M. Smith. Pp. 15-26. 25 cents. (Chicago: Field Museum of Natural History.) [103]

State of Connecticut: State Geological and Natural History Survey. Bulletin No. 60: Additions to the Check-List of the Insects of Connecticut (First Supplement to Bulletin No. 81), by Dr. Wilton Everett Britton; and Check-List of the Spiders of Connecticut, by Dr. Benjamin Julian Kaston. Pp. 202. (Hartford, Conn.: State Geological and Natural History Survey.) 1 dollar. [103]

Carnegie Institution of Washington. Year Book No. 37, July 1, 1937-June 30, 1938, with Administrative Reports through December 9, 1938. Pp. xxxiv+443. (Washington, D.C.: Carnegie Institution.) [103]

Biosophical Institute. Biosophical Series, No. 4: The Synthesis of Science and Religion. By Frederick Kettner. Pp. 22. (New York: Biosophical Institute.) 10 cents. [103]

Bulletin of the National Research Council. No. 102: Industrial Research Laboratories of the United States, including Consulting Research Laboratories. Sixth edition. Compiled by Oelle Hull. Pp. 270. (Washington, D.C.: National Research Council.) Paper, 2.50 dollars; cloth, 3 dollars. [113]

Advisory Committee on Education. Staff Study No. 5: Principles and Methods of Distributing Federal Aid for Education. By Paul B. Mort, Eugene S. Lawler, and associates. Pp. ix+98. (Washington, D.C.: Government Printing Office.) 20 cents. [113]

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 23: Report on a Village Inquiry regarding Cattle and the Production and Consumption of Milk in seven Breeding Tracts of India. Pp. x+127. 2.8 rupees; 5s. 6d. Miscellaneous Bulletin No. 24: A Brief Survey of some of the Important Breeds of Cattle in India. Part 2: Prize Winners at the First All-India Cattle Show. Pp. H+4+38 plates. 1.6 rupees; 2s. Miscellaneous Bulletin No. 27: Definition of Characteristics of Seven Breeds of Cattle of All-India Importance. Pp. H+26+31 plates. 1.10 rupees; 2s. 6d. (Delhi: Manager of Publications.) [133]

Geological Survey of Uganda. Bulletin No. 3: A Series of Papers relating to the Geology of Uganda with Bibliography and Provisional Geological Map. Pp. vii+196+8 plates. (Entebbe: Government Printer.) 10s. 6d. [133]

Mysore Geological Department. Popular Studies, No. 1: An Introduction to the Geology of Mysore. By R. Rama Rao. Pp. xiii+68+34 plates. (Bangalore: Government Press.) 1 rupee. [133]

Journal of the Indian Institute of Science. Vol. 23A, Part 2: Supersonic Velocity in Gases and Vapours. Part 6: Specific Heats of the Vapours of Alcohols and Ethyl Acetate. By S. K. Kulkarni Jaikar. Pp. 59-68. (Bangalore: Indian Institute of Science.) 1.8 rupees. [153]

Indian Forest Records (New Series). Botany, Vol. 1, No. 4: A Sketch of the Vegetation of the Aks Hills, Assam; a Synecological Study. By Dr. N. L. Bor. Pp. ix+108-223+23 plates. (Delhi: Manager of Publications.) 6.6 rupees; 10s. [153]

Conseil Permanent International pour l'Exploration de la Mer. Bulletin hydrographique pour l'année 1937. Pp. xiv+106. (Copenhague: Andr. Fred. Hæst et fils.) 7.00 kr. [133]

Thèses: recueil annuel des travaux de l'Institut d'Histoire des sciences et des techniques de l'Université de Paris. Année 3, 1936. Pp. 266. (Paris: Félix Alcan.) 60 francs. [163]

U.S. Department of Agriculture. Technical Bulletin No. 653: A Revision of the Mites of the Subfamily Tarsoneminae of North America, the West Indies, and the Hawaiian Islands. By H. B. Ewing. Pp. 64. (Washington, D.C.: Government Printing Office.) 15 cents. [173]

League of Nations: Economic Intelligence Service. Statistical Testing of Business Cycle Theories. 1: A Method and its Application to Investment Activity. By J. Tinbergen. Pp. 164. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 3s. 6d. [173]

Report of the Haffkine Institute for the Year 1937. By J. A. Col. S. B. Bokhey. Pp. iii+88. (Bombay: Government Printing and Stationery Office.) 3 annas; 4d. [173]

India Meteorological Department. Scientific Notes, Vol. 7, No. 79: Atmospheric Electric Potential Gradient, Conductivity and Air-Birth Current on Electrically 'Quiet' Days at Oolaba. By S. M. Mukherjee. Pp. 123-143+6 plates. (Delhi: Manager of Publications.) 1.4 rupees; 2s. [173]

Plant and Animal Communities. Comprising the Proceedings of the Conference on Plant and Animal Communities, held at the Biological Laboratory, Cold Spring Harbor, Long Island, New York, from August 29 to September 2, 1938. Edited by Theodore Just. Pp. 255. (Notre Dame, Ind.: University of Notre Dame.) [173]

Catalogues, etc.

Matthey Cadmium Pigments. Pp. 12. (London: Johnson, Matthey and Co., Ltd.)

Cambridge Instruments for Food Storage and Transport. (Folder No. 64.) Pp. 6. (London: Cambridge Instrument Co., Ltd.)

Wild-Barfield Electric Furnaces for Works and Laboratories. Pp. 52. (London: Wild-Barfield Electric Furnaces, Ltd.)

Die Aakania-Werke. Jahrgang 4, Nr. 16, März-April. Pp. 25-48. (Berlin-Friedenau: Aakania-Werke A.G.)

History of Science and a few rare and important Old Medical Books. (Catalogue 51.) Pp. 76+8 plates. (London: H. P. Goldschmidt and Co., Ltd.)

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Education in a Democracy

A HOPEFUL effect of the challenge thrown down to democracy in the crisis of September last and in the events which have followed is the turning back to the beliefs and principles upon which our liberties are founded, and which are our justification for holding them and the frank facing of the issues involved. Men are freely recognizing that if the democracies are to withstand the challenge of the totalitarian regimes, with their threat to so much of the noblest in our heritage, it can only be as they prove themselves inherently superior and able by force of example as well as precept to check the ruthless doctrines which threaten alike the peace of the nations and the liberties of individuals. The survival of democracy depends on its ability to make constructive contributions in the present and future, not merely on its achievements in the past.

An admirable example of this tendency is to be found in the question of education, and especially education for citizenship. The certainty of aim of education under any form of dictatorship is a challenge to the educational systems of democratic countries which cannot be ignored. These systems produce citizens who believe the doctrines which their rulers wish them to believe, and are imbued with a fierce nationalism and devotion to the State. If we repudiate the charge that democratic systems produce pupils whose knowledge is unrelated to their country's needs, and whose minds are adapted for argument but not for loyalty or constructive criticism, we may fairly be asked what purpose or set of principles we have to set up against those of the authoritarian regime.

This, indeed, is a central problem of democracy to-day. It is an element of almost every question

of national defence or preparedness for war, and the choice between a compulsory or voluntary national register will probably be determined by our efficiency in solving this problem. Essentially we require to define good citizenship in a democracy, and to show how education can escape being an aimless pursuit of facts without becoming an instrument of propaganda. A significant section in the Spens Report points out that on the extent to which the youth of Great Britain can be fitted to fulfil later their duties and to take advantage of their opportunities as citizens of a democratic State may well turn the whole future of democracy, and the report emphasizes the need for conscious effort by teachers at every point to use their opportunities.

An admirable discussion, by Michael Stewart, of the fundamental problem has been issued under the auspices of the Association for Education in Citizenship.* Under the title "Bias and Education for Democracy", Mr. Stewart gives us a highly suggestive and stimulating discussion of matters which are as relevant to the question of preserving freedom of thought and exposition as to teaching, and the wise and effective use of the opportunities which science no less than other subjects affords for training in citizenship.

Sooner or later, the difficulty of propaganda crops up, and Mr. Stewart meets it by a frank and careful analysis which deserves the attention of scientific workers, whether primarily concerned with the social sciences or not. He discriminates between two types of propaganda. The first, non-rational propaganda, aims at securing acceptance for certain views by appealing to the emotions and neglecting the reason, and sometimes

* Oxford University Press.

by vilifying opponents. This type is not confined to politics: much advertising material, though free from scurrility, is of this type, and whether in advertisement or in politics is frequently due to bias in the mind of the propagandist. While, however, propaganda may be a justifiable activity, biased judgment is at all times to be avoided, and it should not be confused with the deliberate selection which must be practised in teaching no less than in art or in science.

Rational propaganda, on the other hand, seeks support for a given view by marshalling reasoned arguments in its support, and fortunately there are both politicians and advertisers who use this method. Although its object is to serve a cause, it will not express opinions without examination of the facts so far as its time and ability permit. Where rational arguments are employed to propagate beliefs which represent the experience of the race, the resulting activity is certainly part of education and we might hesitate to call it propaganda. A sound principle may, however, be advocated by inaccurate or dishonest methods with results no less disastrous than attempts to propagate controversial views by rational methods.

Mr. Stewart accordingly stresses the danger of using ordinary lessons to propagate controversial opinions, even by rational methods, and in regard to the impartial presentation of controversial subjects stresses the need for handling such matters in a realistic way, even while excluding rational propaganda. He asserts indeed that this is the subject problem of the social sciences. Just as the teacher of chemistry, by putting acids and explosives into his pupils' hands, has an opportunity for training them in sensible conduct, so it is a positive advantage of the social sciences that they promote clear and unprejudiced thinking on disputed topics.

In the early stages of education some statements must be presented authoritatively as statements of fact; but even among beginners the use of authoritative statement has its dangers. A community which transmits its rules of conduct solely by authoritative teaching will make no progress towards a sounder moral judgment, and Mr. Stewart directs attention to possibilities in the use of broadcasting, the film, and dramatic work, as well as in the use of books which might make the promotion of right conduct attractive and interesting. The development of the critical process should begin at a comparatively early stage in education with the teacher's aid.

Especially are the social sciences important as vehicles for such training. From the study of human motives and actions in the past, the pupil sees that wisdom and honourable conduct are not the monopoly of those who hold a particular set of opinions. He becomes aware of the need for intellectual honesty and learns the nature of fair argument, and the difference between sound and unsound methods of proof. The power of rational criticism can, of course, be developed in many other subjects, such as the natural sciences. Dr. Thouless and Mr. Jepson have shown how accurate thinking can be taught at school, and Dr. Thouless ("Education for Citizenship in Secondary Schools", chap. xvi, p. 235) emphasizes that one object must be to create citizens intelligently approaching the problems of their citizenship and not young logicians or psychologists.

The essential point is that reasoning powers should be used not only to appraise the value of arguments, but also to handle facts and, if excessive effort is spent in encouraging criticism, education may produce only sceptics or persons without the power of decision. Life demands action as well as belief, and scepticism, if a necessary part of education, is by no means the only part. The pupil must learn how to act as well as to think for himself. Accordingly, Mrs. Wooten (*Adult Education*, Dec. 1937, pp. 96-7), in a plea for constructive teaching, urges that for a teacher to discuss any practical problem without, in the end, indicating what he himself thinks the best way of tackling it, is incompetent and irresponsible teaching.

Discussing the value of particular subjects in this respect, Mr. Stewart points out that, in teaching natural science, the social and economic effects of scientific discovery should be considered. Discussions on the effects of mechanized production on wealth and employment, and on the military use of scientific research, are often conducted by people who have little knowledge of the real possibilities. It should be the function of the teacher of science to remedy this defect. At least, he can equip his pupils to avoid the more serious errors of fact and reasoning, and can help them in the search for evidence. Science should be treated at the outset as a body of knowledge by which mankind can help itself.

Once again we encounter in this discussion the importance of training in the citizen's own language. Unless he can express himself clearly and attractively, a citizen cannot make a contribution

to public life commensurate with his abilities. The purpose of democratic education, moreover, is human welfare, and this it is that dwarfs the narrow purpose of totalitarian education. Whatever impetus the enthusiasm of the dictatorship may give to society at first, there is no continuous springing up of new thought to give society flexibility and the power to adapt itself to changing circumstances. Influences which preserve society and sweeten life are cut off, and the State has no inherent principle of virtue.

The democratic citizen has the privileges and responsibilities of freedom; he is required to decide public policy and accept the consequences of his choice. Only in democracy can the teacher whole-heartedly see that his pupils get so much enjoyment from using their minds that they will not fear responsibility. Moreover, the teacher in a democracy must not fail to point out the mistakes of democracies in the past, whether the denial of elementary rights to subject peoples or the failure in foreign relations to accord to other nations the

consideration and justice which their citizens displayed to each other at home.

Failure to understand that freedom means responsibility has brought about sloth and corruption which have paved the way for dictators, and scientific workers are no more free from responsibility for such failures than other classes of their fellow citizens. Mr. Stewart's lucid analysis of bias and propaganda indicates the causes of some of the defects in the teaching and exposition of science and the failure of scientific workers to make their full contribution in the solution of social and economic problems. At the least, it may be hoped that this admirable pamphlet will arouse them to a sense of the opportunities and responsibilities which are theirs, whether as citizens or as teachers of science, and to the resolute action which is demanded no less in the interests of scientific advance itself than in the safeguarding of those rich values of civilization which we owe to the freedom of thought and speech and criticism inherent in democracy alone.

The Botany of Crop Plants

Introduction to the Botany of Field Crops By Prof. J. M. Hector. (South African Agricultural Series, Vol. 16.) Vol. 1: Cereals. Pp. xii + 478 + xiii-xxxiv. Vol. 2: Non-Cereals. Pp. viii + 479-1128 + ix-xxxiii. (Johannesburg: Central News Agency, Ltd.; London: Gordon and Gotch, Ltd., n.d.) 70s. net.

THE plants making up the miscellany known as 'field crops' are distributed throughout the families of the flowering plants almost haphazard. The qualities which make them valuable in industry or as food for man or stock, such characters as the production of fleshy roots or shoots, starchy or oily seeds, long fibres, etc., are usually of little or no importance to the botanist tracing phylogenetic relationships (although when correlated with wider ecological and soil studies they may be of fundamental interest) and, in consequence, the study of field crop plants has been seriously neglected by academic botanists.

During the last three decades, however, the study of field crops has been taken up by agricultural botanists, more especially in the United States, Germany and the U.S.S.R., but notably in Great Britain by Percival, and of many crop plants we now have a greater knowledge than of

many plants of more theoretical interest. Much of this knowledge is of such a character that it could usefully and justifiably be incorporated in the pure botanical curriculum and the agricultural plants used as bases of study. If principles can be equally well exemplified in plants of great economic importance, it is surely better to use those plants in teaching than traditional examples of little or no human value.

Prof. Hector has aimed at surveying certain aspects of this field of work and, in his two imposing volumes, has presented in co-ordinated form a vast amount of information leading to an understanding of the nature and life processes of crop plants. His range covers field crops important as food for man or beast or valuable as producing economic fibres but, with the exception of the hop grown for brewing, he does not touch upon beverage plants or, with the exception of tobacco, upon medicinal and drug plants. Vol. 1 is devoted entirely to the Gramineae, including the various temperate and semi-tropical cereals and sugarcane, but excluding pasture and other cultivated grasses. Vol. 2 covers a very wide field: the various root and cole crops, fibre plants such as hemp, flax and cotton, leguminous and other forage and oil-seed crops, and various oddments such as

onions, asparagus, tomato, pumpkins and cucumbers, and a few salad plants.

The author's point of view throughout is botanical and not agricultural, and he confines his attention to the developmental anatomy, reproduction, systematics and cyto-genetics of the plants: there is nothing of ecology, physiology or pathology. Perhaps more attention might, with advantage, even accepting the author's restriction of boundaries, have been given to description and illustration of the plants themselves and their developmental stages as met with in the field: the author assumes a familiarity with them in his readers which many may not possess. The amount of detail in the book is enormous, and, if one were to abstract and combine related portions, one would have a series of fairly compendious monographs on the anatomy, genetics, etc., of agricultural plants.

Such a *magnum opus* could not on its publication be up to date, but here and there, as for example in the section on the sugar beet, the book is seriously out of date. In fact, the entire chapter on the Chenopodiaceae, as well as those on the Cruciferae and Leguminosae, provide many grounds for cavil. The author does not claim to deal adequately with the literature after 1935, although a few 1936 references are included in the bibliographies, and a few of 1937 are inserted as textual footnotes. There are, however, some striking omissions in the period 1930-35: for example, the author devotes ten pages to a discussion of the root nodules of the Leguminosae, but does not refer to the work of Virtanen or to the fine monograph published in 1932 by Fred, Baldwin and

McCoy. Considering, however, the wide field covered by the author, serious lapses are rare, especially in view of his statement "that there is marked difficulty in obtaining certain literature in the Union of South Africa". The author index to each volume includes about a thousand names and, as references are cited in full at the end of each chapter, the book is a splendid introduction to the literature of the subject.

One or two points of criticism may perhaps be made. The volumes are illustrated by 448 text-figures nearly all copied from other publications. Often the figure is enlarged from the original so that crudities of drawing which did not show in the original figure are badly exaggerated in the reproduction, or where half-tones have been used the reproduction is poor and often obliterates any detail of the original illustration. Further, the "Contents" of each volume is a single page list—Ch. IV. Wheat Species (*Triticum*); or Ch. XVII. Leguminosae. But there are, for example, 121 pages devoted to wheat, and 168 to legumes, each a book in itself, and although main headings are in heavier type and one can, of course, always refer to the excellent plant and general indexes at the end of each volume, yet a synoptic "Contents" would have made the book much easier to use.

By and large, however, one has little but admiration for the author's achievement. He has digested and co-ordinated a wealth of information from all countries, including much Russian work, and has clarified this in the light of his own researches and experience. His book will be useful to agricultural botanists the world over.

W. B. BRIERLEY.

The Psychology of Society

(1) Social Psychology

By Prof. Daniel Katz and Prof. Richard L. Schanck. Pp. xiv + 700. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 18s. 6d. net.

(2) The Psychology of Social Movements

a Psycho-Analytic View of Society. By Dr. Pryn Hopkins. Pp. 284. (London: George Allen and Unwin, Ltd., 1938.) 10s. 6d. net.

VERY different approaches to the psychology of society are presented by the two books under review.

(1) The strength of Dr. Katz and Dr. Schanck's text-book on social psychology lies in its detachment and impartiality. The authors make a careful and critical analysis and classification of

the problems of conformity and non-conformity within social groups; the question of the motivation of behaviour, and the mechanisms of social interaction; the psychology of individual differences, illustrated by the clinical study of personality; and the problems arising within a group, as the complexity of the structure of the group increases.

Much experimental work is summarized and used to illustrate and to support the points developed from theoretical analysis; but it is inevitable that the strength of the book should contain its weakness. The problems of unemployment, delinquency, making two ends meet, betting and gambling, and so on are omitted. They are problems that it is almost impossible to analyse as impartially as those with which the authors are

concerned—such problems, for example, as the analysis of types of conformity into oenotropes, folkways, institutional ways, fads and fashions, etc. Yet some place in a text-book on social psychology should perhaps have been found for them. That, however, is not the orientation of this text-book, but what it sets out to do it does admirably and with a wealth of detail.

(2) No one could accuse Dr. Hopkins of avoiding topical issues or of being too detached. He discusses sadism and war, the acquisition of property, marriage and birth control, smoking and religion. The explanation of these social phenomena he finds in oral and anal eroticism, the oedipus complex, and, occasionally, homosexuality. His line of argument may be illustrated by his view that the most important element in war is the oedipus complex. The enemy is identified with the evil father-figure, and our repressed desire to kill our father may be let loose on the enemy. Similarly, our country is identified with our mother, and when foreign troops threaten her we describe it as an act of invasion or of assault. In extension of this view, Dr. Hopkins mentions that all the allies in the Great War "felt outraged by the rape of Belgium".

While the oedipus complex is not regarded as the sole determining factor in the social psychology of war, it is held to be the most important. Now although there might be some reason for identifying one's native land with one's mother, it seems to be stretching the point a bit for Englishmen to extend this identification to Belgium. Why should Belgium be regarded as the mother of Englishmen?

If the identification developed after we had been fighting for a while for Belgium, is it possible for a mother-identification to occur before we have fought for a country? Did the British, in fact, identify in turn Austria and Czechoslovakia with their mother last year? Then again, why should countries go to war if they refer to their native land as their fatherland or patria? Why do individuals show patriotism rather than matritism? Presumably, if Dr. Hopkins's view is correct, they should fight for their fatherland, so as to prevent him from being homosexually assaulted by the evil father-figure of the enemy. But if they are motivated by the oedipus complex, they ought to be only too pleased to see their father assaulted or maimed.

Similar logical difficulties in the way of accepting Dr. Hopkins's doctrines present themselves in the other problems he discusses. In all of them, in spite of his stimulating and persuasive presentation, there is so much substitution and identification and extension to be made to the original doctrine, that one who finds it sufficiently difficult to appreciate the full significance of the Freudian doctrine when applied to individuals, must fail to see the relevance to social psychology of some of the extensions which appear to Dr. Hopkins to be so obviously satisfactory. Dr. Hopkins would no doubt agree that one needs to be an analyst or to have been analysed before one can properly appreciate his book: to the uninitiated, many of the arguments must suffer from their apparent lack of logical consistency.

J. M. BLACKBURN.

Bio-meteorology

The Patient and the Weather

By Dr. William F. Petersen, with the assistance of Margaret E. Milliken. Vol. 4, Part 1: Organic Disease—Cardio-Vascular-Renal Disease, including a Chapter on Experimental Endocarditis, by Prof. Alexander J. Nedzel. Pp. xxxiv+663+19 plates. 10 dollars. Vol. 4, Part 2: Organic Disease; Hypo- and Hyperthyroidism, Diabetes, the Blood Dyscrasias, Tuberculosis. Pp. xxviii+729+22 plates. 11 dollars. Vol. 4, Part 3: Organic Disease; Surgical Problems. Pp. xxxvii+651. 10 dollars. (Ann Arbor, Mich.: Edwards Brothers, Inc., 1937-38.)

DR. PETERSEN'S *magnum opus*, as the title implies, deals with the effects of that most changeable of mundane things, the weather, rather than with different kinds of climate. In previous volumes (see NATURE, Jan. 16, 1937) he has

brought together a mass of observations showing its influence in a great variety of diseases. In the present ante-penultimate volume, in three parts, he discusses the operation of the same causes in another large group of diseases in which disturbance of the blood vessels and blood supply is the characteristic feature.

Great importance no doubt is attached to the possible influence of weather conditions on the heart and circulation, the main feature here described being the production of "pressor episodes", that is to say, a narrowing of the small vessels with resulting deprivation of oxygen (*anoxia* or *anoxemia*). The cardinal importance of the "basic variable in the oxidative mechanism" is here especially emphasized. Weather changes are of two kinds, producing (1) contraction, or (2) enlargement of the vascular bed, with, in each case, a

series of associated changes in the organism as a whole. These changes are accentuated at certain seasons and in certain climates. The seasonal influence in general is shown by the fact that the contractor, spastic and pressor effect (A R S phase) with relative alkalosis, is more common in autumn, and the enlargement or dilator effect (C O D phase) is most observed in the spring of the year. These are due to disturbances of the autonomic nervous function. In health, the recurring rhythm, A R S—C O D, is balanced and physiological. In numerous cases where this balance is unstable with, for example, a *tendency* to spasm and pressor episodes, as in many disorders of the cardio-vascular system, "meteorological damage" is very apt to occur.

Circulatory diseases especially are much influenced by meteorological environment. The medical reader may be reminded of the anginiiform symptoms which in many persons occur on exposure to slight changes of wind and temperature. Emotion, effort, tobacco, all contribute to pressor episodes, but the climatic factor is held to be more important. Coronary spasm is said to be most frequent in February and least so in August.

There is, in the author's view, clear evidence of a constitutional tendency to autonomic dysfunction, and that this is exhibited in a large group of apparently widely different diseases—ulcer of the stomach and duodenum, exophthalmic goitre, diabetes, urticaria, colitis, migraine and epilepsy. He has not noted a very common and suggestive observation, that many local climates, in winter resorts for example, are of a protective and sedative quality and so prevent or minimize 'pressor episodes' in a great variety of cases. Again, in hard climates and the winter season an artificial

compensative regime can be devised with excellent effect for the prevention of chills, as in the popular hot pithead baths.

It is known that many diseases, which are presumably due to specific invasions, may show a definite seasonal incidence. Rheumatic fever, which is associated with temperate latitudes, has a maximum incidence in the north-east American States in the late winter and early spring.

The author's argument in this volume may be expressed in a syllogism: cardio-vascular alterations enter into all diseases, even in surgical and mental crises; these alterations are especially conditioned by environment; all diseases are therefore more or less subject to environmental changes. He contends that the mechanism is always the same, the clinical expression variable without end. Above all, the human organism is to be considered *as a whole*. Many authors have stressed this doctrine (for example, Brugsch in his "Ganzheitsproblematik in Medizin"); the physiological balance of the whole spells health, its unbalance disease. To this end the body must be studied synthetically rather than organically. Lastly, the *biological rhythm* of the organism is well exemplified in autonomic peaks and troughs, the disturbance of which causes "the precipitation of disease".

It is impossible to draw conclusions as to the effect of change of weather upon patients from the experience of young and vigorous persons. Normal individuals in the prime of life find in the polar air mass with its fall of temperature, its pressor episode and resulting anoxemia, a powerful stimulant which fortifies their general resistance. For the weak and ailing, the same weather impressions may be disastrous, quickly followed by fatigue and failure of resistance.

The Land of Parrots

Australian Parrots:

their Habits in the Field and Aviary. By Neville W. Cayley. Pp. xxviii+332+27 plates. (Sydney and London: Angus and Robertson, Ltd., 1938.) 15s.

MR. CAYLEY a few years ago wrote a general guide to the birds of Australia which was followed by a more detailed work on the weaver finches, and now we have one on the parrots.

Of the thirty-seven species in Australia, nine are lorries, twelve cockatoos and the remainder true parrots. They range in size from the little budgerigar to the large black cockatoo, and many are very beautifully coloured. Australia, therefore, may be called the 'Land of Parrots'.

The large works of Gould and Matthews are beyond the pockets of most people and a well-illustrated book at a moderate price, such as the present volume, is very welcome. The discovery of each species is told in detail, and we realize how much Australian ornithology owes to Sir Joseph Banks. He sent George Cayley to collect plants in New South Wales and arranged for Robert Brown to accompany Flinders. Both collected birds in addition to plants, which were described by Vigers, Horsfield and others. Banks also encouraged the governor and officers of the young colony to take an interest in natural history, and one of them, we do not know who, employed Watling, the Scots convict, to draw birds and

animals. These drawings were sent to England and were seen by Dr. Latham, who made them known to science.

Just over a hundred years ago, John Gould landed in Australia to collect materials for his great work. He spent eighteen months in different parts of the country, discovered many new birds, and perhaps what was more important, made notes on different species in the field, which were afterwards reproduced in his volumes. Mr. Cayley quotes freely from these notes, and they are of much interest, as the status of many of the parrots has changed since Gould's day.

Flocks of certain species do harm to the crops of farmers and fruit growers, but on the other hand, we learn that both the yellow-tailed and red-tailed cockatoos devour quantities of forest pests. Parrots are generally considered arboreal, feeding on fruit and flowers, although quite a number of those in Australia feed on the ground and live on seeds of grasses and other plants. All lay white eggs and nest in holes in trees, with few exceptions. The rock parrots deposit their eggs in fissures or cracks in rocks, the night and owl parrots lay theirs on

the ground, and several of the smaller species form tunnels in termite mounds.

The distribution given is all too brief, and the maps showing the range of each bird might have been clearer.

The great majority of parrots in Australia are resident, some are nomadic, depending on the flowering trees and fruits, and at least three are migratory. The common budgerigar only visits the southern parts of the continent in winter, departing north again in February; while the little blue-wing and swift parakeets are summer visitors to Tasmania. The interesting night parrot appears to be extinct, but it may possibly turn up again like the paradise parakeet, which was lost for many years and then rediscovered. Several of the other smaller species are very rare and suffer from illicit trapping.

Mr. Cayley's plates are up to the high standard of his previous works, and in addition there are several other illustrations—reproductions of old drawings. Avicultural notes are given on each species, and Mr. Michin, of the Adelaide Gardens, contributes a chapter on parrots in captivity.

Alfred Brown : South African Naturalist

Gogga Brown :

the Life-Story of Alfred Brown, South Africa's Hermit-Naturalist. Told from his Journal by Prof. M. R. Drennan. Pp. xiii + 100 + 8 plates. (Cape Town : Maskew Miller, Ltd. ; London : John Clark, n.d.). 4s. 6d.

ALFRED BROWN was an Englishman who emigrated to South Africa in 1858. He there settled in the newly established town of Aliwal North, holding various minor offices in it until he retired on a pension, dying in 1920. He was an ardent and very successful collector first of fossils and eventually of stone tools, and for sixty years kept large numbers of lizards and tortoises in the garden behind the small cottage in which he lived. He observed the habits of these animals continuously and recorded his observations in the great diaries which formed the basis of Prof. Drennan's short 'life'.

Brown's early collections of fossils from the rather barren district round Aliwal North, were sent by him to Murchison, the more important specimens, a number of incomplete dinosaur bones, the first ever found in Africa, being described by Huxley. Unfortunately, Brown felt that he had been badly treated by these men, and sent his next consignment of fossil bones to Lartet in

Paris, and another to Vienna. Thus different parts of the same bone may now be found in three separate countries.

Some twenty years later, Seeley visited Brown and borrowed from him specimens which became the types of the Cynodont *Diademodon* and the Bauriomorph *Microgomphodon*. These remained in England and fifteen years later they and other specimens were presented by Brown to the British Museum (Natural History). About this time Dr. R. Broom called on Brown and succeeded in inducing him to allow him to describe further materials, including a great series of Triassic fishes from a locality which Brown would not reveal. When the present writer visited him in 1911, Brown produced still further materials which had not been seen by anyone, again from a secret locality. Finally, in 1920, the whole collection reached the South African Museum. But Brown's very large collection of implements lost all its value because the specimens became separated from their records.

The whole story is a pathetic one, a man of great intelligence and an ardent collector gradually becoming a recluse, a miser so secretive in all his ways that much of the value of his work was lost.

D. M. S. W.

Farm Machinery

By C. Culpin. Pp. 405. (London: Crosby Lockwood and Son, Ltd., 1938.) 18s. net.

A TEXT-BOOK on modern farm machinery by a British author was long overdue, and this book is a praiseworthy attempt to make good this deficiency. To-day there are few operations on farms to which machinery has not been applied, and an effort has been made to cover the whole field. In addition appendixes dealing with elementary principles of mechanics and prime movers have been added. These are well chosen, concise and clear.

The main subject is admirably marshalled but often details of design and operation are meagre; furthermore there is a lack of expression as to the true value of implements from the practical point of view.

One or two mistakes have been missed in proof-reading and there are some statements in working descriptions that need correction. At p. 170 the bills of the knotting mechanism are said "to grasp the twine between the loop and the sheaf". This is incorrect, but the correct version is given in note 3 to Fig. 87 (p. 173). In dealing with milk coolers (p. 269) it is stated that with water coolers the water runs in copper tubes covered with heavily tinned corrugated metal. There are no tubes in corrugated coolers, the water being in direct internal contact with the corrugations. At the foot of the same page we find that "the refrigerant cools a solution of brine which is then used for cooling the commodity". Brine is not used in farm refrigerating coolers; they work by direct expansion.

In conclusion, while admiring Mr. Culpin's courage and devotion to the subject in which he lectures, we think that if more than a bird's-eye view of the subject is to be attempted, the task is a composite one to be handled by specialists rich in both practical and theoretical knowledge in their own particular branches. Nevertheless, we welcome this book as an introduction to further study. C. E. E.

The Microscopical Study of Drugs

By Lillian A. Kay. Pp. viii+228+47 plates. (London: Baillière, Tindall and Cox, 1938.) 10s. 6d.

THIS book comprises a series of forty schedules, each designed to occupy a three-hour practical period, intended for students following courses of training in pharmacognosy where a knowledge of microscopy of drugs, starches, textile fibres, etc., is required. Introductory chapters deal with such fundamental subjects as the technique of drawing of microscopic objects, micro-measurement, maceration, and micro-chemical tests. Then follow directions for the detailed examination of surgical dressings, fabrics and organized drugs. Finally are given methods and examples of quantitative analysis of mixed and adulterated powders, and an appendix of useful information.

Practically all the above is already covered for students by Mr. T. E. Wallis in his "Practical Pharmacognosy". The chief advantage of Miss Kay's book lies in the illustrations, in which are set forth

the anatomical structure and histology of organized drugs prescribed for microscopical study in the syllabus of the Pharmaceutical Chemist Qualifying Examination of the Pharmaceutical Society of Great Britain. These drawings are generally faithful representations of what should be seen under the microscope, and will be appreciated by students, especially those who have not had the advantage of a sufficient botanical training.

Certain corrections will have to be made in a new edition, notably the references to the perimedullary phloem in the three solanaceous leaves, confused with the endodermis; and to the vascular bundles of fennel fruit, named primary ridges.

W. O. HOWARTH.

La Biologie des Orthoptères

Par Lucien Chopard. (Encyclopédie entomologique, Tome 20.) Pp. 542+5 plates. (Paris: Paul Lechevalier, 1938.) 250 francs.

THE name of Dr. Lucien Chopard is in itself a guarantee of the value and reliability of this work. It constitutes the most up-to-date and comprehensive account of the order of insects with which it is concerned. The work is arranged in thirteen chapters, each accompanied by a selective bibliography of publications relating to it. Chapter i deals with geographical distribution, which also takes into account insular faunas and distribution in geological periods. Reproductive phenomena occupy two chapters, and these are followed by chapters on development and activity, on sound-production, on autotomy and regeneration, and on reflexes and means of defence. Among other chapters, those on variation and heredity and on rudiments of social life are also noteworthy.

The book is a veritable storehouse of biological information and will prove valuable to workers in many fields. Its illustrations number 453 figures, all of which are clearly reproduced. The book is well supplied with both a general and an author index. A. D. I.

St. Thomas's Hospital Reports

Editors: Prof. O. L. V. S. De Wesselow, C. Max Page, assisted by N. R. Barrett, Dr. J. St. C. Elkington, Dr. A. J. Wrigley. Second Series, Vol. 3. Pp. 240+23 plates. (London: St. Thomas's Hospital, 1938.) 10s.

THIS volume contains thirty-nine articles from various departments of the Hospital, of which the following are examples: "A Complete Clinical and Pathological History of One of the Earliest Cases of X-Ray Carcinoma", by the late Prof. Leonard S. Dudgeon; "The Biological Test for Hodgkin's Disease", by Dr. D. P. King; "Vitamins in the Treatment of Rheumatism in Children", by Drs. H. W. Everley Jones and S. Taylor; "The Functions of a Psychiatric Department for Children in a General Teaching Hospital", by Dr. W. H. de B. Hubert, and "The Evaluation of the Modern Treatment of Gonorrhoea", by Dr. T. Anwyl-Davies.

The papers, which are well printed and illustrated, are all of a high scientific standard.

A Proposal to Redefine the Thermodynamic Temperature Scale: with a Parable of Measures to Improve Weights

By Prof. W. F. Giaque, University of California

IN several papers published between 1848 and 1854, Lord Kelvin¹ proposed the establishment of an absolute scale of temperature, based on Carnot's principle and "quite independent of the physical properties of any specific substance". On such a scale "the absolute values of two temperatures are to one another in the proportion of the heat taken in to the heat rejected in a perfect thermodynamic engine working with a source and a refrigerator at the higher and lower of the temperatures respectively".

The size of the degree used in connexion with Kelvin's thermodynamic scale is arbitrary. The natural way to define the size of the degree is also the easiest way and the one which best enables the widest attainment of accuracy, namely, to select *one* easily obtained and accurately reproducible fixed point, for example, a melting point, and assign to it a number such that degrees of the desired size are obtained. Unfortunately, this has not been done.

In practice, *two* fixed points are selected. The temperature interval between the freezing point and the boiling point of water is assigned some definite number of degrees, for example, 100 on the centigrade and 180 on the Fahrenheit scales of temperature. The above two points define the size of the degree and thus the number of degrees between the ice point and the absolute zero. As a consequence of this procedure, the values of the ice point and the boiling point of water on the absolute scale are frequently changed, depending on the experimental observations accepted as being the more reliable.

When an experiment is performed to measure a temperature by means of the fundamental criterion which Kelvin has pointed out, the final result contains not only the experimental error of the measurement itself, but also any error which exists in the particular value of the ice point which may have been adopted as the 'best value'. The value of the ice point on the absolute scale has been the subject of many investigations which certainly must be classed among the more accurate of scientific measurements. Nevertheless, even now the values of the several investigators vary by the larger part of the range 273.10° to 273.20° K., although an intermediate value may be selected which is almost certainly correct within two or three hundredths of a degree.

The *only* basic temperature scale defined with sufficient completeness to enable the determination of *any* temperature is the thermodynamic scale. For example, the centigrade scale gives the freezing point and the boiling point of water by definition and nothing more. If it were necessary, for example, to interpolate and extrapolate linearly, by means of such devices as those based on the expansion of liquids and gases, various thermocouples, resistance thermometers, etc., there would be little or no agreement as to the value of a given temperature. As a matter of fact, there is agreement only because the thermodynamic criterion of Kelvin is used in conjunction with the one hundred degree centigrade interval. Interpolation or extrapolation by means of the ideal gas law happens to be a convenient special case of the thermodynamic method.

The basic equations of gas thermometry may be written as:

$$T_{0^\circ\text{C.}} = \frac{100}{[(PV)_{100^\circ\text{C.}} / (PV)_{0^\circ\text{C.}}] - 1}, \quad (1)$$

and

$$T = T_{0^\circ\text{C.}} \frac{(PV)_T}{(PV)_{0^\circ\text{C.}}}; \quad (2)$$

where, in each case, PV is the product of gas pressure and volume corrected for gas imperfection. The T 's refer to the absolute temperatures.

In Equation 1 the per cent error in $T_{0^\circ\text{C.}}$ is 3.73 times that in the experimental ratio $(PV)_{100^\circ\text{C.}} / (PV)_{0^\circ\text{C.}}$, and this error is superimposed on the experimental inaccuracy involved in the determination of the ratio $(PV)_T / (PV)_{0^\circ\text{C.}}$ of Equation 2. Moreover, observations at the boiling point of water offer greater difficulties than do those at the melting point of ice, and thus contribute more to the inaccuracy of measurement of the ratio $(PV)_{100^\circ\text{C.}} / (PV)_{0^\circ\text{C.}}$.

The errors in temperatures on the thermodynamic scale which have their origin in Equation 1 may be eliminated by using the natural method mentioned above, namely, by defining $T_{0^\circ\text{C.}}$ as equal to a suitable number. It appears unlikely that a reference point more useful and satisfactory than the ice point can be found.

A proposal of this kind should be advanced only after a careful examination of its consequences. In this connexion, we ask the simple yet significant

question: Why is it important to know temperatures accurately in terms of any particular scale? For many purposes it would obviously be sufficient to refer temperatures to any arbitrarily adopted scale; for example, this would suffice to permit the reproduction of a desired set of conditions. It would also permit the accurate use of all energy considerations based on the first law of thermodynamics. However, even if one did not care to inquire further into the basic laws of Nature, there is no escape from their consequences, and it would be found difficult and inconvenient to represent certain important properties by simple equations; for example, the gas law would appear complex if data were obtained in terms of a linear interpolation on a thermometer based on the expansion of a liquid.

The insurmountable objection to an entirely arbitrary scale became evident when Clausius and Kelvin discovered the wide implications of the second law of thermodynamics, which requires the use of a temperature based on Carnot's principle. The use of this temperature leads to the simplest possible representations of all natural phenomena. In fact, all other temperature scales are forced to be as consistent as possible with the thermodynamic scale or they would long since have fallen into disuse.

In addition to the unnecessary inclusion of the experimental error in Equation 1 in the fundamental thermodynamic scale, there is a very common type of mistake that would be permanently eliminated by defining the value of T_{0C} . This may be illustrated by an example. Let us say that Laboratory A uses a value of $T_{0C} = 273.19^\circ \text{K.}$, whereas Laboratories B and C have decided that $T_{0C} = 273.13^\circ \text{K.}$ Each of these laboratories makes a determination of the boiling point of oxygen. Their results for the actual observed quantity, $(PV)_T/(PV)_{0C}$, are in exact agreement. A finds $T = 90.16^\circ \text{K.}$ but reports it as -183.03°C. whereas B and C find $T = 90.14^\circ \text{K.}$ and each reports -182.99°C. A calculation is carried out in a fourth laboratory that favours $T_{0C} = 273.19$ but the calculator accepts the value -182.99°C. because two observers have given it. As is practically always the case, the absolute temperature is required. The calculator obtains it incorrectly by adding 273.19 and -182.99 , which gives 90.20°K. in place of the correct 90.16°K.

The calculator may be accused of inexcusable carelessness, but it is quite probable that the literature failed to specify the reference T_{0C} , and abstractors are almost unanimously negligent in this respect. By way of analogy, the point we wish to make is that it is more sensible to remove a wire which circumstance has stretched across

a path rather than to continue avoiding it by what often amounts to the expenditure of considerable time. This type of confusion caused by emphasis given to the centigrade temperature scale approaches its limit when one laboratory may report an observation at -273.18°C. , whereas another laboratory says there are only 273.13 degrees below 0°C.

It is not our purpose here to discuss the various observed values of T_{0C} , but as mentioned above it appears probable that a value can be selected which will not differ from the true value by more than two or three hundredths of a degree. Thus a T_0 can be selected which will not disagree with the centigrade scale by more than one hundredth of one per cent. We know of no thermodynamic observations which are accurate enough to require a correction if a 'best value' of T_{0C} should be selected to define permanently the absolute scale of temperature. Thus no corrections to any existing literature would be necessitated merely because a best value of T_{0C} is adopted *permanently*.

It is not suggested that the centigrade scale be discarded, although, since its main advantages would appear to be only traditional and to permit the use of one less digit in representing ordinary temperatures, it might be desirable to substitute a scale with degrees defined as above but with the ice point taken as zero. At most, the difference between the boiling point and the freezing point on the two scales would not be found to differ by more than one hundredth of a degree, and until at least one experimenter succeeds in making thermodynamic measurements with an accuracy exceeding 0.01 per cent the difference may be ignored. If it should become necessary to make corrections for a few measurements of extraordinary accuracy, it would be a comparatively simple matter to do so.

It should also be made clear that while the thermodynamic criterion is regarded as basic, there is no suggestion of discarding such valuable secondary reference standards as resistance thermometers. It is obviously impractical to measure small temperature differences as accurately by direct observation with a gas thermometer as with a resistance thermometer. For example, a difference of 0.01°C. is near the limit of error with a gas thermometer, but it can be determined with considerable precision by many other thermometric devices. Nevertheless, it should be kept in mind that it cannot be proved that such useful devices correctly denote what they are assumed to represent except by comparison with the thermodynamic scale. It is hoped that this presentation of the above proposal will initiate wide discussion leading to appropriate action for its general adoption.

To summarize: The permanent adoption of the best value of the ice point, $T_{0^\circ\text{C.}}$, on the absolute temperature scale would:

(1) Permit an increase in the accuracy with which temperatures may be fixed on the thermodynamic scale.

(2) Eliminate confusion which results from lack of agreement as to the 'best value' of $T_{0^\circ\text{C.}}$ and

which would still result if there were occasional changes in a generally adopted 'best value'.

(3) Not in itself necessitate any changes in published thermodynamic data.

In order to emphasize the existing status of temperature scales, we will present the following account of the scientific method which will be entitled:

A Parable of Measures to Improve Weights

An early scientist, who deserves much credit, desired a standard of weight. He selected two convenient stones. The lighter stone was very smooth, hard and dense, and gave every indication of durability; the heavier stone was definitely of lower quality.

Now the accumulation of information available to this scientist being much less than that of the present, he failed to see the matter with as much clarity as might reasonably be expected of his current successors. His solution of the problem was to state that the heavier stone weighed 100 convenient units more than the lighter standard, which was taken as the zero of weight.

This system served very well for a time, but presently weights below zero were found to be necessary and the tradesmen scarcely knew whether they were buying or selling when the customers asked for 50 units of bread and minus 10 units of cheese.

A temporary respite from this difficulty was obtained in the following manner. A practical scientist decided to search for the lightest stone to be had. The search took him far and wide and, having failed to see nothing, he returned with a somewhat lighter standard for the new zero of weight. As a heavier standard he decided to use the weight of man, and the difference between the two standards was again defined as a certain number of units.

The new choice of the heavier weight was not a very fortunate one and it was soon decided to return to the former standards, but nevertheless the main feature of the plan was retained by making an approximate comparison of the two scales and defining a new unit. There has always been a diversity of opinion as to the desirability of this new unit; some called it more convenient and others called it less convenient, so we will refer to it as the more-or-less convenient unit. Thus 5 convenient units were found to equal 9 more-or-less convenient units and the old standards came out 32 and 212 more-or-less convenient units, respectively, on the new scale, while the new zero of weight was no standard at all. This scheme was of some temporary help to the tradesmen; but it

was not long before someone found weights below zero again and the whole more-or-less system became unpopular among scientists although it is still used by a few practical groups.

It was all very confusing and the difficulties were of an astonishing variety, but we must leave to the imaginations of our readers the trials of the early scientists who tried to develop such concepts as mass, gravitation, and the laws of dynamics with a system including negative weights.

Eventually it became apparent that weight had an absolute value and the standards were themselves determined in terms of convenient units. The lighter stone was found to weigh about 273 convenient units, but as always, there were experimental errors, and various contemporaries used values ranging from 270 to 276.

In due time the atomic theory was developed, and many years later the absolute weights of atoms were determined. For example, the deuterium atom was found to weigh 3.32×10^{-24} convenient units; however, in accordance with an international agreement this result was recorded as $-272.999,999,999,999,999,999,999,68 \pm 3.0$ convenient units.

The principal difficulty in the system was that the ratio of the weights was obtained by adjusting their positions on a supporting beam and fulcrum and using the relation

$$W_0 = \frac{100}{(W_1/W_0) - 1} \quad (1')$$

The percentage error of W_1/W_0 was unfortunately multiplied by 3.73 in obtaining W_0 . The limiting sensitivity of the balance was only one convenient unit of weight and one hesitates to contemplate the state of affairs if the standard stones had been 273 and 274 convenient units respectively. The experimenters would have obtained values of W_0 ranging from 137 to ∞ .

Now it so happened that the pedestal on which the heavier standard was kept was not very resistant to acid fumes from the laboratory and it became weakened almost to the point of collapse.

Moreover, it was observed that the standard itself had acquired some tarnish. Some say that this was hastened by workers with the small weights, who purposely heated some vitriol because they had tired of being on the negative end of things, but be that as it may, it was only the inevitable that happened when the standard was finally removed from its primary status.

In order to preserve the units in general use it was decided to adopt only the unexcelled lighter stone as a standard of 273 convenient units and soon everyone wondered why they had done otherwise.

Explanatory Note. It has not been expedient to simulate more closely the actual historical sequences and facts in making a point that refers to a twentieth century situation. As a matter of fact, there was an excellent reason for two easily obtainable fixed points in the early days of thermometry.

In 1654, Grand Duke Ferdinand II of Tuscany had bulb and stem thermometers calibrated in thousandth parts of the bulb volume. This very sensible approach to the problem, which required only one fixed point, was discarded later only because the expansion of various liquids did not yield identical results. This led to two fixed points

with the scale interval divided into a certain number of divisions and brought various thermometers into somewhat better yet crude agreement.

In 1701 Newton proposed the interval between the ice point and the none too uniform temperature of the human body as a scale of 12 degrees, and in 1714 Fahrenheit substituted the ammonium chloride - ice eutectic temperature for the ice point to avoid negative temperatures; but unfortunately the stage had not been set sufficiently so that he could see the ultimate goal. Later, Fahrenheit investigated and adopted the present fixed points. The centigrade scale was not proposed until 1742, when Celsius suggested it in reverse form.

The discovery and investigation of numerous gases took place in the eighteenth and nineteenth centuries. If this kind of investigation had not been delayed for so long, the first thermometer, based on the expansion of air and invented by Galileo in 1592, would have developed sooner into the modern gas thermometer, and it is difficult to imagine that the systems based on two fixed points would ever have originated.

¹ Kelvin, *Proc. Camb. Phil. Soc.*, 1, 66 (1848); *Phil. Mag.*, (3), 22, 313 (1848); *Trans. Roy. Soc. Edinburgh*, March 1851 and May 1854; *Phil. Mag.*, (4), (1853). "Mathematical and Physical Papers, Thomson (Kelvin)", 1, 235 (Cambridge Univ. Press, 1882).

Molecular Layers

THE foundation of the Pilgrim Trust series of lectures, of which the first was delivered by Dr. Irving Langmuir before the Royal Society in the theatre of the Royal Institution on December 8, 1938, was noted in NATURE of December 17 last. In this lecture, the subject-matter of which is printed *in extenso* in the *Proceedings of the Royal Society*, A, 170, 1 (1939), he gave a comprehensive account of his investigations on monolayers and multiple layers of complex organic molecules. These researches, initiated by him in 1917, and carried on by many workers, Langmuir himself always taking a leading part in advancing both theory and experimental technique, show no sign of ceasing to be a fertile field for investigation.

The orientation of organic molecules, with a water-soluble group at one end of a long hydrocarbon chain, at a water surface with the chains perpendicular, or nearly so, to the surface, now forms part of the subject-matter of many advanced text-books. The molecules orient themselves in this manner only if the hydrocarbon chains are sufficiently long for the lateral adhesion between

them to control the thermal motions of the molecules. If either the temperature is raised, or the length of the hydrocarbon chains is diminished, or the amount of adhesion between the adjacent molecules in the surface film decreases from some other change in constitution of the molecules, this simple orientation of the molecules may be destroyed. If the lateral adhesion is completely overcome, the molecules separate completely, the film becoming 'gaseous'. In the 'gaseous' state of the films, the molecules lie flat on the surface, provided there is sufficient space, and the relation between the area and the surface pressure is similar to that between volume and pressure in a gas.

There is an intermediate stage (the liquid-expanded films) between the condensed films, with molecules nearly upright, and the 'gaseous', in which they lie flat, which presented some very puzzling features until in 1933 Langmuir showed that they simulate very closely the behaviour of thin layers of a non-spreading paraffin oil, in which a small amount of a spreading substance such as a fatty acid is dissolved, thus forming a thin liquid layer of paraffin separated from the water by an

interface containing a gaseous film of fatty acid. In the liquid-expanded films, the hydrocarbon chains in the molecule appear to be in chaotic oscillation, similar to that of the molecules in a liquid except that the water-soluble end is anchored to the water. The greater part of the cohesion of such films is provided by the adhesion between the hydrocarbon chains, which persists just as in a liquid, in spite of the chaotic motions of these chains.

During the last four years, there have been important experimental developments. It has been shown that the properties of the monolayers of fatty acids may depend on the ions with which the end groups are associated, and that this may serve as a very delicate test for minute amounts of divalent or trivalent ions in the underlying solution; as little as one ion of aluminium for thirty atoms of stearic acid may alter noticeably the properties of the material skimmed up off a surface covered by a film, this quantity corresponding to a concentration of as little as one part in three thousand million of water. As a microchemical technique, the effects of ions on monolayers appear very promising, the amount of silver or gold dissolved when a piece of the pure metal is simply dipped into water sufficing to alter the viscosity of a monolayer of stearic acid appreciably, in a few minutes. This recalls the mysterious 'oligodynamic' poisonous action on living cells, caused by contact of these metals with water, and may be a first step to the understanding of this action.

Langmuir and Blodgett's multiple layers built up by repeated dipping of a solid plate into water covered by a monolayer under constant surface pressure are perhaps the most important recent development. These layers may be built up to several thousands of molecules thick, if dipping is continued long enough; their structure seems to be very similar to that of crystals of long-chain aliphatic substances with polar groups at one end of the molecule; that is, they have sheets of molecules parallel to the solid surface, with the molecules in successive sheets arranged with the polar groups pointing alternately towards, and away from, the solid. The layers with the polar groups directed to the solid are called 'endotropic'; those with these groups directed outwards, 'exotropic'. There are differences in the manner of deposition of these layers, according to the acidity of the water, and the salts contained in it; if the solution under the monolayer has a pH greater than about 9, layers are deposited only on entering the water (X films); on slightly less alkaline solutions the layers are deposited both on entering and on leaving the water (Y films). Multiple layers are not easily deposited unless there is some calcium

or barium in the solution, and they consist of a mixture of the free acid and the alkaline earth soap.

The free fatty acid may be dissolved out of the films by treatment with benzene, leaving the thickness of the film unchanged, but its refractive index is much diminished. It is possible to eliminate the reflection of light from glass, by covering it on both sides with a multiple film having a refractive index equal to the square root of that of the glass, and an optical thickness equal to one quarter wave-length; if this is done to any instrument having a glass front, the glass becomes invisible and the instrument can be used with light reflected at any angle, without disturbance from the 'shine' on the glass front.

There is some evidence that the molecules in the multiple layers can turn over. Drops of water on the surface can apparently, in some circumstances, cause the molecules to turn with their polar groups outwards. Dipping into solutions of such salts as thorium nitrate turns the exterior molecules over, and such 'conditioned' surfaces have remarkably interesting powers of adsorption; they are hydrophilic instead of hydrophobic, as the exterior 'endotropic' layers normally are. Adsorption of bile acids on such conditioned surfaces confers hydrophobic properties on the surfaces, but not of exactly the same kind as the properties of the original unconditioned outer layer. For some reason which is not yet clear, the surface of the unconditioned films, although hydrophobic, forms a finite angle of contact with oil and does not easily adsorb paraffin vapours. A conditioned layer on which a bile acid is adsorbed can in its turn adsorb hydrocarbon vapours, thus showing that adsorption even in simple cases depends on the detailed molecular architecture of the surface. Quite small stereochemical differences, for example that between cholesterol and epicholesterol, make a great difference between the power of penetration of digitonin into the outer layers of deposited films.

Monolayers of proteins are another field in which opportunities seem abundant. In solution, the proteins are compact molecules; on surfaces, they are unfolded to a thickness of probably one amino-acid. This may account for the denaturation of the protein, since the re-folding of a very complicated molecule, once it has been spread on a surface, is likely to be difficult. Some preliminary work on enzymes indicates some loss of activity when they are spread at a surface.

The lecture contains not only a survey of the whole of the work on molecular layers, but also it is full of most valuable new hints on technique, and suggests several new fields for further research.

N. K. A.

Obituary Notices

Prof. H. M. Dawson, F.R.S.

HARRY MEDFORTH DAWSON, professor of physical chemistry in the University of Leeds since 1920, died on March 9 at the age of sixty-three years, after an illness which had disabled him during the whole of the current University session.

All his life, apart from three years' Continental training, was spent in Leeds, first at the Leeds Modern School and then in turn as student, demonstrator, lecturer and professor at the University of his home city. In the last year of his studenthip at Leeds he was engaged on research work with Prof. A. Smithells, and received the highest award then open to a student of science in his election to the 1851 Exhibition. There followed three years at Berlin, Leipzig and Gießen, which were all-important in bringing home to him the conviction that no work could henceforth make the first claim on his time and thought but that of research.

This inspiration came at a time when the atmosphere of the German universities was permeated by the research spirit to an extent then almost unknown in Great Britain, when brilliant young men were forming the research habit, and when new vistas were being opened out by theories and experimental investigations of the first importance. In the years just preceding, van't Hoff's original paper on "Osmotic Pressure and the Thermodynamic Deductions for Dilute Solutions," Arrhenius's "Theory of Isohydric Solutions" and Nernst's "Electromotive Activity of the Ions" had been published and Ostwald's text-books were presenting physical chemistry in a new light. Dawson and fellow-students from Great Britain (including Donnan), were brought under vivifying influences of personal contact and example and of the written word. On returning from Germany with a Ph.D. from the University of Gießen, he was appointed to a demonstratorship in physical chemistry in the department at Leeds from which he had gone as a student. From then onwards came a steady stream of papers on the mechanics of chemical change in solutions, embodying the results of experimental work carried out by himself and many senior students who received in succession the benefit of his training in research methods. A vast amount of matter was thus accumulated, and it was his reward that after many years a more generalised treatment of the results became possible. He was elected to the fellowship of the Royal Society in 1933, to the great gratification of his friends, who had come to fear that his devotion to work in the laboratory at Leeds rather than its effective exposition elsewhere might tell against that form of recognition. He had received the D.Sc. degree of Leeds many years before, in 1907.

Meanwhile, as primarily responsible for the lecturing and laboratory teaching in physical chemistry in the University, Dawson had developed the subject

not only for the students of pure chemistry but also for those of the various departments of applied chemistry and medicine, and in 1920 a professorship in physical chemistry was instituted, to which he was appointed. Throughout this time he had been an indefatigable worker, whose laboratory light was shining on most evenings and who seemed to regard the University vacation as a provision for minimizing interruption to research work. It was only during the last few years that warning of overstrain necessitated some diminution of effort.

Dawson's literary output was almost entirely that of his papers in the *Journal of the Chemical Society*, but he also contributed the section on general and physical chemistry to several numbers of the annual report of the Society and was one of the authors drawn upon by Abegg for his (German) treatise on chemistry.

Dawson's departmental preoccupations left him little time for the more general administrative work of the University, nor was it with him a primary interest, but he concerned himself with the award of scholarships, was for a considerable period a representative of Leeds on the Joint Matriculation Board of the Northern Universities, and at different times was dean of the Faculty of Science and the representative of Convocation on the Council. He will also be remembered as for many years the secretary of the Priestley Club, with a membership drawn from inside and outside the University, and notable for its friendly informality and the wide range of its scientific interests.

Prof. Dawson was fortunate in his family life. He married Miss Phillis Mary Barr, and she, with three sons and two daughters, survives him.

JOHN W. COBB.

Dawson's researches on solutions form a contribution to chemical science of great significance and importance. His earlier work was connected in the main with various aspects of chemical equilibria and more particularly with the formation of complex ions. Thus he was able, by means of distribution experiments, to establish the existence of the complex ion $(\text{Cu}_4\text{NH}_4)^{++}$ in ammoniacal copper sulphate solutions. The other group of compounds in which he was interested was the polyiodides. Here, having confirmed Jakowkin's conclusion of the existence of the tri-iodide in aqueous solutions, he extended the observation to organic solvents such as nitrobenzene, in which he showed that, under appropriate conditions, the higher polyiodides KI_3 , KI_4 , KI_5 exist in significant proportions.

Although this work was of considerable importance, Dawson's name will be particularly associated with the kinetic measurements which were so largely instrumental in the successful development of the modern theory of acids and bases. A commencement

was made in 1909, when, following Lapworth's classical experiments on the bromination and chlorination of acetone, it was shown that iodination is similar in that the chemical change the speed of which is measured is the conversion of the ketone into the enol form. This was followed by a study of the catalysis of the reaction by acids, which led in 1913 to the conclusion that both the ionized and unionized portions of an acid exert a catalytic effect.

The work was not resumed until some years after the Great War, but then followed a rapid succession of papers which resulted in the establishment of the multiple theory of catalysis. The reactions studied included the iodination of acetone, the hydrolysis of ethyl acetate, the iodination of mesityl oxide and the intramolecular transformation of phorone, all of which are catalysed by acids and bases. Dawson demonstrated that in these reactions it is necessary to attribute catalytic activity not only to hydron and the hydroxyl ion, but also to undissociated acid molecules and to acid anions, and in fact to any substance which can either receive or donate a proton, that is, to any substance which in the Brønsted-Lowry view is an acid or base. Dawson was not content until his multiple theory was proved up to the hilt, and to this end he subjected the very considerable amount of experimental material to an exhaustive and searching analysis. A more complete and convincing proof of a scientific theory has rarely been achieved.

An account of Dawson's work in this field would be incomplete without some mention of his contribution to our knowledge of the effect of catalytically inert salts on the strength of acids, the effect which Brønsted calls the secondary salt effect. By means of kinetic measurements he showed that the dissociation constant of an acid is markedly affected by the presence of such salts. The change in dissociation constant is represented by an equation of the same form as that to be anticipated by the application of the Debye-Hückel theory of strong electrolytes, but Dawson was at pains to emphasize that quantitatively the results are incompatible with this theory.

During the last few years, Dawson was engaged in a study of the kinetics of the hydrolysis of the halogenated acetates. He revealed the complex nature of these apparently simple processes, and by an extremely elegant method succeeded in disentangling the various reactions, and evaluating the corresponding coefficients.

R. WHYTELAW-GRAY.
G. F. SMITH.

Prof. S. P. L. Sørensen

SØREN PETER LAURITZ SØRENSEN, whose death, at the age of seventy-one years, was recently announced, was the son of a farmer, Hans Sørensen. He was born at Havrebjerg, Slagelse, on January 9, 1868.

Leaving the High School at Sorø in 1886, Sørensen proceeded to the University, where he gained the University Gold Medal in the years 1889 and 1895. Having taken the degree of master of science at the

University he soon found himself consulting chemist to the Danish Naval Department's Laboratory. As the result of his work on cobalt oxalates he obtained the degree of doctor of philosophy in 1899. From what we know of Sørensen's early activities it is scarcely surprising to find that at the age of thirty-three years he was appointed director of the world-famous Carlsberg Laboratory in Copenhagen, a position he held until his lamented death in the present year. With the passing of Sørensen, the Carlsberg Laboratory has lost another of its distinguished line of workers. Who will forget Emil Oh. Hansen, its first director, whose work on the cultivation of single-cell yeast created such a drastic change in Continental methods of brewing; Johannes Schmidt, the eminent biologist, or Sørensen's immediate predecessor, Joh. Kjeldahl, whose name is familiar to everyone who has ever made a determination of nitrogen?

Although primarily interested in fermentation problems, Sørensen's classic work on hydrogen ion concentration will remain as a permanent monument among those who know little of his other work. The term 'pH' has become so much a part of scientific literature and its influence so important a factor in considering biological problems that one wonders how theories of acidity and alkalinity were ever formulated without a knowledge of Sørensen's fundamental conceptions. So far has the influence of this famous theory spread that to-day one hears golfers talking of the pH of their 'greens' and gardeners of their lawns.

Less spectacular perhaps, but equally important in the region of fermentation, was Sørensen's work on the synthesis of amino-acids, his studies on the proteins and his detailed and comprehensive investigation of enzyme behaviour. This latter study led him to perfect the well-known 'formol-titration' method for the estimation of certain types of nitrogen. Although Sørensen published from time to time in the *Journal of the Institute of Brewing*, most of his original work appeared in the *Biochemische Zeitschrift* and the *Comptes rendus* of the Carlsberg Laboratory.

Sørensen was an early member of the Royal Danish Academy of Science and later its chairman. He enjoyed honorary membership of a very large number of scientific bodies, including institutions in Uppsala, Stockholm, London, Paris, Boston (U.S.A.) and in other countries. He held three Danish Orders in addition to the Chevalier de la légion d'honneur and other foreign decorations.

I cherish the recollection of a happy meeting with this remarkable man in his laboratory in Copenhagen. He was kindly, courteous, ever willing to listen to those who had not his fund of knowledge and always ready and glad to impart something from his vast store of learning. Sørensen was happy in his domestic life and his second wife, Margrethe Høyrup, a woman of considerable intellectual ability, collaborated with him in much of his later published work.

Sørensen's reputation is assured, and his name will go down among the most illustrious of the past. With his going the world of science loses one of its great men and Denmark one of her most worthy sons.

A. J. CURTIN COBBIN.

Prof. A. M. Hocart

WE regret to record the death of Prof. A. M. Hocart, professor of social anthropology in the University of Cairo, which took place on March 9 at the age of fifty-five years.

Arthur Maurice Hocart was born in Guernsey, and entered Exeter College, Oxford, as an open scholar in classics in 1902. On taking his degree he was elected to a senior studentship of Exeter College and afterwards of Jesus College, where he devoted himself to the study of anthropology. He afterwards joined an anthropological expedition to the Solomon Islands organized by the late Dr. W. H. R. Rivers, with whom he contracted a close friendship, and by whom the subsequent trend of his studies was strongly influenced. After a period of travel and research in Melanesia, Hocart accepted a Government post as inspector of schools on the appointment of Sir Everard im Thurn, then Governor of the Western Pacific, and during the residence in Fiji entailed by his duties he engaged in anthropological observation among the Fijians, collecting much material on the traditions, social organization and beliefs of the people, which he utilized to good purpose in his later writings. Its influence is especially apparent in his book on "Kingship" (1927).

In 1921, Hocart was appointed director of the Archaeological Department in the island of Ceylon, and the influence of his energy, scholarship and enthusiasm for his subject soon made itself apparent in an increased and extended activity in his department's survey of the ancient monumental remains of the island, as well as in the standard, character and range of its publications.

Hocart's health, never robust, and showing traces of the effects of his residence in the Pacific, led to the resignation of his post in Ceylon, and in 1929 he returned to England, where for a period he acted as librarian of the Royal Anthropological Institute. In 1934 he succeeded Dr. E. E. Evans-Pritchard in the chair in the University of Cairo, which he occupied until his death.

Hocart's work in Melanesia had provided him with a wealth of ethnographical material which he was engaged in digesting over a considerable period of years and of which he published selections from time to time in the *Journal of the Royal Anthropological Institute* and other publications of a more or less technical character. His books were of a more general and theoretical outlook. In "The Progress of Man" (1933) he made a general survey of the subject-matter of anthropological science. It is both sound and original, while salted with a humour which at times was biting. In 1936 his "Kings and Councillors" was published in Cairo.

Hocart in outlook and method was a diffusionist in the sense that he followed Rivers in making use of precise cultural analysis in tracing the history of cultural and ethnic distributions; but in applying this method to general anthropological problems, his meticulous sense of scholarship deprecated any loose generalization based upon vague analogy, avoiding it in his own work and criticizing it sharply in others.

Sir Basil Thomson, K.C.B.

THE sudden death of Sir Basil Thomson, formerly assistant commissioner of the Metropolitan Police and director of intelligence at Scotland Yard, which took place on March 26 at the age of seventy-eight years, brings to a close a career no less remarkable for the versatility it displayed than for its actual achievement. Its interest for the anthropologist lies in the fact that as a colonial officer, Thomson was an outstanding example, among members of the old school of administrators, of those who, while without special training in anthropology, attained efficiency in their methods of administration in dealing with native affairs by acquiring and applying a sympathetic knowledge and understanding of native institutions and ways of thought.

Basil Home Thomson, son of William Thomson, Archbishop of York, was born on April 21, 1861, and educated at Eton and New College, Oxford. He entered the Civil Service and served for ten years in Fiji, Tonga and New Guinea. In 1900, after he had retired from the Colonial Service for some years, he returned for a period to the Pacific, being seconded under the Colonial Office as a special commissioner to negotiate treaties with two of the native Governments.

Among Thomson's numerous works, the writings of his earlier years are of more than passing interest to the anthropologist. He was an accurate and systematic observer, with insight into the characters and ways of thought of the peoples with whom he had to deal. His books, describing conditions which have now passed away, have a permanent value as records. In "The Diversions of a Prime Minister" (1894) he describes with no little humour the remarkable condition of affairs which he encountered as prime minister of Tonga, when he succeeded the notorious Shirley Baker. This was followed by "Discovery of the Solomon Islands" (1901) and "Savage Island" (1902), and "Fiji and the Fijians" (1908), now a standard book, which commands a rising price in the market. He also contributed papers to the *Journal of the Anthropological Institute*, of which one is a careful description of the remarkable stone trilithons of Tongatabu.

WE regret to announce the following deaths:

Sir William Butler, president of the Institute of Brewing in 1906, who was connected with the School of Brewing in the University of Birmingham for many years, on April 5, aged seventy-two years.

Prof. J. W. Edington, professor of bacteriology in the University of Sheffield, known for his researches on diphtheria, on April 8, aged fifty-four years.

Prof. W. E. Ford, professor of mineralogy in Yale University since 1920, on March 23, aged sixty-one years.

Prof. G. Hellmann, professor of meteorology in the University of Berlin.

Dr. W. H. Park, emeritus director of the Bureau of Laboratories of the New York City Health Department, known for his work on combating diphtheria and other diseases, on April 5, aged seventy-five years.

News and Views

Dr. Aleš Hrdlička

ON March 29, Dr. Aleš Hrdlička, curator of the Department of Physical Anthropology of the U.S. National Museum, Washington, D.C., and the founder of the study of physical anthropology in America, celebrated his seventieth birthday. The occasion has been marked by a gathering of the American Association of Physical Anthropologists at Washington during April 4-5, and a commemorative volume is being prepared, to which the principal anthropologists of the world have contributed. Aleš Hrdlička was born in Bohemia on March 29, 1869, and graduated in medicine in New York. In 1903 he was invited to become assistant curator in the U.S. National Museum to organize a department of physical anthropology, of which he became curator in 1910. Under his direction, a collection has been built up, which is now the largest in the world, including more than 16,000 skulls, human and sub-human, from all parts of the world and of all ages. As an authority on the descent and racial affinities of man, Dr. Hrdlička's judgment is universally received as authoritative. Bold in theoretical argument, his views are invariably characterized by an intensely conservative regard for the precise limitations of the evidence in question. He is best known, perhaps, as the foremost authority on the occurrence of early man in America and the Asiatic origin of the American Indian race, of which he has found the ancestral stock in the primitive strata of Siberian peoples. For more than a decade Dr. Hrdlička has engaged in expeditions to the far north in each summer to investigate the evidence of the migrations of the Eskimo and their predecessors into the American continent. He will submit the results of his research to the Royal Anthropological Institute at a meeting to be held in London on April 25.

Herschel's Researches on the Structure of the Heavens

To celebrate the bicentenary of the birth of Sir William Herschel, the first president of the Royal Astronomical Society, a conversation was held in the rooms of the Society on November 16. Sir Arthur Eddington delivered the lecture with the above title twice during the evening (*Occasional Notes, Roy. Astro. Soc.*, No. 3, January 1939). He pointed out at the beginning that in about thirty years the dimensions of the galactic system have been enlarged tenfold and the number of stars is now estimated to be 100,000 millions. It is remarkable that the picture of the universe which has resulted from modern research is very like the universe described by Sir William Herschel. His greatest enterprise was the systematic survey of the heavens, in the course of which he catalogued 2,500 nebulae and 800 double stars, and in all his research there was a definite plan to find out something about the structure of the universe. It seems remarkable that most of his observational

work on the general distribution of stars and nebulae was done with a reflector of only 19 inches aperture; the famous telescope of 4 ft. aperture was not a success and was not used very much. It is surprising that Herschel's speculations did not lead him astray more often. As one example, he assumed all stars to be of the same brightness, so that first magnitude stars were nearer than second magnitude stars, and so on. Actually, as we know to-day, apparent magnitude is a poor guide to distance. At the end of the lecture, Sir Arthur said that it is impossible for us to communicate with nebulae and receive a reply if they are more than 950 million light-years from us, owing to the speed of recession of the nebulae. It is expected that the 200-in. telescope will reach nebulae 1,000 million light years from us, so it is possible that we shall see galaxies with which it is impossible to communicate and receive a reply.

Study of Edmund Burke's Financial Integrity

DIXON WECOTER has recently investigated with the help of new material the vexed question of Edmund Burke's financial integrity, and the extent to which he was involved in the discreditable ventures of his brother Richard and his kinsman William Burke ("Edmund Burke and His Kinsmen", by Dixon Wecoter. University of Colorado Studies, No. 1, 1, Feb. 1939). Since he vehemently defended their actions at all times and denounced their adversaries and critics in unbridled terms, it is not surprising that Edmund Burke himself came under suspicion of conniving with them. Nevertheless, the author concludes from all the evidence now available that Burke honestly believed them to be upright in their financial transactions, however unfortunate their outcome, and there is no doubt that in his office as paymaster Burke reduced the nation's finances to order at considerable cost to himself. In any event he was always vague as to his own income and expenditure, and it is difficult to imagine him following the tortuous ways of his kinsmen with any care. Burke's passionate championship of those shady characters, while not historically important, shows how completely his judgment was blinded by sentiment. Of more material consequence is the parallel traced by the author between the changing course of William Burke's fortunes in India and Edmund Burke's change of attitude towards the East India Company, leading to the impeachment of Warren Hastings. It is not suggested that this connexion was perceived by Burke himself, whose advocacy the author believes to have been at all times passionately sincere. Of all men a great orator is perhaps the least likely to be aware of the less reputable sources of his interest. He was temperamentally unfitted to judge objectively either friends or adversaries, and this study admirably illustrates the importance of temperamental make-up in life.

Carnegie Trust for the Universities of Scotland

THE recently published report for 1937-38 of the Carnegie Trust for the Universities of Scotland includes detailed reviews by Sir William Bragg and other eminent authorities of the operation during the quinquennium 1933-38 of the Trust's scheme for the endowment of post-graduate study and research. The scheme involved last year the expenditure of £19,000—about 15 per cent of the Trust's total disbursements, of which £51,000 went in grants to universities and colleges and £54,000 in assisting needy students to pay their class fees. The reports indicate that its results amply justified the research scheme, being fully up to the standard set in previous years. A noteworthy feature of its operation is the large number of the recipients of awards of fellowships and scholarships who are appointed to responsible positions on the staffs of universities and other institutions for teaching and research. This, remarks Prof. J. T. Wilson, emeritus professor of the University of Cambridge, in his report on the biological and medical section of the scheme, is in keeping with one of its outstanding functions: the establishment and reinforcement of a trained corps of scientific investigators constantly available for recruitment to the service of the community in its higher schools of scientific learning. As regards expenditure by the Trust on payment of class fees, a number of the beneficiaries afterwards refund the amounts thus paid on their behalf. Such voluntary refunds fluctuate between 2½ and 5 per cent of the total amounts advanced by the Trust.

Chemical Society: Anniversary Meetings

THE anniversary meetings of the Chemical Society were held in London on March 29-31. On March 29, the Rutherford Memorial Lecture entitled "Lord Rutherford: His Life and Influence on Chemistry" was given by Sir Henry Tizard, at the Royal Institution (see p. 651). In the evening, fellows of the Society and their guests, numbering in all about four hundred, were entertained by the chairman and directors of Imperial Chemical Industries, Ltd., at Imperial Chemical House. On March 30, there were visits in the morning to Bedford College for Women and to the Wellcome Research Institution, where conducted parties were taken over the Museum of Medical Science and the Historical Medical Museum and the Chemical and Physiological Research Laboratories. In the afternoon, the business part of the annual general meeting was held at Burlington House, and the presentation of the Longstaff Medal for 1939 was made to Prof. I. M. Heilbron and of the Harrison Memorial Prize for 1938 to Mr. Alexander King. Prof. F. G. Donnan then delivered his presidential address entitled "The Role of Osmotic Pressure in the Development of Chemical and Biochemical Science". The anniversary dinner was held the same evening at Grosvenor House, the number present being 270. Prof. F. G. Donnan occupied the chair, the principal guest of the evening being Viscount Samuel. On March 31, there were visits to the British Drug Houses, Ltd., and also to

the Central Laboratories of the Shell Marketing Co., Ltd., at Fulham. In the afternoon, there were visits to the Research and Development Department of the Distillers Company at Great Burgh, Epsom, and to the Laboratories of the Research Association of British Paint, Colour and Varnish Manufacturers at Teddington. The following have been elected officers of the Society: *President*, Sir Robert Robinson; *Treasurer*, F. P. Durin; *Secretary*, Prof. G. M. Bennett.

Population and Fertility

A PAMPHLET of 101 pages, entitled "Population and Fertility", has been issued by the Population Investigation Committee, 69 Eccleston Square, London, S.W.1 (price 3s.). It has been prepared for the Committee by Mr. D. V. Glass and Dr. C. P. Blacker. The Population Investigation Committee was formed to examine the trends of population in Great Britain and the Dominions and to investigate the causes of these trends with special reference to the fall in the birth-rate. Many causes for this decline have been suggested; but multiple causes are at work affecting different occupations and different parts of the country in many complicated ways, so that effective counter-measures will not be easy to find. The problem is to find out how and why fertility has declined. For analysis of the first part, statistics of birth-rates and fertility-rates are given for England and Wales, the Dominions, U.S.A., Sweden, Germany, France, Italy, Ukraine and Japan. The table of net reproduction-rates for thirteen countries shows that only five of these populations are now replacing themselves. Interesting details are given regarding the history of the census in Great Britain and the recent Population (Statistics) Bill. It is pointed out that the latter is inadequate for a full fertility census, and certain additional questions are suggested for the next census. In the last two chapters, the limitations of vital registration statistics in analysing the psychological motives of childlessness are discussed and possible counter-measures are considered.

Royal Aeronautical Society

THE Royal Aeronautical Society has now moved into new headquarters at 4 Hamilton Place, London, W.1. This is the first time during its seventy-three years of existence that the Society has had its own building. The Society's new home is a four-story building which will allow for expanding activities for some years to come. The library will be one of the finest and best equipped aeronautical libraries in the world. There will be, in addition, a reading and other rooms for members and special committee rooms for the use of the many aeronautical committees which are now sitting. It is hoped to make the building the centre of aeronautical engineering and scientific activity in Great Britain. Dr. A. H. R. Fiddan, president of the Society, announced at the recent annual general meeting that to meet the increasing work of the Society and the upkeep of its new premises a fund of £100,000 is being aimed at, to which more

than £80,000 has already been promised. In July 1940 the Society will hold an International Aeronautical Conference at Stratford-on-Avon. The active support of the Air Ministry and the Society of British Aircraft Constructors in Great Britain and of the leading authorities in the United States, France, Germany and Italy has been promised.

New Air Speed Record

It is reported that Herr Dieterle, flying a German Heinkel aeroplane fitted with a Mercedes-Benz engine, has set up a new speed record of 483.8 miles an hour over a three kilometre course. This does not rank as an official record until it has been examined and homologated by the Fédération Aéronautique Internationale; but there is no reason to doubt that this formal recognition will be given in due course. This has beaten three world records at the same time: the 3 km. of 380 m.p.h. held by Wurster (Germany), the 100 km. of 394 m.p.h. held by Udet (Germany), and the absolute speed record of 440.7 m.p.h. held by Agello (Italy). No certain details of the aircraft are known, but it was probably developed from the Heinkel He.112.U used by Udet for the 100 km. record in June 1938. Statements that have appeared in non-technical reports that the machine was a single seater fighter fitted with an engine of 1,175 horse-power are obviously misleading. Any machine of this class must have been very thoroughly 'cleaned up' in design for such speeds, and even with such alterations the engine must have been both speeded and boosted up to a power of well over 2,000 b.h.p.

Deaf-Aids in Theatres

An interesting development in deaf-aids has been recently demonstrated in Wyndham's Theatre, London, and is being installed in a number of cinemas. Hitherto a deaf person in a cinema could frequently be supplied with a listening telephone, operated by an amplifier following a microphone located near the loud speakers behind the screen, or from the actual sound-film amplifying equipment itself, but the user was necessarily tied to his seat by the connecting wire. In the 'Telesonic system', made practicable by Messrs. Multitone Electric, an efficient type of deaf-aid is operated by a pick-up coil, in which are induced currents from an energized cable hung round the auditorium or placed under the carpet. In a theatre, a microphone in the footlights operates a specially corrected amplifier of about ten watts capacity, the output of which is fed into the magnetizing cable by a specially designed transformer. On demonstration, the device worked well and adequate audition was obtained, with freedom to move over the whole area of the seats, or even some distance outside this area. The fundamental idea of direct speech or music induction without a radio carrier is not, of course, new, but it is understood that the main feature of the invention is the disposition of magnetizing coils such that cross-talk between adjacent theatres or cinemas using the system is obviated. The normal

deaf-aids manufactured by the Multitone Company are now arranged to operate with the 'Telesonic system' in theatres.

Visual Aids in American Schools

A RECENT survey of the employment of visual aids in schools representing two thirds of the total enrolment in public elementary and secondary schools in the United States indicated that the use of (1) pictorial materials, (2) objects, specimens and models, and (3) visual aids which require mechanical equipment, was habitual in the instruction of (1) 61 per cent, (2) 52 per cent and (3) 27 per cent, respectively, of the pupils included in the survey, and that about 10,000 projectors were owned by the schools. A large percentage of the school systems not reporting were in rural districts, and the data concern, therefore, conditions in urban communities primarily. An interpretative study of these data has been published by the Office of Education ("School Use of Visual Aids". Supt. of Documents, Washington, D.C. 10 cents). There is very widespread interest in the subject (which formed the theme of thirty-seven research studies in 1936-37), and there is general agreement that the motion-picture has great potential educational value and but little apprehension that it may prove, as forecast by Georges Duhamel (in "Défense des Lettres") and others, to be one of applied science's Greek gifts to culture. Among the further developments recommended in the light of this survey are the production of high-grade educational films, a nation-wide distribution system, training courses in the technique of teaching with motion pictures and other visual aids and improvement of the 16 mm. projector so as to make it easier for amateurs to operate.

Antiquity

AN editorial note in *Antiquity* of March, 1939, directs attention to an important development in the study of European prehistoric chronology. E. H. de Geer, it is stated, has succeeded in equating the growth-rings of trees from the ancient mound of Rakenhangen in the Romerike district of Norway with those of a giant Californian sequoia on one hand, and with clay varves from Angermanland in North Sweden on the other. The tree trunks examined were preserved when a shaft was sunk to the base of the mound in 1868. The investigation points to A.D. 931 as the date of the cutting of the trees and the erection of the mound. As the editor of *Antiquity* points out, the acceptance of the full implication of this important discovery must await further critical examination; while the application of dendrology to European chronology is not without its peculiar difficulties. The March issue of this enterprising periodical well maintains its high standard of interest, in part owing to the inclusion of Prof. V. Gordon Childe's lecture on the relations of India to the West before the time of Darius, which originally was delivered before the Warburg Institute on October 10, 1938, and Dr. R. E. Mortimer Wheeler's report on his excavations in Brittany, to which

reference has already been made in *NATURE* (see *NATURE* of March 4, p. 386). The report is fully illustrated and accompanied by plans. Mr. James Hornell draws on his world-wide knowledge of the construction of various forms of boat to trace the plank-built boat to its origin. Among the interesting shorter notes which are always a feature of the contents, mention should be made on this occasion of a valuable suggestion from Mr. Stanley Casson, urging the prosecution of submarine research in the coastal waters of Greece. He points out that not only are the sea routes of antiquity well known, but recent discoveries of statuary, especially bronzes of the best period of classical art, support the argument that cargoes of artistic loot on the way to Rome may have been lost with some frequency.

Design of Electric Power Stations

AN important paper by F. W. Lawton was read to the Institution of Electrical Engineers on March 9 dealing with the design of Hams Hall power station at Birmingham, designed twelve years ago, and with a new Hams Hall power station *B* which will be constructed shortly for the same purpose and on a neighbouring site. The author stresses the point that from the time when the calculations for a proposed power station are made until it is completed and running on a commercial load, several years may have elapsed and great changes may have occurred. For example, the average price of the coal used in the furnaces is now 17s. per ton as against 9s. 6d. in 1925. In designing the new station it was reasonable to consider which features of the old station should be repeated and which rejected in the new station built twelve years afterwards. During this time coal prices have increased, high voltages have become normal and the progress made in metallurgy has made much higher steam temperatures feasible. All these changes call for modification in the designs if the best efficiency and economy are to be obtained. As regards the general lay-out, the simplicity and uniformity of the existing station will be repeated. There is a single row of boilers parallel to a single end-on row of turbo alternators. Electrostatic flue-gas cleaning plant will be retained. The absence of architectural adornment of the new buildings will be more rigorously enforced. Air raid precautions insist that there must be no roof lights or external windows to basements. For economic reasons the superstructure will be made of ferro-concrete instead of structural steel. Turbo-alternators of 50,000 kw. capacity each will again be used in the new station, but they will generate at 33,000 volts instead of at 11,000 volts as in the present station. A true understanding of what is real economy is obscured by the ever-changing technology of power production, by the difficulties of accurately forecasting operating conditions many years ahead, and by reactions of local trade developments.

Research at the Kodak Laboratories

THIRTY-NINE papers are covered in the recently published "Abridged Scientific Publications from Kodak Research Laboratories" (vol. 19. Pp. viii+

288. Rochester, New York: Eastman Kodak Co.). The wide variety of subjects studied at the Kodak Laboratories is well illustrated. Most of the papers have some obvious connexion with photographic manufacture or technique. Among these may be mentioned specially four papers dealing with the measurement of photographic density. This has never yet been standardized and, though for most technical purposes 'density' is sufficiently well understood to permit useful application of measurement to laboratory testing and works control, yet for precise comparison of results obtained on different instruments of slightly different design, there is need for much further progress. Perhaps the new information may be useful in achieving this. There are, however, several papers which are devoted to subjects which are outside the photographic field altogether, and here we may cite a group of papers by Dr. K. C. D. Hickman and colleagues dealing with fractional distillation of phlegmatic liquids. The work has resulted in development of much improved apparatus for distillation of vitamins. As with previous volumes, each paper is presented without drastic shortening, so that to those who are not able to turn to the full papers in their original journals the volume is of exceptional value.

Scottish Wild-Life Preservation

THE Council of the Zoological Society of Scotland recently set up a Scottish Nature Reserve Committee, on which various public bodies are represented, for the purpose of promoting the preservation of Scottish wild-life. The Committee wishes to obtain full and accurate information regarding the existence, numbers, increase or decrease, and generally the most complete statistics, of native species in different parts of the country. The Committee believes that helpful information of this kind could be furnished by local natural history societies and other associations as well as by landowners, gamekeepers and others, and, therefore, it desires the co-operation of anyone who could furnish such information and who would collaborate with the Committee in the work which it hopes to do. Another aspect of the work which the Committee might usefully undertake would be the mapping out of areas in Scotland which might be suitable for Nature reserves or sanctuaries. Anyone who possesses local knowledge of the suitability of land for such a purpose could greatly assist the Committee by communicating such information to it. Communications should be sent to the Director-Secretary, the Zoological Society of Scotland, Zoological Park, Edinburgh, 12.

Biology and Social Studies

Fact, now successfully at the end of two years' activity, which produces, in its own phrase, "A monograph a month", has just brought out another scientific number bearing the title "Biology and Man: Past and Future" by Prof. Marcel Prenant of the Sorbonne. This for the most part consists of an interesting and well-written summary of the main trends in the history of biology in relation to

contemporary social and economic backgrounds. This is seconded by an able essay from Dr. H. J. Muller, who is well known as a geneticist, now of Edinburgh, entitled "The Dominance of Economics over Eugenics" in which the relationship of social systems to human inheritance, and the true value of eugenic hopes, are discussed. He propounds the question whether the present social systems of western Europe do not involve a selection of socially inferior rather than of socially superior human material. These contributions should be of interest not only to all biologists, but also to much wider circles. *Fact* is edited by Mr. R. W. Postgate; Mr. H. G. Wells has recently joined its editorial board.

Standards on Electronics and Radio Receivers

THE Institute of Radio Engineers (330 West 42nd Street, New York) was founded in 1912 to advance the theory and practice of radio and allied branches of engineering and to maintain a high professional standard amongst its members. Although dominantly in the United States of America, the Institute membership of more than 5,000 persons is distributed throughout the world. The *Proceedings*, published since 1913, is issued monthly and contains contributions from leading workers in the theoretical and practical fields of radio communication. It has co-operated with many other bodies in the establishment of standards. It has published many reports dealing with the definitions of terms, letter and graphical symbols, and methods of testing and rating equipment. Now it has issued "Standards on Electronics, 1938" and "Standards on Radio Receivers, 1938" (price 50 cents each). The committees which drew up the pamphlets are to be congratulated on the thorough way they have done their work. Every radio engineer and teacher of technical electricity should have a copy of these pamphlets, for they are most useful for reference.

Interplanetary Travel

WE have received vol. 5, No. 1 of the *Journal of the British Interplanetary Society*, a body "founded for the stimulation of public interest in the possibility of interplanetary travel, the dissemination of knowledge concerning the problems which the epoch-making [*sic*] achievement of an extra-terrestrial voyage involves, and the conducting of practical research in connection with such problems". This number of the *Journal* contains designs for a "space ship" intended to perform a voyage to the moon and back. While we may invite the charge of obstructionism if we dismiss the whole affair as a wild-cat speculation, it is necessary for us to remark that, while the ratio of research results accomplished to speculative theorizing is so low, little confidence can be placed in the deliberations of the British Interplanetary Society.

The Midwifery Service

THE annual report of the Central Midwives Board for the year ended March 31, 1938, has been issued (London: H.M. Stationery Office. 4d. net). At the

end of the year, there were 67,089 women on the midwives roll, a net increase of 2,043 on the total for the previous year, but only a little more than a quarter of the total number of those on the roll are engaged in the practice of their profession. The number of candidates entering for the examination was 4,420, the highest number ever recorded, of whom three quarters were successful. The report sets out the arrangements made by the Board for the approval of institutions, lecturers and teachers under the rules, of which a detailed explanation is given.

Science Abstracts

NEITHER science nor industry is standing still and to anyone who wishes to keep abreast of the advances made, the two sections of *Science Abstracts*—Physics and Electrical Engineering—are of great service. The two index numbers published in the last week of February completed the volumes for 1938. The Physics Section contains 5,081 abstracts from about half that number of publications, the average number of the abstracts being about 4.3 per page. The index of subjects covers 189 pages, that of apparatus 22, and the author index 65 pages. The Electrical Engineering Section has 3,622 abstracts, about 4.6 to a page, with a subject index of 59 pages and an author index of 31 pages. The Physics volume is thus about 10 per cent less than, and the Electrical Engineering volume about 3 per cent larger than, the volume for 1937.

British Empire Cancer Campaign

THE seventieth quarterly meeting of the Grand Council of the British Empire Cancer Campaign was held on April 3. The following grants were approved, making a total to date for the year 1939 of more than £48,000: £1,000 to the North of England Branch of the Campaign for the continuation of the special short-wave investigations being carried out under the direction of Dr. F. Dickens; and £160 to Mr. E. Nevill Willmer, working at the University of Cambridge. The Council received a report regarding the joint discussions which had taken place between representatives of the Campaign, the Medical Research Council and the National Radium Commission on the subject of the installation of a cyclotron in Great Britain primarily for medical and biological investigations as affecting the cancer problem. The three bodies have now jointly agreed to refer this matter for further consideration to the Radiology Committee. A further sum of approximately £6,500 is to be allocated to meet the expenses to be incurred during the second year's working of the scheme of the Clinical Cancer Research Committee. This scheme covers an inquiry into all fresh cases of cancer in the London area, and during the first two years the results of investigations into approximately 34,000 cases will have been placed at the disposal of the Committee. Dr. J. M. Woodburn Morison has been invited to become the representative of the Campaign on the Scientific Advisory Committee of the newly amalgamated Radium Institute and Mount Vernon Hospital.

Travelling Fellowships in Medicine

THE Medical Research Council invites applications for six Rockefeller Medical Fellowships for the academic year 1939-40. These are provided from a fund with which the Council has been entrusted by the Rockefeller Foundation of New York. They are intended for British graduates who have had some training in research work in clinical medicine or surgery, or in some other branch of medical science, and who are likely to profit by a period of work at a centre in the United States or elsewhere abroad, before taking up positions for higher teaching or research in the United Kingdom. The stipend will ordinarily be at the rate of £360 per annum for a single Fellow, and of £480 per annum for a married Fellow. Travelling expenses and some other allowances will be paid in addition. The Council also invite applications for four Dorothy Temple Cross Research Fellowships in Tuberculosis, which are awarded from a special endowment of which the Council is the trustee. The object of these Fellowships, as defined in the Trust deed, is to give special opportunities for study or research to suitably qualified British subjects of either sex "intending to devote themselves to the advancement by teaching or research of curative or preventive treatment of tuberculosis in all or any of its forms". The stipend will ordinarily be at the rate of £350 per annum for a single Fellow, and of £480 per annum for a married Fellow, with an allowance for travelling and incidental expenses. Further information can be obtained from the Secretary, Medical Research Council, 38 Old Queen Street, Westminster, S.W.1.

International Foundry Congress

ARRANGEMENTS for the 1939 International Foundry Congress, to be held in London during June 12-17, are now almost complete. The official opening of the Congress by the Lord Mayor of London, Sir Frank Bowater, will take place on the morning of June 13, and afterwards Prof. W. L. Bragg will deliver the fourth Edward Williams Lecture entitled "The Atomic Pattern of Metals". Some forty papers will be presented to the Congress, and a joint meeting with the Iron and Steel Institute will be held on June 16. In addition to these technical sessions, at which all phases of ferrous and non-ferrous foundry practice and metallurgy will be discussed, eleven companies in London and the home counties have consented to open their works to Congress delegates, and the director of the National Physical Laboratory has offered to show a party round the metallurgical section of the Laboratory. The Government will give a reception on June 13, and other social functions include the annual banquet on June 14 and the reception to be given by Mr. W. B. Lake, president of the Congress, and Mrs. Lake on June 15. A tour of the principal foundry centres of Great Britain has been arranged to follow the Congress, and is divided into two sections: June 18-24 and June 25-30. Delegates may participate in either the first or both weeks of the tour, during which they will be able to inspect twenty-six of Britain's leading foundries.

Further particulars concerning the Congress and the tour are obtainable from the organizers, the Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, 3.

Announcements

THE Linnean Gold Medal, awarded annually by the Linnean Society of London "to an eminent biologist as an expression of the Society's estimate of his services to science", has been awarded to Prof. E. D. Merrill, professor of botany in Harvard University and supervisor of the Arnold Arboretum.

PROF. E. J. SALISBURY will deliver the Symons Memorial Lecture of the Royal Meteorological Society on April 19 at 7.30. The subject of Prof. Salisbury's lecture will be "Ecological Aspects of Meteorology".

PROF. WERNER KNOTHE, of Berlin, has been elected president of the Berlin Röntgen Society.

THE University of Bologna has awarded the Umberto Prize, given every five years for the best scientific work on orthopaedics, to Dr. Pauwels, head of the Municipal Orthopaedic Clinic at Aachen.

THE annual Congress of the Society for British Entomology will be held in the Manchester Museum and the University of Manchester during July 15-17, under the presidency of Prof. W. A. F. Balfour-Browne.

THE tenth International Congress of Military Medicine and Pharmacy will be held at Washington on May 7-15. Further information can be obtained from the general secretary, Colonel Harold W. Jones, 7th Street and Independence Avenue, Washington, U.S.A.

ENTRIES for the next award of the Henry Saxon Snell prize must be delivered on or before September 30, 1939, to the Secretary, Royal Sanitary Institute, 90 Buckingham Palace Road, S.W.1. The prize was founded to encourage improvement in the construction or adaptation of sanitary appliances, and is to be awarded by the Council of the Institute at intervals of three years, the funds being provided by the legacy left by the late Henry Saxon Snell, fellow of the Institute. The prize for 1939 will consist of fifty guineas and a silver medal, and is offered for an essay describing suggested improvements in the construction or adaptation of sanitary appliances.

THE British Museum (Natural History) has recently issued (1939) a fourth edition of the pamphlet entitled "The House-fly" which forms No. 1 of the economic series of brochures. The work has been revised by Dr. John Smart, an assistant keeper in the Department of Entomology. The chief modifications, as compared with the previous edition, concern the account of preventive measures and remedies. The pamphlet is obtainable from the Director, British Museum (Natural History), London, S.W.7, price 6d.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 644.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

New Products of the Fission of the Thorium Nucleus

In a preceding communication¹ it has been shown that the 'transuranium' elements are found among the fission products of uranium under neutron bombardment. Consequently they must be lower elements, probably partly somewhere near tellurium², partly (the complementary fission fragments) in the region of ruthenium.

It was then natural to carry out similar experiments with thorium in order to see whether the fission of thorium gave rise to elements with chemical properties similar to those of the 'transuranium' elements, that is, elements which can be precipitated with hydrogen sulphide from a strong hydrochloric acid solution. No search for such elements had previously been carried out with thorium, since the formation of elements beyond uranium, from thorium, was not to be expected. So far, chemical analysis of the radioactive bodies produced in thorium by neutron bombardment has revealed (apart from a thorium and a protactinium isotope resulting from pure neutron capture) only products which, on the basis of their chemical properties, had originally to be assigned to radium and actinium isotopes³ and which have more recently been identified with barium and lanthanum isotopes⁴.

A 'thick' layer of thorium oxide on a glass plate was irradiated by neutrons obtained by bombarding a lithium target with deuterons of 800 kv. from the high-tension equipment of the Institute of Theoretical Physics, Copenhagen. In order to collect the recoil nuclei, a water surface was used in the way previously described¹. After irradiation (of about one hour) a fraction (2 c.c.) of the water was evaporated without chemical separation; with the rest (9 c.c.) the usual hydrogen sulphide precipitation was carried out in exactly the same way as in the uranium recoil experiments¹.

The precipitate showed a clearly measurable activity, the decay of which was distinctly different from the decay of the analogous uranium products. After an initial decrease with a half-value period of about 40 minutes, an activity remained which was followed for almost two days and showed a single decay period of 14-15 hours. The evaporated sample showed first a much faster decay which then gradually became slower; after two days, the activity had vanished.

A second experiment with 2.5 hours' irradiation gave the same result, with correspondingly greater intensity, especially of the longer period. In this experiment, after the sulphide precipitation, the filtrate was neutralized and the barium and lanthanum¹ were precipitated as carbonates. The carbonate precipitate decayed first with about 20 minutes and then with 4 hours half-value period, in agreement with the periods already known^{3,4}.

Analysis of the decay of the sulphide precipitate showed again the presence of a substance of half-period about 40 minutes and of one of 14.5 hours, which was followed for nearly three days and found to decay to zero. The initial intensities of the two periods were about equal, in spite of the short duration of bombardment. The possible existence of very short or very long additional periods can, of course, not be excluded on the basis of this experiment. The two periods observed are quite different from those of the chemically analogous uranium products.

Several check experiments without neutrons showed that there was no contamination of the water by thorium B or C, which might have resulted from radioactive recoil or traces of emanating thoron. As a further protective measure, the thorium layer was sealed, in the second experiment, by a celluloid membrane of 0.3 mm. stopping power.

From the evidence given above, one can conclude that some of the fission products of thorium show a chemical behaviour similar to that of the 'transuranium' elements. This is a further indication that essentially the same chemical elements are produced in the fission of uranium and thorium.

In conclusion, I wish to express my thanks to Dr. T. Bjerre, Dr. J. Koch, and K. J. Broström for kind help in the irradiations with the high-tension tube. I am especially grateful to Prof. N. Bohr for the opportunity to carry out these experiments and for the facilities kindly put at my disposal at the Institute of Theoretical Physics, Copenhagen.

LISE MERTNER.

Physical Institute,
Academy of Sciences,
Stockholm.
March 26.

¹ Mertner, L., and Frisch, O. R., *NATURE*, **143**, 471 (1939).

² Abelson, P., *Phys. Rev.*, **55**, 418 (1939). Feather, N., and Bretscher, E., *NATURE*, **143**, 516 (1939).

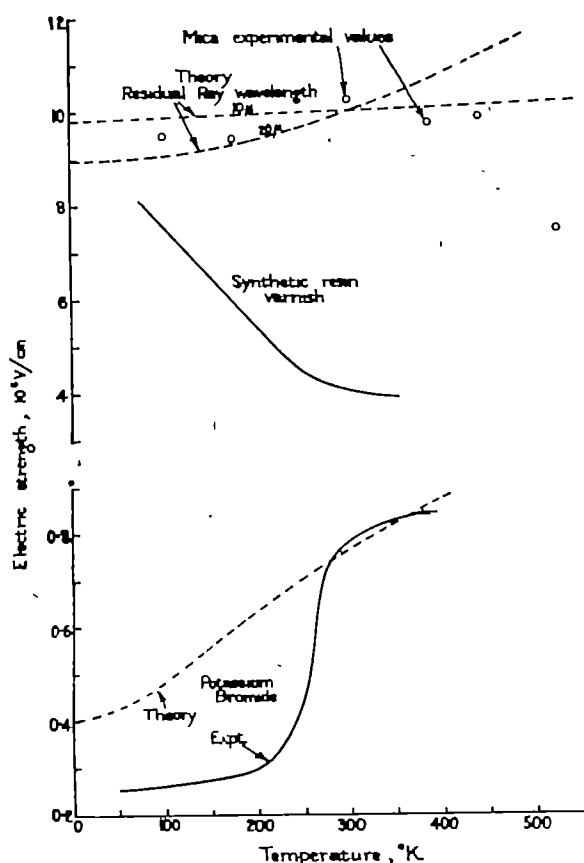
³ Mertner, L., Hahn, O., and Strassmann, F., *Phys.*, **2**, 186, 538 (1938).

⁴ Hahn, O., and Strassmann, F., *Naturwissenschaften*, **27**, 39 (1939).

Electronic Breakdown in Solid Dielectrics

In a recent paper¹ Dr. Fröhlich has advanced a theory of the electronic breakdown of ionic crystals under electric stress. The theory was applicable to diatomic crystals such as the alkali halides, but an extension to any polar crystal (made at the instigation of the Electrical Research Association) is in course of publication by Dr. Fröhlich.

The E.R.A. has conducted a number of experiments in order to determine whether electric breakdown in a uniform field, brought about in a manner such that the breakdown is independent of external conditions, is of the electronic type envisaged by Dr. Fröhlich.



A measure of agreement between theory and experiment has been obtained in respect of the following points.

(1) The absolute value of the electric strength of polar crystals may be calculated from the optical properties, the dielectric constant and the molecular volume. The theoretical value for potassium bromide at room temperatures is in good agreement with the experimental value (see accompanying graph). For mica, certain of the required constants are not known and the theoretical value is therefore uncertain; on taking probable values, however, the value of the electric strength obtained is $8.6 \times 10^6 \text{ v./cm.}$, with a possible upper limit of $15 \times 10^6 \text{ v./cm.}$ The experimental values for both sustained and impulse stresses lie within these limits.

(2) The theory predicts that the electric strength of thin sheets of insulating material should increase with decrease of thickness when the thickness is comparable with the mean free path of an electron, that is, 10^{-4} to 10^{-5} cm. The electric strength of mica has been found to increase from about $11 \times 10^6 \text{ v./cm.}$, at thicknesses from 10^{-4} to 10^{-5} cm. , to $16 \times 10^6 \text{ v./cm.}$ at a thickness of the order of 10^{-3} cm.

(3) The variation of electric strength E with temperature T (in °K.) is predicted by the theory for the simple case when there is only one residual ray frequency ν as:

$$E \propto \left\{ 1 + \frac{2}{e h / k T - 1} \right\}^{1/2},$$

where h is Planck's constant and k is Boltzmann's constant.

This form, applicable to diatomic crystals, may also be used as a first approximation for other polar crystals with several residual ray frequencies, the more accurate formulae for which are in course of publication. The electric strength should therefore increase with increase of temperature up to a critical value above which other phenomena intervene. For mica, satisfactory agreement is obtained up to about 400° K. with theoretical curves based on the assumption that the observed value is correct at room temperature and that the effective residual ray wavelength is between 10μ and 20μ . The experimental variation for potassium bromide is in the same direction as, but of greater magnitude than, that predicted by theory. The discrepancies at lower temperatures, though considerable, are, however, small in comparison with the divergences which are found with those materials to which the existing theory does not seem to apply, and where indeed a completely opposite variation with temperature frequently occurs. An example of this also is shown in the graph, by the inclusion of the electric strength of a synthetic resin varnish, determined by A. Morris Thomas and M. V. Griffith in this laboratory.

It is hoped that a complete account of these and other similar investigations will be published in due course.

A. E. W. AUSTEN.
W. HACKITT.

E.R.A. Laboratory,
Perivale, Middlesex.
Feb. 14.

¹ *Proc. Roy. Soc., A*, 166, 230 (1937).

Supersonic Dispersion and Infra-Red Radiation

A propos of the Herzfeld and Rice¹ theory of acoustic dispersion in gases, by which a lag in the transfer of translational energy into vibrational energy in high-frequency collisions of molecules is supposed to take place, Dwyer² has recently described experiments in which the after-effect of collisions produced when a discharge passes through a gas is evidenced by the persistence of absorption lines in the visible spectrum for a short time after the discharge has ceased. While these experiments give credence to the 'relaxation theory' in its original form, they have no necessary connexion with supersonic dispersion, since Dwyer made no supersonic experiments on the gas in question (iodine).

During the past year, I have been attacking the same problem from a different angle. Attempts have been made to find a direct effect on the well-known supersonic dispersion of carbon dioxide by subjecting it to optical radiation of its own natural (vibrational) frequencies. A Pierce acoustic interferometer was constructed of the usual type, save that the centre portion, including the region between the quartz oscillator and the reflector, was provided with quartz windows. The apparatus was evacuated and filled with carbon dioxide. Frequencies between 80 and 100 kc./sec. for the supersonic source were used, corresponding roughly to the peak of the dispersion region for the gas in question. The infra-red radiation came from a hot tube of the original Rubens and Ashkinas³ type containing carbon dioxide, and was focused by mirrors on to one of the quartz windows.

Two experiments were tried. In the first, the beam emerging from the opposite window was passed through a Hilger infra-red spectrometer and the

intensity of the 4μ , 8μ and 15μ lines of carbon dioxide compared when the quartz was quiet and when it was set in oscillation, to see if the supersonic energy caused any change in the absorption of these radiations. No positive effect was found, though this was not surprising in view of the limited amount of supersonic energy which one can get into a gas at such frequencies, and the already small residual infra-red energy after the gas had exercised its selective absorption.

In the second experiment, the gas was again irradiated at the three infra-red wave-lengths quoted and measurements made of the wave-length and dissipation of the supersonic energy in the gas. No change in wave-length, other than that which could be attributed to the rise of temperature, was found; but the supersonic attenuation was definitely greater when the gas was irradiated than when it was not, as though the molecules, excited in their natural vibrational states, were able to absorb more supersonic energy.

It is, however, difficult to generalize from this result in respect to the relaxation theory, since Penman⁴ and others have shown that a mere increase in thermal agitation of the molecules, induced by rise of temperature and irrespective of any particular natural mode of vibration, produced a change in the supersonic dispersion.

E. G. RICHARDSON.

King's College,
Newcastle-upon-Tyne, 2.
March 3.

¹ *Phys. Rev.*, **31**, 591 (1933).

² *J. Chem. Phys.*, **7**, 40 (1939).

³ *Ann. Phys.*, **64**, 584 (1908).

⁴ *Proc. Phys. Soc.*, **47**, 543 (1935).

Mechanism of Excitation of the Forbidden Lines of Oxygen and Nitrogen in the Spectra of the Aurora and the Night Sky

RECENT publications concerning the identification of the ^4S - ^3P forbidden transition of NI in the spectra of the aurora and the night sky require a revision of previously published results. Actually, R. Bernard¹ has shown that the wave-length of the auroral radiation considered is undoubtedly 3466.5 ± 1 Å, instead of 3470 Å. On the other hand, laboratory² and theoretical³ determinations give respectively λ 3466.3 and 3466.5 Å. Owing to this fair agreement in wave-length, the attribution of the auroral radiation to the forbidden transition of NI may be accepted fairly safely, whereas this identification is not yet acceptable in the night sky spectrum (owing to unduly high $\Delta\lambda$).

In this communication we want to suggest a new excitation mechanism for the forbidden line of NI and for the increasing intensity of the red O I-line with height and auroral type; this mechanism does not require polyatomic compounds.

It has been shown⁴ that the auroral spectrum exhibits the system of Vegard-Kaplan bands. According to L. Vegard⁵, it is not yet proved that the intensity of these bands is increasing with height; but this may be safely assumed as the initial state is a metastable level. On the other hand, L. Vegard⁴ has observed, on many occasions, that the intensity ratio of the red and green lines increases in the spectra of diffuse auroras; this must be connected with Bernard's observation¹ of a different behaviour

of the Vegard-Kaplan bands in the auroras of the diffuse and of the other types. Finally, there must be noticed a close connexion⁶ between the Vegard-Kaplan bands and the newly identified NI transition, this meaning that the concentration of the ^3P metastable nitrogen atoms is connected with the forbidden emission A $^3\Sigma \rightarrow ^1\Sigma$.

The Vegard-Kaplan bands which have been identified with the strongest evidence⁷ correspond to the final levels $v' = 9$ to 15. If we determine the excitation energies corresponding to the vibrational states $v' = 7$ and 15 of the normal level of N_2 , we get the following figures: $E_{v'=7} = 16884.5 \text{ cm}^{-1} = 2.08 \text{ ev}$. $E_{v'=15} = 31103.4 \text{ cm}^{-1} = 4.08 \text{ ev}$. These values exceed the ^1D excitation potential of O I but are inferior to ^1S .

It is therefore justifiable to assume that by collision of a normal O I atom with a N_2 molecule which has emitted the Vegard-Kaplan bands, the oxygen atom is actually only able to be excited to the ^1D state and not to ^1S . As we know that N_2 and O I are the major constituents of the upper atmosphere (above 100 km.), it seems doubtless that collisions must happen between these two constituents. Still this mechanism requires the absence of a spontaneous emission of the vibrational bands of N_2 . This is actually the case owing to the fact that N_2 has no electric dipole. Thus N_2 molecules may spend a long time on the excited vibrational levels of the lowest electronic state, and consequently the number of excited ^1D oxygen atoms will be a function of the emission of the Vegard-Kaplan bands.

If NI atoms are present in the high atmosphere, the same mechanism explains the observation of the ^4S - ^3P forbidden transition associated with the emission of the Vegard-Kaplan bands in the spectra of diffuse auroras. As the excitation energy of the ^3P level of NI amounts to 5.56 ev., a certain number of N_2 molecules, after emission of the Vegard-Kaplan bands, will collide with the normal ^4S nitrogen atoms and bring them to the ^3P state.

A more detailed paper concerning the identification and excitation processes of the forbidden transitions in the spectra of the earth's atmosphere will appear in the *Mémoires de l'Institut Royal Météorologique de Belgique*.

MARCEL NICOLET.

Lichtklimatisches Observatorium,
Arosa.
Feb. 25.

¹ *Bull. Soc. française de Phys.*, **7**, 157 B. (1938).

² Kaplan, J., *Phys. Rev.*, **54**, 541 (1938).

³ Nicolet, M., *Die Naturwiss.*, **26**, 830 (1938).

⁴ Vegard, L., *Byggnads. der exakt. Naturwiss.*, **17**, 220 (1938).

⁵ Vegard and Tonsberg, *Geof. Publ.*, **11**, No. 16, 33 (1937).

⁶ Bernard, B., *NATURE*, **141**, 1140 (1938).

⁷ Kaplan, J., *Phys. Rev.*, **54**, 143 (1938).

Resistance-Capacity Tuning

VALVE oscillators and selective amplifiers, in which tuning is carried out by a combination of condensers and resistances, have been developed in recent years and provide means of obtaining sinusoidal oscillations of low as well as high frequency.

In an oscillator which I am developing, the lower frequency limit has been brought down one hundred-fold and more by making use of the Miller effect. The principle involved is as follows. If a condenser C be connected between the grid and cathode of a valve and a potential difference V exists between these

points, then a current I enters the condenser. Let the condenser be now connected between the grid and the anode of the valve, the grid-cathode potential being still V . The potential of the anode will be $-mV$ if the gain of the valve is m (assuming the anode and grid potentials to be in antiphase), and the potential difference across C will be $(m+1)V$. Accordingly, the current entering C will be increased $(m+1)$ times. This new current is the same as that which would be taken by a condenser of capacity $(m+1)C$ between grid and cathode. As the gain may be of the order of hundreds, the equivalent of many microfarads may easily be obtained.

Using this effect, I have built an oscillator with a periodic time of several minutes, although the largest condensers and resistances employed are 0.2 microfarad and 2 megohms respectively. With periodic times of a few seconds available, one may demonstrate the production of rotating magnetic fields, for the synchronous speed is low enough to be followed by a compass needle.

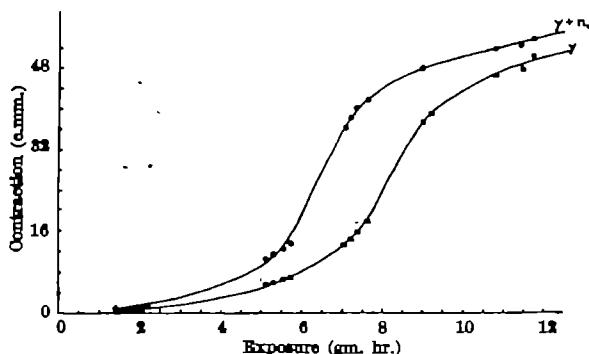
In a similar manner, the 'equivalent' resistance of a grid leak may be increased many times. An additional phase-reversing valve stage is necessary here. This possibility has not been developed, as other and simpler means for producing the same effect exist.

N. H. ROBERTS.

Department of Electrical Engineering,
University of Cape Town,
Rondebosch.
Feb. 25.

Polymerization of Liquids by Irradiation with Neutrons and Other Rays

IN continuation of previous work on the effects of radiations on liquids¹, we have for some time been investigating the action of neutrons, alpha-, beta- and gamma-rays in inducing polymerization of a number of hydrocarbon compounds. Of the different methods used for observing the rate of polymerization—changes in colour, refractive index, viscosity, streaming polarization, etc.—we have found it convenient to follow the changes in density consequent on irradiation by means of a volume dilatometer. The sources of radiation were sometimes placed inside the bulb of the dilatometer, and sometimes surrounded it.



POLYMERIZATION OF METHYLACRYLATE BY IRRADIATION WITH NEUTRONS AND GAMMA RAYS.

Strength of source: $\gamma = 78$ mgm. Ra [SO₄] in Pt needles 0.5, 0.6 mm. filter; $\gamma + n = 78$ mgm. Ra [SO₄] + Be in monel metal tubes, 2 mm. filter. Irradiated volume = 6 c.c.

In the case of neutron irradiation, the liquid under test was placed in a small double-walled vessel, similar to a Dewar vessel, to which a capillary stem had been sealed. The gamma-ray or neutron sources were placed in the central cavity and the whole apparatus immersed in a large bath of water. A typical series of observations during the gamma-ray and neutron irradiation of methyl methacrylate is shown in the accompanying graph. Similar results were obtained with beta-rays.

The liquids investigated so far include, in addition to methyl methacrylate, styrene, vinyl acetate, and a ketone. The expulsion of dissolved substances which had been deliberately added, for example, cresin, indole, etc., was often strikingly shown during the polymerization.

F. L. HOPWOOD.

J. T. PHILLIPS.

Medical College,
St. Bartholomew's Hospital,
London, E.C.1.
March 31.

¹ Hopwood and Phillips, *NATURE*, 136, 1028 (1935). Hopwood and Phillips, *Proc. Phys. Soc.*, 50, 428 (1938).

New Acetylated Derivatives of Amino Sugars

A RECENT communication from this laboratory reported the preparation of 3-amino α -methylaltroside hydrochloride and 2-amino α -methylaltroside¹. Development in this field of work has been rapid, and it therefore seems desirable to publish additional information which has been obtained since our last letter on the subject.

The material obtained by the action of ammonia on 2:3-anhydro 4:6-benzylidene α -methylaltroside has been acetylated and separated into two fractions, which prove to be 2-acetamido 3-acetyl 4:6-benzylidene α -methylaltroside (1) in sixty per cent yield, and 2-acetyl 3-acetamido 4:6-benzylidene α -methylglucoside (2) in 1 per cent yield. The production of (1) and (2) in this reaction, previously shown by Peat and Wiggins², has thus been confirmed, but the yield of (2) obtained by us shows a wide discrepancy from that claimed by the authors mentioned above.

In analogous fashion, we have found that the material obtained by the action of ammonia on 2:3-anhydro 4:6-benzylidene α -methylmannoside, followed by acetylation, may be separated into two isomeric substances which prove to be 2-acetyl 3-acetamido 4:6-benzylidene α -methylaltroside (3) in 60 per cent yield and 2-acetamido 3-acetyl 4:6-benzylidene α -methylglucoside (4) in about 1 per cent yield. Substance (4) is therefore a derivative of glucosamine.

Galactose has been converted into a 2:3-anhydro 4:6-benzylidene α -methylhexoside, which has either the gulose or talose configuration³. When this substance is submitted to the action of ammonia followed by acetylation, the product may be separated into two isomeric 4:6-benzylidene amino α -methylhexoside diacetates, (5) and (6), which have not yet been identified.

Robertson and Dunlop⁴ obtained two isomeric α -methylhexoside chlorhydrins by the action of very dilute hydrochloric acid on 2:3-anhydro 4:6-benzylidene α -methylaltroside. These substances give amino α -methylhexosides on treatment with ammonia, and when the product so obtained is acetylated, the resulting material may in both cases be separated

into two isomeric substances by means of crystallization. The α -methylhexoside chlorhydrin, m.p. 160°, yields triacetyl 3-acetamido α -methylglucoside (7)² in 60 per cent yield, and a trace of an isomer (8), which has not yet been identified. The other chlorhydrin, m.p. 188°, after similar treatment, yields (7) in 50 per cent yield and an isomer (9), which has not yet been identified, in 20 per cent yield.

A syrupy mixture of α -methylhexoside chlorhydrins has been obtained from 2:3-anhydro 4:6-benzylidene α -methylmannoside by the method mentioned above, but we have not yet been able to separate the constituents. On treatment of this mixture with ammonia and subsequent acetylation, however, a crystalline product is obtained, from which we have separated (7) in 15 per cent yield and an isomer (10) in 65 per cent yield, which differs from (8) and (9).

Finally, the benzylidene group has been removed from 2-acetyl 3-acetamido 4:6-benzylidene α -methylaltroside (3), and the product acetylated to give 2:4:6-triacetyl 3-acetamido α -methylaltroside, which proves to be identical with (10).

Constants for the derivatives described are appended.

- (1) m.p. 181–183°; $[\alpha]_D^{25} + 51.5^\circ$ in chloroform ($c = 2.13$).
- (2) m.p. 266°; $[\alpha]_D^{25} + 45.6^\circ$ in chloroform ($c = 0.56$).
- (3) m.p. 201°; $[\alpha]_D^{25} + 14.6^\circ$ in chloroform ($c = 2.33$).
- (4) m.p. 235°; $[\alpha]_D^{25} + 45.5^\circ$ in chloroform ($c = 0.85$).
- (5) m.p. 188°; $[\alpha]_D^{25} + 43.4^\circ$ in chloroform ($c = 1.25$).
- (6) m.p. 260°; $[\alpha]_D^{25} + 70.3^\circ$ in chloroform ($c = 0.87$).
- (7) m.p. 179°; $[\alpha]_D^{25} + 105.0^\circ$ in chloroform ($c = 2.12$).
- (8) m.p. 130°; $[\alpha]_D^{25} + 96.7^\circ$ in chloroform ($c = 0.74$).
- (9) 5 group; $[\alpha]_D^{25} + 50.4^\circ$ in chloroform ($c = 2.73$).
- (10) m.p. 177°; $[\alpha]_D^{25} + 24.7^\circ$ in chloroform ($c = 2.33$).

Full details of the above transformations and evidence of identification will be published shortly.

G. J. ROBERTSON.

W. H. MYERS.

Chemical Research Laboratory,

The University,

St. Andrews.

March 1.

¹ Robertson, Myers and Tello, *NATURE*, **143**, 1076 (1938).

² Peat and Wiggins, *J. Chem. Soc.*, 1810 (1938).

³ Robertson and Tello, unpublished result.

⁴ Robertson and Dunlop, *J. Chem. Soc.*, 472 (1938).

Use of *dl*-Menthol for the Preparation of Biosynthetic Glucuronic Acid

GLUCURONIC acid, within recent years, has been shown to be a compound of considerable biological importance. Besides playing an important part in the detoxication mechanisms of the body, this carbohydrate derivative is also an essential component of certain immuno-polysaccharides¹. It is found in many mucoproteins² and may be a component of the blood anti-coagulant, heparin³; furthermore, certain sex hormones of human pregnancy urine are found combined with glucuronic acid⁴. Investigations on the chemical nature and biological function of these substances, which will also involve synthetic experiments, will be greatly facilitated if glucuronic acid is obtainable in relatively large amounts. A convenient chemical synthesis of glucuronic acid, such as exists for galacturonic acid⁵, is not available. The main source of it has been biological, advantage being taken of its function in the mammal as a detoxicating agent.

A good method for obtaining biosynthetic glucuronic acid, worked out by Quick⁶, depends upon the

formation and excretion of bornylglucuronic acid following the ingestion of borneol by dogs (under the best conditions the administration of 1 gm. borneol gives 1 gm. zinc bornylglucuronate). In many laboratories, however, it may be inconvenient to keep dogs for long periods, and the collection of urine from dogs fed with borneol requires a large metal-lined cage. Rabbits, however, are much more convenient to use, and an ordinary wire cage set in a suitable funnel can be utilized for collecting the urine.

In a recent paper⁷, I showed that good yields of conjugated glucuronic acid are obtainable from rabbits fed with *dl*-menthol, *dl*-isomenthol and *d*-isomenthol. This investigation has now been extended, and it has been found that *dl*-menthol is the most suitable substance to use when relatively large amounts of glucuronic acid are required. *dl*-Menthol conjugates with glucuronic acid to the extent of 60 per cent in the rabbit, and a higher yield of conjugated glucuronic acid is obtained than in Quick's method using dogs and borneol. *dl*-Menthol (synthetic) can be purchased in large amounts and has no effect on rabbits at the dose level (8 gm.) used. It has a low melting point (34° C.) and can therefore be administered by stomach tube as a partial emulsion in a small amount of warm water. Maximal conjugation with glucuronic acid occurs on using a dose of 3 gm. per rabbit (weighing 2–2.5 kgm.) and excretion of the conjugated product is complete in about 30 hours.

The isolation of menthylglucuronic acid (as the ammonium salt) is a short and easily effected procedure⁷. Ammonium menthylglucuronate is obtained in consistent yields of 1.4 gm. per gm. of *dl*-menthol fed. Thus, on feeding 3 gm. of *dl*-menthol to each of six rabbits, 25 gm. of the ammonium salt was isolated. On suitable treatment with acid, this salt gives glucuronic acid in good yields. The ammonium menthylglucuronate ($[\alpha]_D = ca. -30^\circ$ in water), containing about 60 per cent *d*- and 40 per cent *l*-menthylglucuronic acid, can be resolved by fractional crystallization from water, and the hitherto undescribed *d*-menthyl- β -*d*-glucuronide, $C_{16}H_{24}O_7$, $1\frac{1}{2} H_2O$ (m.p. 110–112° C., $[\alpha]_D = ca. +5^\circ$ in alcohol) can be obtained. *l*-Menthyl- β -*d*-glucuronide has been previously described on several occasions.

R. TROWYN WILLIAMS.

Physiology Department,

Medical School,

Hospitals Centre,

Birmingham, 15.

March 8.

¹ *Ann. Review Biochem.*, **6**, 103 (1937).

² See Levine, "Hexosamines and Mucoproteins" (London, 1925).

³ *Ann. Reports Chem. Soc.*, **34**, 204 (1937).

⁴ *Ann. Review Biochem.*, **7**, 273, 279 (1937).

⁵ Bell and Link, *J. Amer. Chem. Soc.*, **60**, 1813 (1938).

⁶ Quick, *J. Biol. Chem.*, **74**, 331 (1927).

⁷ Williams, *Biochem. J.*, **32**, 1849 (1938).

Diaphorase I and II

WE have used the name 'diaphorase' to designate the enzyme which catalyses the transport of hydrogen from dihydrocoddahydrogenase I (CoH_2 , I) to acceptors like methylene blue or cytochrome, but not to molecular oxygen^{1,2}. This enzyme, which had been detected independently by Dewan and Green³ ("coenzyme factor"), occurs in all animal tissues so far examined as well as in yeast^{4,5} and in higher

plants'. Diaphorase from heart muscle, purified to some extent by precipitating a phosphate extract from washed tissues with low concentrations of acetone and ammonium sulphate⁴, was shown to attack CoH_2 I specifically, that is, it was inactive against dihydrocodehydrogenase II (CoH_2 II).

Recently we studied the action of crude, dialysed extracts from various acetone-dried tissues upon CoH_2 I and CoH_2 II, and found (a) that the rate at which these substances were oxidized was extremely low in all cases, which means that an auto-oxidizable enzyme of the type of the 'old' flavin enzyme probably does not occur in animal tissues, (b) that after addition of methylene blue a more or less rapid dehydrogenation of both hydrogenated ooenzymes occurred. Therefore besides the previously known CoH_2 I-specific diaphorase, a similarly acting enzyme transporting hydrogen from CoH_2 II to methylene blue is present in animal tissues. We propose to call the CoH_2 I-specific diaphorase now "diaphorase I", and the CoH_2 II-dehydrogenating enzyme "diaphorase II".

The dialysed and centrifuged water extracts from acetone-dried tissues were used. CoH_2 I and CoH_2 II were prepared by reduction of Co I and Co II with sodium hyposulphite and their dehydrogenation was followed directly by spectrophotometric observation of the disappearance of the typical absorption band at 334 m μ . A typical experiment contained 1.0 ml. m/2 phosphate buffer pH 7.2 plus 0.1 mgm. CoH_2 (I or II) plus 0.1 ml. m/1000 methylene blue plus 0.1 ml. enzyme; total volume 4.0 ml.; at the beginning of the experiment was $\epsilon_{334 \text{ m}\mu}^{\text{CoH}_2 \text{ I}} = 0.42$ or $\epsilon_{334 \text{ m}\mu}^{\text{CoH}_2 \text{ II}} = 0.38$.

The activities of diaphorase I and II are expressed by the decrease of the extinction ($-\Delta\epsilon$) at $\lambda = 334 \text{ m}\mu$ calculated for 0.1 ml. enzyme during the first 10 minutes.

Tissue	Activity ($-\Delta\epsilon$ for 0.1 ml. enzyme and 10 mm.)		$A_1 : A_2$
	Diaphorase I (A_1)	Diaphorase II (A_2)	
Heart	0.33	0.055	6
Liver	1.40	0.80	1.75
Ovary	0.14	0.10	1.4
Adrenal gland	1.45	1.50	0.97

As can be seen from the last column of the accompanying table, the ratio of the activities of diaphorase I and II (A_1/A_2) is different in various extracts, which is in accord with the view that the enzymes are not identical. Whether diaphorase II is specific for CoH_2 II or active against CoH_2 I as well, cannot be decided from these experiments, but it is clear that this enzyme is different from the CoH_2 I-specific diaphorase I. Dewan and Green's statement⁴ that "oenzyme factor" from heart muscle attacks CoH_2 II as well as CoH_2 I can now be explained by the existence of the two different enzymes.

Recently it was found in this Institute^{5,6} that heart muscle contains a flavoprotein which has the same function as diaphorase I, and Corran, Straub and Green¹⁰ suggest the identity of Straub's heart flavoprotein with diaphorase. Our experiments show that the diaphorase I and II activity of our tissue extracts is greatly reduced by precipitation with HCl-ammonium-sulphate and partly regenerated by addition of flavin-adenine-dinucleotide, in analogy

with what has been found by Warburg and Christian¹¹ for the known flavoproteins; thus diaphorase II probably is a flavoprotein.

Biochemical Institute,
University,
Stockholm.
Mar. 7.

E. ADLER.
H. v. EULER.
G. GUNTHER.

- ¹ Adler, Euler and Holstrom, *Sv. Vet. Ark. Kemi*, 12 B, Nr. 38 (1937).
² Euler and Holstrom, *S. physiol. Chem.*, 262, 31 (1938).
³ Adler, Euler and Gunther, *Sv. Vet. Ark. Kemi*, 12 B, Nr. 54 (1938).
⁴ Dewan and Green, *NATURE*, 140, 1097 (1937). *Biochem. J.*, 32, 628 (1938).
⁵ Green and Dewan, *Biochem. J.*, 32, 1200 (1938).
⁶ Euler and Gunther, *Naturewiss.*, 26, 676 (1938).
⁷ Lockhart, *Biochem. J.* (in the Press).
⁸ Adler, Euler, Gunther and Plass, *Stand. Arch. Physiol.* (in the Press).
⁹ Euler and Adler, *Svensk kem. tidn.*, 51, 11 (1939).
¹⁰ Corran, Straub and Green, *NATURE*, 143, 337 (1939).
¹¹ Warburg and Christian, *Biochem. Z.*, 298, 368 (1938).

Resonance in the External Auditory Meatus

DR. LITTLE's method of investigating resonance in the external auditory meatus¹ by replacing the air in the meatus by hydrogen is very interesting. The manner in which his results are to be interpreted, however, is not clear.

The resonant frequency will depend, amongst other things, on the length of the meatus and upon the impedances at its terminations. The frequency which he quotes for the resonance in normal human beings—2,000–3,000 cycles per second—refers apparently to the condition in which the ear is open to the air. It is somewhat surprising, therefore, that Dr. Littler should obtain a frequency of the same order in experiments in which the meatus was closed by a telephone receiver. In this condition, however, it is to be expected that the resonance will be considerably influenced by the volume of air enclosed between the ear cap and the entrance to the meatus and will be a function, therefore, of the particular receiver employed. It would be interesting to have also the results of similar experiments carried out with this volume reduced to a minimum, say, by employing a receiver of the type designed to fit into the entrance of the meatus.

I have recently made some measurements, by the probe tube method, on the resonance of the meatus when open to the air. The flexible probe tube employed had an external diameter of about 2 mm. and led to a microphone placed behind the observer's head. The ratio of the sound pressure near the ear drum to that in an approximately plane progressive wave coming from directly in front of the observer was measured. The pressure change observed is due partly to resonance in the meatus and partly to diffraction by the head. In the eight ears examined the frequency of maximum pressure increase at the ear drum varied from about 2,500 cycles per second to 4,000 cycles per second, and the maximum increase from about 9 to 15 decibels. The mean values for the eight ears are given in the accompanying table.

Frequency (cycles per second)	Ratio of pressure near ear drum to that in unobstructed progressive wave (decibels)
500	— 2
1000	— 3
2000	0
3000	12
4000	13
5000	6

In devising appropriate objective methods of measuring the gain of hearing aids, resonance of the meatus under these conditions thus requires consideration, since they are the conditions of normal hearing with which aided hearing has to be compared.

N. FLEMING.

Physics Department,
National Physical Laboratory,
Teddington, Middlesex.
Feb. 28.

¹ NATURE, 142, 118 (1939).

Post-Partum Estrus in a Bat

ALL the insectivorous Chiroptera in which details of the breeding cycle are known are monœstrous, producing a single offspring, or sometimes twins, once a year.

In *Nyctoris luteola* Thos. there is a post-partum estrus, so that at least two pregnancies occur in quick succession. Out of thirteen adult female specimens collected at Mto-wa-mbo, Tanganyika Territory, in December 1935, nine were in full lactation, and at the same time pregnant with fetuses up to 12 mm. in length. Two others were lactating and in estrus; and two young adults were not lactating but pregnant for the first time.

The ovaries of these bats contained no corpora lutea, which must disappear early in pregnancy. They contained many healthy ripening follicles, and presented an appearance widely different from the heavily atretic ovaries usually found in pregnant monœstrous bats. They gave every indication of being prepared for a further œstrous cycle during the forthcoming lactation period.

The genital tracts of all the adult males, collected at the same time and place, were in full functional condition. These facts point to the possibility of this species being polyœstrous.

Observations on the anatomy and physiology of the genital tract in *Nyctoris luteola* and other species of African bats will be published elsewhere in due course.

L. HARRISON MATTHEWS.

Department of Zoology,
University,
Bristol.
March 9.

Colchicine-induced Polyploidy in Nature

IN a recent communication¹, Prof. D. Kostoff describes experiments in which he has produced a polyploid condition in seedlings grown in close association with disintegrating pieces of the corms of *Colchicum autumnale*. He further suggests that the sites of colonies of this species might prove fruitful sources of polyploids.

On examining several such sites, I have failed to find anything of an abnormal nature, in respect of external morphological characters, either in grass-like or other species. One colony was known to be at least twenty years old, and was associated with a mixed flora.

It is well known that the influence of colchicine is to delay germination and to cause stunting of growth with a delayed establishment of a root system. In the case of mustard, every seedling was affected after soaking the seed for four days in a 1:2,000

aqueous solution of amorphous colchicine. Control plants reached a height of 50 mm. after 20 days growth, whilst the treated seedlings averaged only 15 mm. in height.

In the case of rye-grass (*Lolium perenne*), colchicine appears to affect a smaller proportion of seedlings. The difference in the rate of growth and resulting height of unaffected and control seedlings, as compared with affected ones, is even more pronounced. The average height of the former individuals was 65 mm. after 28 days growth, while that of affected plants was 7 mm. with a complete absence of root growth.

It is obvious that in a state of Nature, the polyploid individuals would be suppressed in competition with normal seedlings or established vegetation. This would be quite sufficient to explain their absence in the field.

G. H. BATES.

The Farm Institute,
Penkridge,
Stafford.
March 4.

¹ NATURE, 142, 237 (1939).

Open-Air Sites of the Upper Palæolithic Period in Kent and North Lincolnshire

FROM time to time I have recorded in the columns of NATURE the discovery of artefacts and pottery fragments in lateral valleys of the Lower Thames. The geological conditions under which these finds were made caused me to attribute to them an Upper Palæolithic date; a precedent for which is to be found in the discoveries and claims made by Mr. J. Reid Moir, as a result of investigations conducted by him at Ipswich during the past twenty years.

The prolonged and extensive excavations I have since been enabled to make in the Lower Thames Valley and elsewhere compel me unreservedly to withdraw all claims I have made for the alleged discovery of pottery of Upper Palæolithic age, and to regard the pottery in question as belonging to Neolithic - Bronze Age times.

The comprehensive series of deposits, twenty-five feet thick, exposed in the Ebbsfleet Channel, near Northfleet, has established the fact that during Middle and Late Pleistocene times south-east England was peopled by Levalloisian races and that the characteristic Upper Palæolithic cultures of the Continental caves are unrepresented.

Some years ago I directed attention to the apparent close relationship of the Ebbsfleet Channel beds to the estuarine deposits underlying the Brown or Heale Boulder Clay at Kirmington and Barton-on-Humber, in north Lincolnshire¹.

Preliminary investigations at these two sites have resulted in the discovery of two distinctive types of artefacts, namely, Clactonian and Creswellian². The former are similar to the Clactonian examples found in the Levalloisian horizons of the Ebbsfleet Channel: whilst the latter are the counterpart of the Continental cave types mentioned above, and so conform to the Upper Palæolithic series of implements found by Mr. A. L. Armstrong in the Derbyshire caves.

Thus it would appear that at Kirmington and at Barton-on-Humber there is evidence of the overlapping of these two fundamentally different implement-making techniques.

It is to be hoped that further evidence on this point may be obtained from these sites during the present year.

J. P. T. BURCHELL.

30 Southwick Street,
Hyde Park,
London, W.2.
March 8.

¹ *Geol. Mag.*, 72, 337 (1935).

² *NATURE*, 130, 279 (1932); *Anthrop. J.*, 16, No. 2, 180 (1936).

Storage of Radium in War Time

RADIUM is not only a valuable but also a very dangerous substance. If, during an air raid, any quantity of radium was dispersed by violence, the buildings in which it was dispersed, as well as a considerable area surrounding the buildings, would be for many years to come a menace to any people who inhabited them. One-hundredth of a milligram would probably be fatal if inhaled.

It is therefore necessary that steps should be taken to provide for the safe custody of radium in war time, and a conference has been held between representatives of the British X-ray and Radium Protection Committee, King Edward's Hospital Fund for London, the Ministry of Health and the National Radium Commission, to consider this matter.

The National Radium Commission is compiling a register of owners and holders of radium, with a view to satisfactory arrangements being made. The Commission earnestly requests all persons who have radium in their custody or possession (including the responsible official of institutions holding radium) to notify the Commission, stating the amount of radium held.

GEORGE F. STEBBING.
(Secretary).

National Radium Commission,
18 Park Crescent,
London, W.1.

Points from Foregoing Letters

L. MEITNER has collected recoil nuclei resulting from the fission of thorium and has found that some of the fission products are chemically analogous to those fission products of uranium which have formerly been assigned to elements beyond uranium. The decay of the new fission products has been analysed into two exponentials with 40 minutes and 14.5 hours half-value period.

In accordance with Fröhlich's theory of electronic breakdown, A. E. W. Austen and W. Hackett find that the electric strength of polar crystals such as potassium bromide may be calculated from the optical properties, the dielectric constant and the molecular volume. Similarly, the electric strength of thin sheets of insulating material (mica) is found to increase with decreasing thickness (from 10^{-2} to 10^{-3} cm.) and also with increasing temperature up to a critical value around 400° K.

E. G. Richardson shows that the absorption of supersonics in carbon dioxide is increased by subjecting the gas to infra-red radiation of wave-lengths corresponding to the natural (vibrational) frequencies of the carbon dioxide molecule.

A new mechanism for the excitation of the forbidden nitrogen line N I and for increasing the intensity of the oxygen line O I with height and according to the type of the aurora, is suggested by M. Nicolet, who states that, after the emission of the Vegard-Kaplan bands, the nitrogen molecules can excite the atom O I and bring it to the metastable state ^3D , and the atom N I to the state ^3P .

The Miller effect has been employed by N. H. Roberts to increase the periodic time of oscillations obtainable from valve oscillators using capacity-resistance tuning.

F. L. Hopwood and J. T. Phillips record the polymerization of a number of unsaturated liquid hydrocarbons by neutrons and ionizing radiations. They submit a graph illustrating the difference in the rate of polymerisation of methyl methacrylate when irradiated by two similar sources of gamma rays, of which only one has a marked neutron emission.

A number of new acetylated derivatives of amino hexoses, in which the amino group is attached in the 2 or 3 position in the carbon chain, have been isolated by G. J. Robertson and W. H. Myers. One of them proves to be a derivative of glucosamine.

R. T. Williams states that when *d*-menthol is administered to rabbits, 60 per cent of it is excreted in the urine combined with glucuronic acid. Menthyl-glucuronic acid is easy to isolate from the urine in excellent yields as the ammonium salt. This salt contains unequal amounts of *d*- and *l*-menthol, the *d*-form predominating.

Animal tissues contain besides the known diaphorase I, which transforms dihydrocodehydrogenase I from dihydrocodehydrogenase I to methylene blue or cytochrome, which catalyses the analogous reaction of dihydrocodehydrogenase II, according to Adler, H. v. Euler and G. Günther. The new enzyme, for which the name "diaphorase II" is proposed, is probably a flavoprotein.

Commenting on Dr. Littler's communication on resonance in the auditory meatus, N. Fleming directs attention to the influence of the conditions at the entrance to the meatus, and gives results of some measurements, by the probe tube method, with the meatus open to the air.

L. Harrison Matthews records the occurrence of a post-partum oestrus in *Nyctotis luteola*, an East African bat, and points out the species being polyoestrous.

An examination of sites of *Colchicum* failed to reveal anything of a morphological or abnormal nature in the associated flora. It is suggested by G. H. Bates that the influence of the distigating corms in producing polyploids, as demonstrated by Kostoff, would be nullified by the suppressing effect of the taller normal species.

As the result of extensive excavations in the Lower Thames valley and elsewhere, J. P. T. Burchell withdraws previous statements concerning the discovery of pottery of Upper Palaeolithic age, which he now considers as belonging to Neolithic - Bronze Age times.

Research Items

Duration of Life in Early Man

PROF. F. WEIDENREICH supplements the recent conclusions of Prof. H. Vallois as to the duration of life in Neanderthal, Late Palaeolithic, and Mesolithic man (see *L'Anthropologie*, 47, 499; 1937: *NATURE*, 141, 292; 1938) by an examination of the question of age in relation to Peking man and Late Palaeolithic man as occurring in China. At the same time he analyses the evidence bearing on the cause of death and the incidence of disease in this population, so far as it is known. The most adequate information relating to the age of individual specimens is to be derived from the state of the sutures of the skull. Out of 38 individuals of *Sinanthropus* now known, of whom fifteen are juvenile, seven only provide skulls sufficiently well preserved to afford evidence. Of these, three belonged to individuals aged less than thirty years, three may range between thirty and forty years, and only one, apparently that of a female, may have been really old, more than fifty, or even sixty years. Within the *Pithecanthropus* group two skulls show complete fusion of the sutures of the skull-cap, pointing to an age of more than fifty years. The recently discovered third skull is juvenile. It is possible, however, that the time of the fusion of the sutures may not correspond to that in modern man. In the anthropoids it is earlier. This would merely serve to confirm the conclusion that the actual duration of life in *Sinanthropus* was shorter than in modern man. With regard to Late Palaeolithic man in China, of the group of seven individuals known from the cave of Choukoutien, the state of the sutures indicates that three were juvenile, and of the four adults, two, probably women, were slightly more than twenty years, the age of the third cannot be determined, though it probably was not advanced, and the fourth was certainly an old man, at least sixty years of age. These figures compare with those of Vallois for the Western world. In both *Sinanthropus* and Late Palaeolithic man, an advanced age was seldom reached; while in both classes of remains from China, the evidence of the skulls indicates a death from violence and not old age or disease.

Factors affecting Sex in a Japanese Beetle Parasite

M. H. BRUNSON, of the U.S. Bureau of Entomology and Plant Quarantine, has recently issued a paper on this subject (*J. Agric. Res.*, 57, No. 5, 379; 1938). It appears that the parasite in question, namely, *Tiphia popilliae*, like its host, has a single generation annually. The Japanese beetle passes through three larval instars and, of these, the second and third are utilized by the female *Tiphia* for purposes of oviposition. Preference, however, is shown for those in the third instar. Adult parasites which emerged from cocoons, formed on second instar hosts, were predominantly males, while those obtained from parasitized third instar larval hosts were largely females; the ratio of females in the two cases being, in percentages, 6.4:87.2. Parasite eggs transferred from second instar to third instar larvae gave a preponderance of males while the reverse transfer produced more females than males, indicating that the sex of the progeny is determined at the time the egg is placed on the host.

Insects of Eastern Ruwenzori

IN 1934 the Trustees of the British Museum appointed two members of the British Museum staff—Dr. F. W. E. Edwards and Dr. G. Taylor—as leaders of an expedition to study the flora and insect fauna of Eastern Ruwenzori. The expedition received support by way of grants from the Percy Sladen and Godwin Funds, the Uganda Government and Mme. de Horraack Fournier. The leaders proceeded to East Africa in September 1934 and returned in March 1935. While in Africa they were joined by several other workers, who assisted in carrying out the aims of the expedition for varying periods. It is noteworthy that, as in the case of other high mountains, Ruwenzori provides numerous examples of species of insects which are either short winged (brachypterous) in the female or in both sexes. Such species were found in the Geometridae and Tineidae among moths and in six different families of flies. Apart from this phenomenon of 'brachypterism' no obvious cases of adaptation to mountain conditions among insects were noted, and nothing to correspond with the giantism of some of the plants. The results of the expedition are in course of publication by the British Museum. Vols. 1 and 2 are to deal with the Diptera, while insects of other orders are to form the subject of vol. 3. The parts published up to date belong to vols. 1 and 3 and are sold by the Museum separately. These are Introduction; Simuliidae (E. G. Gibbons); Mosquitoes (F. W. Edwards and E. G. Gibbons); Psychodidae (A. L. Tonnoir); Ceratopogonidae (J. W. S. Macfie); Trichoptera (M. E. Mosely); Siphonaptera (K. Jordan); Rhopalocera (A. G. Gabriel); Lymantriidae (C. L. Collette); Ephemeroptera and Neuroptera (D. E. Kimmins).

Amphidiploids and other Hybrids in Tobacco Species

AN extensive cytogenetical study of hybrids between *Nicotiana glauca* and *N. Langsdorffii* has been made by D. Kostoff (*J. Genetics*, 37, No. 1) with various results bearing on the evolutionary significance of amphidiploids. *N. glauca* has $2n = 24$ chromosomes and *N. Langsdorffii* $2n = 18$ with differences in chromosome morphology. Abnormal meiosis was induced in both species by acenaphthene. The cross *N. glauca* $\times$ *N. Langsdorffii* is much easier to make than the reciprocal, but crossability depends partly on age of the plant and such conditions as temperature. The F_1 is intermediate in most characters, with 25 per cent of dwarfs in some crosses, and all the plants form non-parasitic tumours, the cells of which have mostly 21 chromosomes like the normal tissues. A small amount of monads and dyads are found in the F_1 pollen, varying with the genotype and the environment. When back-crossed to *N. Langsdorffii* most of the plants had 30 chromosomes ($12 + 9 + 9$), but one was amphidiploid. It probably arose parthenogenetically from a monad megaspore, and in meiosis it formed bivalents, trivalents, quadrivalents and univalents. The original amphidiploid had 51 per cent viable pollen. By the F_2 this had increased to 99.5 per cent, and the seed fertility showed a corresponding increase. The offspring were not constant, but showed segregation in leaf and flower size and shape, alkaloid and citric acid content,

pollen colour, etc., the chromosome numbers ranging from 21 to 52. Changes in the satellite chromosomes showed that translocations had also taken place. Thus inconstant amphidiploids may give rise to a polymorphic species which is physiologically isolated, but in which rapid evolution can take place through natural selection among the progeny. Triple species hybrids are also described with *N. Sandera* ($n = 9$).

Geology of the Lake Rudolf Basin

THE geological results of the Lake Rudolf Rift Valley Expedition have recently been recorded by V. E. Fuchs (*Phil. Trans. Roy. Soc., B*, No. 560; 1939). The lake has usually been considered to lie in the northern continuation of the Kenya Rift Valley; but it has now been found that this belief is only partly true, for though the lake occurs in a region affected by rifting movements, it does not in a proper sense lie within a rift valley. The history of the area is traced from the time when it formed part of the great Central African peneplain. In late Oligocene times the latter was fractured to form the Uganda escarpment. Renewed movement took place in the Pliocene, which resulted in a series of prominent scarps. In numerous sections evidence is found that the faults may be due to compressional rather than tensional forces. It is found that after the extensive plateau eruptions of the early Miocene, volcanic activity became more restricted and almost ceased by the beginning of the Pleistocene. Later, accompanying a renewal of movement in the Pleistocene, further volcanic outbreaks occurred. Within recent times the Telaki and Andrew volcanoes have been active and there are also signs that Central and Höhnel Islands are not yet completely quiescent. The rise and fall of the lake during Pleistocene times is discussed in conjunction with the human cultures associated with the lake beaches. An attempt is made to correlate the events within the Lake Rudolf Basin with those already known to have occurred elsewhere within the East African Province. The report is well illustrated and has an attractively coloured geological map, which, though provisional, is nevertheless of great value.

Calculation of Geological Age

WITH the increasing interest in the determination of the geological ages of minerals and rocks by radioactive methods, and the recent development of greatly improved techniques, it has become essential to reconsider the methods of calculation. This task has been adequately undertaken by N. B. Keevil (*Amer. J. Sci.*, 237, 195; 1939). New equations are developed for computing ages from chemical and radioactivity data, and errors in some of the past work are pointed out. The simple form of equation involving uranium and thorium with either helium or lead yields a good result for young rocks, but it can now be made much more accurate by taking into consideration the actino-uranium series and introducing more recent values for the radioactive disintegration constants. By a suitable choice of equations and successive substitutions, any desired degree of accuracy (assuming the experimentally determined parameters to be correct) can be attained, and at higher ages a new equation, which corrects the results by means of a constant involving the thorium/uranium ratio, can generally be applied. It is pointed out that if an

average value of 3 is adopted for this ratio, the errors introduced into the calculated ages for ordinary rocks are less than those involved in experimental measurements and in changes in the rock since its consolidation.

A New England Hurricane

DETAILS concerning the tropical hurricane that passed across Long Island on September 21, 1938, are given in a paper entitled "Hurricanes into New England", by Charles F. Brooks, that has been reprinted from the *Geographical Review* of January 1939 by the American Geographical Society. This hurricane is held to have developed from a relatively weak cyclonic circulation which was in evidence on September 13 in lat. 19° N., long. 37° W., and to have originated near the Cape Verde Islands where other storms have been known to originate, between the north-east trade winds and the south-west monsoon. The fact that it reached such a high latitude without having lost the characteristics of a well-developed tropical storm—the calm central 'eye' and surrounding ring of hurricanes—appears to have been due partly to the presence of moist tropical air in its northward path after leaving the tropics, and partly to the existence of a favourable field of pressure over the North Atlantic. There was in fact a well-developed anticyclone south of Newfoundland and a trough of low pressure extending from south to north over the eastern part of the United States. The complete statistics of the destruction caused by the storm—about 600 lives lost, more than 15,000 buildings destroyed, and economic loss estimated at 250,000,000 dollars or more, place the storm in the front rank of historic storms in New England, and the economic loss as being in excess of anything previously recorded. The lowest pressure reading reported by a land station was 27.94 in. at Bellport, on the south shore of Long Island. At Blue Hill Observatory a speed of 186 miles an hour was recorded by a 3-cup anemometer; at Mount Washington there were hourly winds of more than 118 miles and gusts up to 163 miles an hour, although the storm had weakened a little when it had reached the north of New England. New York City was sheltered to some extent by Long Island, but on the top of the Empire State Building (1,248 ft.) there were gusts up to 120 miles an hour.

Reaction between Nitric Oxide and Oxygen

THE oxidation of nitric oxide by oxygen, $2\text{NO} + \text{O}_2 = 2\text{NO}_2$, has been the object of much investigation and is still not fully elucidated. E. M. Stoddart (*J. Chem. Soc.*, 5; 1939) finds that Baker's experiments on the non-interaction between the intensively dried gases can be repeated if it is arranged that mixing occurs only in the bulb containing the oxygen. Water has no effect on the non-reactive gases, so that the inhibition of the reaction seems to be wholly due to surface conditions of the containing vessels. It is supposed that drying removes adsorbed water from the glass surface, and the surface then adsorbs a complete gas film. If this film is oxygen, no reaction occurs between the mixed gases, but reaction is possible when it is nitric oxide. When the non-reactive gases are displaced from a vessel previously filled with oxygen into a new flask, reaction at once occurs. It is concluded that the reaction is not a termolecular homogeneous reaction as found by Bodenstein, but that a complex $(\text{NO})_2$ is formed by

a heterogeneous reaction and then reacts homogeneously: $\text{glass}(\text{H}_2\text{O}), 2\text{NO} = \text{glass}(\text{H}_2\text{O}) + (\text{NO})_2$; $(\text{NO})_2 + \text{O}_2 = \text{N}_2\text{O}_4 \rightleftharpoons 2\text{NO}_2$. The negative temperature coefficient of the reaction is explained by the dissociation of the nitric oxide complex: $(\text{NO})_2 = 2\text{NO}$.

Resistance of Gold and Silver at Low Temperatures

THEORIES of electrical conductivity predict that a magnetic field will always cause an increase in resistance, but in the case of gold a decrease was found by Giaque, Stout and Clark (1937). J. W. Stout and R. E. Baricau (*J. Amer. Chem. Soc.*, 61, 238; 1939) have confirmed this result. The electrical resistances of gold and silver wires were measured at temperatures from 1.5° to 20° K. and in magnetic fields up to 8,000 gauss. The resistance and its magnetic coefficient of the silver wire were independent of temperature at the lowest temperatures. As the temperature rises, the resistance was found to increase and its magnetic coefficient to decrease. The gold wire had a minimum resistance about 7.7° K. and the magnetic coefficient of resistance was a maximum at this temperature. The magnetic field tends to eliminate the minimum in resistance. Extrapolation of the measurements indicates that at 1° K. the magnetic coefficient would become zero and below this temperature would be negative.

Petroleum Fuels in Canada

THE Canadian Department of Mines has issued another bulletin (No. 794) giving statistics of petroleum fuels delivered for consumption in Canada during the year 1937. This may be regarded as a companion volume to bulletins 772, 780 and 789 giving similar and directly comparable statistics for the years 1933, 1934, 1935 and 1936. In 1937, 1,338 million Imperial gallons of petroleum products were delivered, consisting of 589 million gallons of fuel oil, 30 million gallons of kerosene and 719 million gallons of gasoline. In addition, more than 48 thousand short tons of petroleum coke were consumed in refineries. More than 91 per cent of the fuel oil was processed in Canadian refineries (as compared with 89 per cent in 1936 and 85 per cent in 1935), the remainder being imported. The proportions allocated to domestic heating, industrial heating and power, tractor fuel, and fuel for rail and water transport were practically the same as for 1936. Kerosene deliveries in 1937 represented only one forty-third of the aggregate of all petroleum fuels as compared with one thirty-third in 1935 and 1936. Approximately 4.1 million gallons less were delivered in 1937 than in 1936. Of the total of 29.9 million gallons delivered, about 75 per cent was used for domestic purposes, 21 per cent for tractor fuel and the remaining 4 per cent for other general uses. The provisional assessment of the quantity of gasoline sold in Canada for all purposes during 1937 shows an increase of more than 194 million Imperial gallons as compared with 1936.

The Escher Wyss Variable-Pitch Airscrew

C. KELLER has recently given a full account of a variable pitch airscrew which has many advantages (*Escher Wyss News*, 11, No. 4; 1938). The incentive to the new design was given by research carried out at the aerodynamic laboratory of the Federal

College of Technology at Zurich. The research laboratory is under the direction of Dr. Ackeret in collaboration with the Federal Air Force. Keller states that a variable-pitch airscrew is an essential accessory to modern aeroplanes for increasing the efficiency of the airscrew and its propelling force. It is practically impossible to design a good propeller of the old type with fixed blades to comply with the demands on the propeller at the lowest and highest velocities of flight. This is due to the fact that, especially at great velocities, a deviation of the blades from the correct angle of incidence results in disturbing effects which lower the efficiency of the airscrew. The increase of the propelling force and of the airscrew due to the provision of adjustable blades is so considerable that the variable pitch type of airscrew is superseding the older types. A special feature of the variable-pitch airscrew is its possible braking effect during the landing run. If the blades are turned in the closing sense to such an amount as to obtain a negative angle of incidence, a negative thrust is produced and thus a braking effect to the forward motion of the aeroplane. The direction of rotation of the airscrew and engine remain constant, and hence the output of the engine itself is utilized to retard the forward motion of the plane, whereas in the old type of propeller the output of the engine was not made use of on landing. In this way the length of the landing run can be considerably reduced and if the aeroplane has more than one engine the ease with which it can be manoeuvred on the ground is considerably increased; any tendency to overturn is also effectively counteracted.

Separation of the Isotopes of Chlorine

K. Clusius and G. Dickel recently described a new process for the separation of isotopes, which was based on the combined effect of thermo-diffusion and thermo-siphon action (*Naturwiss.*, 26, 546; 1938). The process has been further improved, and the results of experiments on the separation of the isotopes of chlorine are now reported (*Naturwiss.*, 27, 148; 1939). Using hydrogen chloride and a separation tube 36 m. long, 8 c.c. of hydrogen chloride containing more than 99 per cent of HCl^{37} were obtained daily. On the 'light' side of the apparatus, hydrogen chloride containing chlorine of atomic weight 35.147 was obtained, and on another occasion chlorine of atomic weight 35.06. The authors have also used the apparatus for the separation of other liquids. With a temperature difference of 80° between the hot and cold walls of the apparatus, and using decinormal sodium chloride solution, a 3.8-fold increase in concentration of the solution at the 'heavy' end was obtained after 4 hours action. It is to be expected that different ions would migrate at different speeds owing to their varying degrees of hydration, so that a selective change in concentration should take place in solutions of many electrolytes. A mixture of acetone and water containing 42.2 mol. per cent of acetone gave after six hours and a temperature difference of 40° , a mixture containing 6.2 mol. per cent of acetone at the 'heavy' end. It is noteworthy that in spite of the low molecular weight of water in its monomeric form, it collects preferentially at the 'heavy' end of the apparatus, thus indicating the polymeric structure of water. A mixture of light and heavy water was also partially separated by the use of the apparatus.

A Derived Patterson Analysis of the Skeleton of the Cyclol C_8 Molecule

By D. P. Riley, Department of Mineralogy, Oxford, and I. Fankuchen, Birkbeck College, London

RECENT publications by Wrinch¹, and in particular by Wrinch and Langmuir², have suggested that the Patterson analyses obtained by Crowfoot³ for air-dried insulin crystals can be interpreted with some precision if one assumes that the basis of the structure of the insulin molecule is the skeleton of the Wrinch cyclol C_8 . Criticisms of their work were made by Bernal at a recent meeting of the Physical Society and in a recent letter in *NATURE*⁴. We have done the work reported here in order to answer, if possible, two questions. How well do the equivalent points chosen by Wrinch and Langmuir represent the cyclol C_8 structure? Does the cyclol fabric give a Patterson diagram resembling the one obtained experimentally? To do this, the separate atoms of the cyclol skeleton were considered and the appropriate Patterson analysis derived from their interatomic vectors.

It must be made clear that only the carbon and nitrogen atoms of the skeleton have been considered. No account has been taken of the side-chains, oxygen or water that Wrinch postulates, and reasons why these omissions should not affect the general validity of the work will be given later. Even so, this derivation was very laborious owing to the large number of atoms in the cyclol skeleton. The first step was to plot a projection of the cyclol network on the basal plane (Fig. 1). The atoms fall very closely on to a hexagonal net, and according to the number of atoms projecting on to a given point on this net, that point

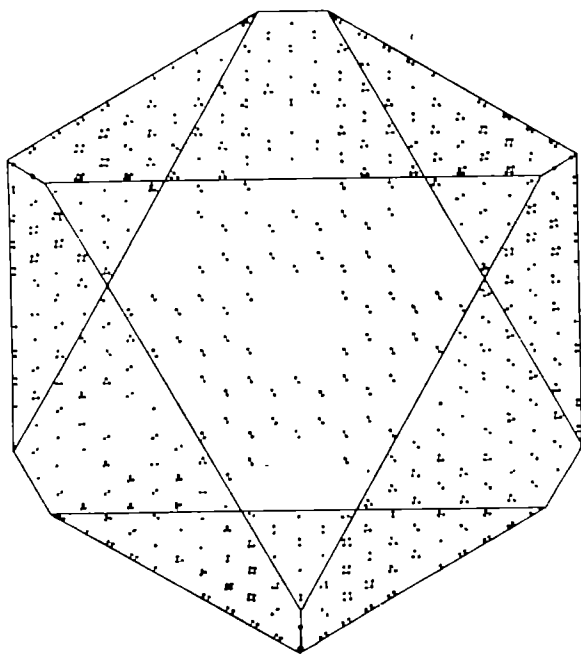


Fig. 1.

PROJECTION ON THE BASAL PLANE (0001) OF THE CARBON AND NITROGEN ATOMS OF THE CYCLOL C_8 SKELETON.

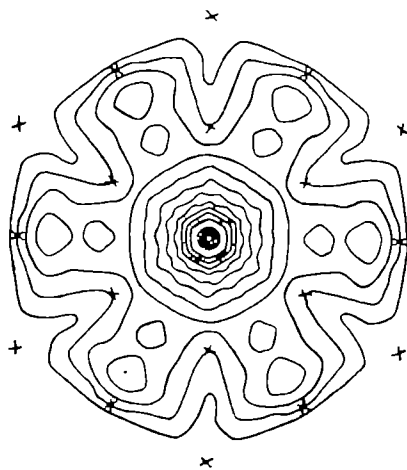


Fig. 2.

DERIVED PATTERSON ANALYSIS FOR ONE C_8 MOLECULE CONSIDERED BY ITSELF.

Contour lines at one unit apart. Crosses mark positions of peaks given by an octahedral arrangement of scattering masses at the 'slits' of the cyclol fabric.

is assigned a weight of 1, 2, 3 or 4. No distinction is made between carbon and nitrogen atoms, owing to the relatively slight difference in their scattering powers. Co-ordinates were assigned to the points in the projection and the Patterson analysis derived as follows. The co-ordinates of a point in the Patterson analysis corresponding to an interatomic vector were obtained by a subtraction of the atomic co-ordinates on the projected network, and the height of the Patterson point is the product of the weights assigned to the points in the projection. By summation the heights of the various points in the Patterson analysis were obtained, and contour lines were then drawn. A derived vector analysis for one C_8 molecule considered by itself was thus obtained (Fig. 2).

The diffuse nature of the pattern should be noted. It exhibits only two weak peaks in each sixth part of the pattern, which form part of a ridge composed mainly of vectors between atoms in different sides of the atomic projection. Such a result indicates that the skeleton of the cyclol molecule cannot be approximated by an octahedral arrangement of scattering masses situated at the slits (that is, at the corners of the basal projection). Such an arrangement gives the hexagonal peak system shown superimposed on the derived analysis in Fig. 2 and the lack of fit is obvious.

The next point to be considered is the vectorial interaction between neighbouring molecules. Wrinch places the molecules (cyclols) with their centres 40 Å. apart and with a tilt of 6° . If this be done with the derived Patterson analysis of the cyclol fabric, the vector map shown in Fig. 3 is obtained. This pattern

also is very diffuse, showing weak peaks (*A*) situated approximately at the mid-points of lines joining origin peaks, and with regions of low density (*B*) situated around the centres of the equilateral triangles the apices of which are the origin peaks. This vector map should be compared with Crowfoot's experimentally derived analysis³. Here, in marked contrast to Fig. 3, there are regions of low density (*O*) at the mid-points of lines joining origin peaks, and a peak system (of which *B* is one peak) around the centres of the equilateral triangles. Such a fundamental dissimilarity clearly shows that the X-ray data for insulin are not readily explained by the cyclol hypothesis as Wrinch and Langmuir claim.

It may be argued that, as we have taken no account of the side-chains in the cyclol molecule, our results are not conclusive or even significant. We do not think that this is so for the following reasons. The cyclol fabric contains approximately one third of the mass of the molecule, the remaining two thirds being contributed by the side-chains, oxygen and water present. A projection derived from the fabric alone could reasonably be expected to bear some resemblance to that due to the whole molecule. Moreover, a certain number of the side-chains are in a direction roughly perpendicular to the plane of the projection and therefore cannot alter the fundamental pattern of the vector map. The other side-chains will cause a maximum difference to the pattern when extending out from the sloping faces of the cyclol cage, that is, towards the periphery of the projection on the basal plane. Hence the peaks would probably be moved out a little along the ridges, but this effect may well be masked by the general blurring of a pattern already diffuse. We are therefore of the opinion that the fundamental pattern of six ridges in the directions shown in Fig. 2 would not essentially be altered by a consideration of the side-chains, and we consider that a similar blurring effect would be the only contribution of the majority of the water molecules present. In any event, we have been concerned only with testing the vectorial properties of those parts of the cyclol molecule which have definitely and precisely been worked out by Wrinch, that is, the atomic skeleton of the fabric, and it is this skeleton which is the essential feature of the theory.

It is therefore indicated that:

(1) The cyclol fabric cannot adequately be repre-

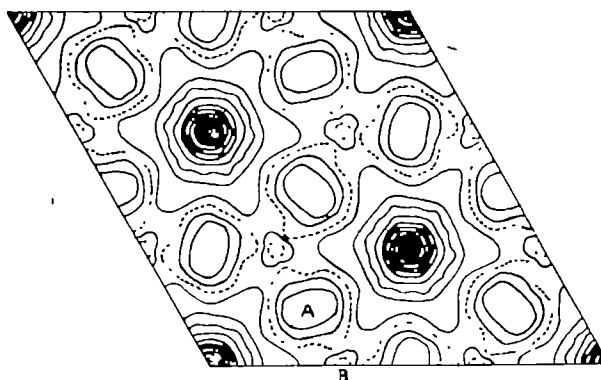


Fig. 3.

DERIVED PATTERSON ANALYSIS OF THE CYCLOL MOLECULES ARRANGED IN THE UNIT-CELL OF INSULIN.

Contours at one unit apart. A is a peak and B a low density region.

sented by the set of equivalent masses chosen by Wrinch and Langmuir.

(2) Even if this representation were correct, the vector maps obtained from these equivalent points do not fit the experimental data if all the vectors are taken into account (Bernal⁴).

(3) The vector map derived from a consideration of the atomic skeletons of the cyclol molecules in the unit-cell does not fit the Patterson analysis of insulin as found experimentally by Crowfoot.

It can consequently no longer properly be claimed that the X-ray evidence furnishes any direct confirmation of the cyclol structure proposed for insulin.

Summary.—Vector maps of the carbon and nitrogen atoms of the skeleton of the cyclol C₂ molecule have been derived. From a consideration of these maps it is shown that the X-ray data obtained by Crowfoot cannot be considered as affording any direct evidence for the cyclol structure proposed for insulin by Wrinch.

¹ Wrinch, D. M., *J. Amer. Chem. Soc.*, **60**, 2005 and 2099 (1938).

² Wrinch, D. M., and Langmuir I., *J. Amer. Chem. Soc.*, **60**, 2247 (1938).

³ Crowfoot, D. M., *Proc. Roy. Soc., A*, **164**, 590 (1938).

⁴ Bernal, J. D., *NATURE*, **143**, 74 (1939).

Transfusion in Petrogenesis*

THIS memoir is probably the most instructive contribution to modern petrology since Brögger published his description of the Oslo area (1931)¹. It describes the north-eastern (British) part of the Birunga lava-field—a region of Tertiary and Recent vulcanism which produced 'alkali' lavas of basic to intermediate composition. The field extends along, and partly across, the Western Rift depression for some fifty miles north and north-east of Lake Kivu.

The 'alkali' character of the Birunga lavas was

first recognized by Finckh (in 1912)², from whose descriptive work fifteen analyses are cited in this memoir.

The Bufumbira lavas are referred by the authors (and their co-workers on the field-staff of the Uganda Geological Survey) to the following main groups or series:

- (1) Olivine-leucitites (that is, 'leucite-basalts') grading into olivine-rich types for which the group name 'ugandite' is proposed.
- (2) Types related to a 'melilite-felspathoidal group' known in other parts of the Birunga field.
- (3) Leucite-basanites.
- (4) Potash-trachybasalts—closely related to (a)

* Geological Survey of Uganda. Memoir No. 3: The Volcanic Area of Bufumbira. Part 2: The Petrology of the Volcanic Field of Bufumbira, South-West Uganda. By Prof. Arthur Holmes (Petrology) and Dr. H. F. Harwood (Chemical Analysis). Pp. xiv + 300 + 5 plates. (Intabbe: Government Printer, 1937.) 21s.

potash-trachyandesites (or latites), and (b) a limburgite-trachybasalt series.

Plutonic rocks occur only as ejected blocks or as corroded fragments enclosed in the lavas. Nevertheless, this scanty material has yielded striking, and often decisive, evidence supporting the important conclusions drawn from the genetic study of the Bufumbira suite as a whole.

A variation diagram (Fig. 3) based on twenty-four new and unusually detailed rock-analyses reveals four roughly linear sequences which, in the basic range, are so intimately linked by bridging terms as to constitute a field of kindred variants. All these sequences converge, at their melanocratic ends, towards a single point—represented by biotite-augite-peridotite.

As a few occurrences of types reputed to be 'true basalts' had previously been recorded from Birunga, the authors took the precaution to check the validity of the description, and they now announce that, with one exception (and even this was found to contain identifiable leucite), every lava previously described as 'basalt' contains more potash than soda and that, as in the Toro-Ankole field of the same igneous province, true basalts are absent from Bufumbira and are unknown from the Birunga field as a whole. A discovery of such fundamental importance in any genetic discussion of the Bufumbira suite raises a lively and critical interest in the authors' quest for genetic evidence.

Finckh assumed the suite to be differentiated from (a) an older 'monzonitic' and (b) a younger 'theralitic' magma. But the authors of this memoir show, convincingly, that the parental status of the two initial magmas presumed by Finckh cannot be sustained: their character, as derivatives from more fundamental units, is repeatedly exposed.

In an earlier (1932) monograph, Prof. Holmes showed that, in the Toro-Ankole field at least, genetic processes could not have involved the co-operation of either basaltic or granitic magma. On the other hand, geochemical peculiarities common to both the Toro-Ankole suite and kimberlite led him to suggest that peridotite-magma might conceivably be in parental relation to both. This hypothesis, which required also the co-operation of peridotite-with basalt-magma, was soon abandoned: Prof. Holmes adduced new data (abstracted in pars. 177 and 752) which rendered the theory untenable. On grounds detailed in the 1932 monograph and recapitulated in this memoir (pars. 758-762), it is shown that carbonate-syntaxis can have no application to the potash-rich lavas and tuffs of Toro-Ankole and Bufumbira.

As Prof. Holmes remarks, genetic hypotheses proposed for rocks of the Bufumbira type are numerous; but none has as yet met with anything approaching general acceptance. Quoting from the memoir (p. 243): "The fundamental source of the difficulties lies in the fact that petrology is concerned with an integration of complications which lies far beyond the scope of present-day physical chemistry. We must, therefore, be temporarily content with empirical hypotheses and we must regard them, not as a substitute for thought, but as a stimulant to further exploration, research, comparison, and correlation. Any hypothesis which shows signs of becoming classical—that is, of deriving its sanction from weight of external authority long after the 'pattern' of facts has expanded—tends to hypnotize its adherents and should be vigorously scrutinized in the

light of every new observation. A fruitful hypothesis is one which reveals previously unsuspected mysteries, not one which hides them".

In the Bufumbira case, the four chief theories now current are shown to be untenable. Hence, the hypothesis finally proposed, and particularly the evidence adduced to support it, are likely to be scrutinized by critical readers with more than ordinary interest.

The conclusions reached by Prof. Holmes may be said to insinuate themselves on the reader from the moment he appreciates the field-setting and implications of glimmerite (biotite-rock) in relation to biotite-pyroxenite and its allies (p. 31, 51-59, etc.). The case clarifies itself as the marshalling of evidential fact proceeds. The genetic hypothesis awaited is formulated in the concluding chapter (xii), after a brief review of recent field studies which demonstrate, unequivocally, the feldspathization of quartz and quartzite, and the granitization of sediments, schists, etc., by alkali-carrying emanations—immigrant either from magma or from solid-rock systems undergoing magmatization. Here, it would seem that the concept of a 'fundamental granite magma' fades completely out of the picture: energized emanations alone remain. The factors involved are generalized by the authors in the following scheme:

(a) Incoming emanations—from other 'active' magmas or the 'substratum', *plus*

(b) Energy (secular, radioactive, ionic reactions, etc.), *plus*

(c) Crustal rock-material—metasomatized, migmatized, or more or less magmatized by (a) and (b), *minus*

(d) Outgoing emanations and associated energy—with effects which include pneumatolysis and many features characteristic of hydrothermal ore-deposits, mineral veins, etc., together with those mentioned in (c) above.

The activating emanations already traced by the authors are "protean in their geochemical range and widely variable in their capacity for transporting and localizing energy. The combination of pre-existing rocks and emanations promises possibilities as manifold as the rocks and ore-deposits to be accounted for" (p. 277).

Transfusion, as a petrogenetic process, is fully appreciated by Fennoscandian geologists and others specially interested in the fundamental crystalline schists and associated injection-complexes. Prof. Holmes' precise, brilliant exposition of the process vindicates those geologists of the French school, and notably Michel-Lévy and Lacroix, who were probably the first to attribute certain aspects of assimilation and hybridization to the transfusion process. The mechanism, described in various ways according to the point of view adopted, has been acknowledged in principle by many leading petrologists who have contributed to the literature describing the evolution of quasi-magmatic rocks from pre-existing solid phases.

The detail and precision which characterizes Prof. Holmes's descriptive work; the discernment manifest in the grouping and alignment of Bufumbira types; the wealth of petrological fact he has co-ordinated, and his masterly integration of evidence to the far-reaching conclusions drawn make this memoir the most outstanding contribution to modern petrology yet published.

A. BRAMMALL.

¹ Brogger, W. O., "Der Grosse Hornvulkan. Die Hauptgesteine des Ologobietes", (5) *Vidensk. Skrift* (1), *Nat.-Hist. Kl.*, No. 6 (1931).

² Finckh, L., "Die Jungvulkanischen Gesteine des Kivu-Gebietes", *Wiss. Ergebn. Deutsch. Zentral-Africa-Exped.*, 1907-1908, 1 (1) (1913).

Conference on Fruit Juices and Syrups

A CONFERENCE and working demonstration on pure fruit juices and syrups was held at the University of Bristol Research Station (which is associated with the Ministry of Agriculture and Fisheries) on March 23. More than a hundred visitors attended the conference. The conference comprised four papers dealing with various aspects of fruit products developments. Prof. B. T. P. Barker, the director, referred to the association of the Long Ashton Station with fruit products research since its inception as a Cider Institute. The production of apple jelly and the pulping of soft fruits by the cold sulphur dioxide method were contributions made by the Station during the Great War period, and in more recent years the Station had commenced a comprehensive investigation into the whole question of the utilization of surplus and low grade fruit.

World developments in fruit juices were discussed by Mr. Roger Morel, secretary of the English Apple Juice Producers' Association, and the enormous annual consumption of juices in Switzerland, Germany and the United States (8, 17 and 100 million gallons respectively) were mentioned.

Mr. Christopher Norbury emphasized the urgent need for the introduction of a series of legal definitions for the strict standardization of all liquid fruit products.

Mr. Vernon L. S. Charley, in charge of the Fruit Products Section of the Station, gave a brief account of the various methods of manufacture and referred to the Long Ashton processes for apple juice and fruit syrups which had been in successful commercial use for three years. He laid special emphasis on the nutritional value of pure fruit juices and syrups,

pointing out that, though sucrose was used in the various processes, the final products as sold to the consumer contained only levulose and glucose, which are the most easily assimilable forms of sugar. The mineral contents of these pure products was such that, despite the organic acids present, the high proportion of potassium and sodium oxides tended to build up an alkali reserve in the system. Although apple juices retain only a small proportion of the ascorbic acid (vitamin C) of the fresh fruit, black-currant syrup is a very rich source of this vitamin, quantities up to 100 mgm./100 gm. of syrup having been found in syrups after twelve months' storage. Mr. Charley suggested that in times of national emergency canned black-currant syrup would assume a considerable importance in view of the possibility of the cessation or restriction of imports of fresh citrus fruits or juices. It was also pointed out that practically the whole of the nutritional value of fresh apples is retained by the processed juices.

In conclusion, details of the use of pure fruit juices and syrups for medicinal purposes were given. In Germany, inflammation of the lungs, diabetes, fevers and a number of other diseases were being treated with juices. In England, Mr. Charley referred to two series of cases in which children suffering from 'pink' disease, and adults and children being treated for hyperacidity with ulceration of the duodenum, had received great relief and in many cases had been cured by the use of apple juice ('pink' disease) and black-currant syrup (ulceration cases).

Working demonstrations enabled the visitors to observe the various cold and hot processes for the production of apple juice.

Lord Rutherford: His Life and Influence on Chemistry

SIR HENRY TIZARD delivered the first Rutherford Memorial Lecture of the Chemical Society on March 29. He began by referring to Rutherford's early life at Cambridge, where he came in 1895 from New Zealand with an 1891 Exhibition. Continuing work on the detection of electrical waves which he had begun in New Zealand, Rutherford was able within a year to receive signals at a distance of half-a-mile; this work was described and demonstrated at the meeting of the British Association in 1896. The discovery, however, of X-rays and of the radioactivity of uranium shortly after his arrival at Cambridge determined his life's work, and he became associated with J. J. Thomson in work on the ionization of gases by X-rays and on the electrical conduction caused by uranium radiation.

In 1898, at the early age of twenty-seven years, Rutherford was appointed to the chair of physics at McGill University, Montreal, where he was joined by Soddy in investigations demonstrating that radioactivity is an atomic phenomenon accompanied by the continuous production of new types of matter with distinctive chemical properties. This work was predominantly chemical in character and led to

Rutherford receiving in 1908 the Nobel Prize in chemistry.

In 1907, Rutherford left Montreal for Manchester. By this time the general nature of radioactivity had been made clear, the disintegration theory was established, and the series of changes in uranium, thorium and actinium were understood. The happiest part of Rutherford's life was spent in Manchester, where he gathered around him a team of able and enthusiastic workers, and it was while there that the most dramatic event of his scientific career happened, namely, the discovery of the real nature of the atom. His work in Manchester was interrupted by the Great War, but at the end of 1918 he returned with renewed vigour to attack the structure of the nucleus, and within a year his efforts were rewarded, for he proved that nitrogen was destroyed by alpha particles and that hydrogen was a product. From that day to this there has been a continuous and almost bewildering addition to our knowledge of the structure of the nucleus.

Sir Henry Tizard said that Rutherford's influence on chemistry can be summarized in the following way. By his early work on the disintegration of

elements he destroyed the chemist's conception of the nature of atoms, and by doing so gave the atomic conception of matter a reality which it never had before. By his work on the scattering of alpha rays he removed the blot on the periodic system by removing its foundation and replacing it with something better. In doing so, he caused the development of a new and fruitful conception of valency. By his work on transmutation of elements he opened up an immense field of experimental work for the chemist, a field which few can doubt will yield results of the utmost importance in biology as well as in chemistry.

The secret of Rutherford's success in inspiring others lay not only in his genius but also in his unselfishness. Surely there was never a great man who gave so much credit to others. It was a pity, said Sir Henry Tizard, that Rutherford had no Boswell; that none of the men who worked in constant contact with him had made notes of his ways, of his sayings, of his few mistakes as well as his many successes; of his manners, good and bad, and of his faults as well as of his virtues. Rutherford's name will live for ever in the history of our times as no man of science has ever lived before.

Electric Propulsion of Ships

IN a paper read to the North-East Coast Institution of Engineers and Shipbuilders at Newcastle-on-Tyne on December 18 by Mr. L. R. Horne, the development of the electric propulsion of ships was traced over the last hundred years.

In 1839, Yacobi made the first successful experiment. He built a boat capable of carrying twelve passengers and propelled it by an electric motor connected with a battery of 69 Grove cells. A speed of between two and three miles an hour was obtained. Owing to the imperfections in the motor, the idea did not receive any wide practical application and the experiment was soon forgotten. In 1882, an iron boat was electrically propelled on the Thames. In 1886, the *Naudius* was built at Tilbury and fitted with twin screws driven by electric motors. In 1888, a submarine, the *Gymnote*, 59 ft. long and displacing 30 tons, was fitted with a 50-h.p. motor and attained a speed of eight miles per hour (7 knots). The vessel was accepted by the French Navy. In the United States, in 1901, John P. Holland's submarine *Holland VIII* attracted attention and became the model on which Vickers submarines for the British Navy were first designed.

The most successful of the experiments in the early years of the century was made in Russia, and the machinery was constructed in Sweden by the firms now called the Atlas Diesel Co. and the A.S.E.A. This vessel was the *M.S. Vandal*, an 1100-ton shallow-draught tanker, built for service on the Volga and the Caspian Sea in 1903. The machinery consisted of three three-cylinder four-stroke cycle, single-acting engines, placed amidship, and each driving a dynamo and exciter, at 240 r.p.m. The propeller speeds could be varied from 20 to 300 r.p.m. with voltages up to 500. Reversal took 8-12 seconds. The weight of the engines, which were each rated at 120 h.p., was 48 tons, and that of the electrical equipment was 31 tons. The vessel continued in service for ten years, and similar installations followed.

So far, the development of electric propulsion was invariably associated with direct current machinery. During 1910-1911, Mr. Henry Mavor evolved from his experiments the passenger launch *Electric Arc*. This was probably the first experiment with alternating current for propulsion. A petrol engine of 45 h.p. was designed to run at 700 r.p.m. and was directly coupled to an alternator, which carried windings which gave four and six pole fields. Speeds of 7½ and 5 knots were obtained.

While European engineers may fairly claim that the initial stages of the development of the electric

drive were the results of their inspiration and work, the most important landmark in its history was the decision of the U.S. Navy Department, shortly before the Great War, to utilize electric drive in its capital ships. Once it was convinced that the scheme was possible, the method was carried out boldly. Electric drive had been found practical with a.c. machinery up to 50 h.p., but at 600 h.p. it was not so good. Tests were made forthwith on a 7,000 h.p. collier and then on the electric propulsion of a battleship. The experimental installation was put in a twin-screw collier *Jupiter* (now an aircraft carrier called *Langley*), completed in 1913, and found most satisfactory. The battleship *New Mexico*, then under construction as a geared-turbine vessel, was consequently fitted with electric drive. A number of U.S. battleships and their two most powerful aircraft carriers have been provided with electric propelling machinery.

In Great Britain, in 1920, there was no enthusiasm for electric drive in any of its forms, but on this date one of the most conservative shipping companies ordered the *Viceroy of India*, and this ship with turbo-electric drive and synchronous motors was a brilliant success. Service speeds of 18½ and 16 knots were given.

The climax of the development of electric drive, at least in the mercantile marine, came in 1935 with the commissioning of the *Normandie*. The machinery installation of this ship was designed for continuous operation at 160,000 h.p., and this power must have been exceeded when it steamed across the Atlantic at 31 knots.

In spite, however, of recent developments, the proportion of large new vessels installed with turbo-electric drive is small. In the latest returns, record is made of forty-one vessels of 469,000 tons so propelled out of a total of 1,264 vessels of 9,439,000 tons driven by turbines. The explanation would appear to be that, in general, owners prefer the type of machinery which they and their engineering staffs understand best.

In the field of small vessels, the rivalry between the different types of engines and systems of distribution is more intense and the successful progress of electric drive is more definite. A large proportion of vessels fitted with Diesel-electric drive are used in inland waters or are of less than 100 tons gross, or for some other reason are not included in classification returns. Probably there are about 250 vessels using Diesel-electric systems, and their total horse-power is of the order of 250,000. The established success of electric tugs promises an increase in the number of small vessels so driven.

Science News a Century Ago

Societies and Academies

Italian Association for the Advancement of Science

In the spring of 1839 many distinguished individuals in Great Britain received circulars announcing the formation of an Italian Association for the Advancement of Science and inviting co-operation in its work. The circular contained the signatures, among others, of Prince Carlo L. Buonaparte, Chev. Antinori, director of the Royal Museum of Natural History in Florence, G. B. Amici, the astronomer and chancellor of the University of Pisa and of Prof. Savi, professor of natural history there. A translation of a part of the circular was given in the *Athenaeum* of April 20, 1839. "Following the advice of many, and the approbation of others," the circular said, "and in conformity with the successful practice in Germany, we have now to announce that from the 1st to the 15th of October will be opened the Association of the Professors and Cultivators of the Physical Sciences in Italy, including Medicine and Agriculture."

The Medical Society of Bombay

On April 20, 1839, the *Athenaeum* published a notice of the "Transactions of the Medical and Physical Society of Bombay, Vol. 1". "From the present volume," the journal said, "we learn that a new society has been formed for the purpose of medical improvement in the East; and it is remarkable on two accounts: First, we observe in it a tendency to return to the methods of the older physicians, and to look to external natural agents, as indexes pointing to the character of diseases. . . . The second circumstance to which we have alluded, is a desire manifested by the profession 'to give the permanent benefits of medical science to the people of India, by introducing an efficient system of medical education'. This is a matter of more extended importance than regards its simple relation to the health of the Hindoo population."

Experimental Subaqueous Explosions at Chatham

Under the title "Experimental Subterranean and Subaqueous Explosions at Chatham by the Voltaic Battery" a correspondent of the *Mechanics' Magazine* on April 20, 1839, described the progress being made under Colonel Pasley's direction. "For several months past," he wrote, "the Royal Engineers at Chatham under Colonel Pasley have been trying experiments in firing gunpowder by the voltaic battery, and after many vicissitudes of partial success and of failure, they have at last succeeded in bringing this process to as much perfection as it seems capable of—that is, as much certainty as the former method of firing mines in dry soil. They have repeatedly fired gunpowder at the distance of 500 feet, with their conducting wires either buried underground or led entirely under water, excepting a few feet connected with the battery, which in their subaqueous explosions was in a boat on the Medway, the powder being lodged at the bottom of that river. . . . The voltaic battery used was that of Professor Danielli's improved construction, which from retaining its energy much longer than any other form of voltaic battery he has named the constant voltaic battery." Colonel (afterwards General Sir) Charles William Pasley, F.R.S. (1780–1861), in 1839–41 used the methods he developed at Chatham for blowing up the wreck of the *Royal George* which had foundered at Spithead on August 29, 1782.

London

Royal Society (*Proc.*, A, 170, 145–299; 1939).

S. LEVINE: Problems of stability in hydrophobic colloidal solutions. (1) On the interaction of two colloidal metallic particles. General discussion and applications. (2) On the interaction of two colloidal metallic particles: mathematical theory.

F. C. FRANK: Melting as a disorder phenomenon.

L. H. MARTIN and A. A. TOWNSEND: β -Ray spectrum of Ra E.

S. TOLANSKY: Nuclear spin of iodine. (4) A new type of hyperfine structure deviation from the interval rule.

J. MONTEATH ROBERTSON and A. R. UBBELOHDE: Structure and thermal properties associated with some hydrogen bonds in crystals. (1) The isotope effect. (2) Thermal expansion.

M. BORN and K. FUCHS: Fluctuations in electromagnetic radiation.

L. C. JACKSON: Principal magnetic susceptibilities of neodymium sulphate octahydrate at low temperatures.

J. T. RANDALL: Fluorescence of compounds containing manganese.

H. DAVENPORT: Sums of positive integral k th powers.

Paris

Academy of Sciences (*C.R.*, 208, 777–852, March 13, 1939).

C. BERNARDIS: Geometrical representation of the fourth dimension, etc.

E. HALPHEN: Co-variation.

J. MARCINKIEWICZ: Summability H_2 of Fourier series.

H. TOKUNOHARA: Generalization of Jensen's formula to analytical functions of many variables.

H. PAILLOUX: Distribution in space of the rotations of an inextensible surface in movement.

G. LITTAYE: Modes of resolution of a liquid jet into drops.

MME. M.-A. TONNELAT: Equations of the photon: relation with the equations of Dirac and of Kemmer.

J. MARIANI: The nuclear field and the elementary quantum of length.

A. COLOMBANI: Development with heat of the conductivity of thin layers of nickel (80–1,200 m μ).

P. DE BROU: Verification of Faraday's laws at the positive pole in 'spark' electrolysis.

M. DODIERO: Electrolysis of fused mixtures of alkaline fluosilicates and fluorides or oxides. Compounds of formulae $SiMn_2$, $SiFe_2$, $SiCr_2$, and Si_2Ti have been prepared.

S. VENCOV: Ultra-violet absorption spectra of some organic molecules.

S. SOHLVITICH: Sensibilization of reversible photo-voltaic piles.

S. NIKETINE: Anisotropy of absorption of different radiations for molecules of some photosensitive colouring matters.

P. BARCHEWITZ: (OH_r) bands of acids in the vapour state; study of a new harmonic.

H. MURAOUB and J. BASSET: Study of the influence of high pressures on the propagation of reactions in explosive solids, and in particular in priming explosives. At pressures of the order of 10,000 kgm./cm.², the explosive is decomposed without producing any mechanical effect.

W. HELLER and E. VASSY: Co-existence of reversible and irreversible aggregates in thixotropic gels with hydrophobe particles.

P. SIE: Chlorination of niobium pentoxide and tetraoxide.

J.-A. GAUTIER: Action of bromine on some *N*-substituted α -pyridones.

G. DARENS: Halogen-methylation of aromatic derivatives in homogeneous acetic medium.

R. ABBARD and E. A. DE LA RÛE: Marine quaternary beds of the north-east coast of French Somaliland.

E. GAGNEBIN: Discovery of a fragment of the Simne nappe in the Pre-Alps of Chablais.

L. ÉBLÉ and G. GIBAUT: Values of the magnetic elements at the observatory of Chambon-la-Forêt (Loiret) on January 1, 1939.

R. BERNARD: Origin of the coloration of the aurora borealis of type B.

R. ROCHVIN and A. BRUNEL: Utilization of glyoxalic ureides by the soy-bean.

P. BERGAL: Contribution to the study of the lodicules of barley (*Hordeum sativum* Jess.).

P.-P. GRASSÉ: Relations of a termitophile coleopterous larva (*Troctonus appendiculatus* Silv.) with its hosts. There appears to be mutual attraction of an olfactory and gustatory nature.

G. BROOKS and R. PAULAIS: Distribution and localization of the carotinoids, flavins and *l*-ascorbic acid in lamellibranch molluscs: oysters and green and white Portuguese oysters.

MILLER, M. HAMON: Characterization of some α -amino acids entering into the constitution of the spermatophores of the Cephalopoda.

MILLER, G. MARTRENT: Study of the variations of molecular concentration of the urine of the freshwater stenohaline teleostean, as a function of the variations of salinity of the exterior medium.

MILLER, A. DRILHON and R.-G. BURNEL: Presence and content of flavin in the Malpighian tubes of insects.

MILLER, J. PORTIER and MILLER, A. DRILHON: Biochemical study of the internal medium of *Eriochor sinensis* and its adaptation to changes of salinity.

H. BULLIARD, I. GRUNDLAND and A. MOUSSA: Activity of exchange of phosphorus and radio-phosphorus in the phosphatids of cytoplasm. Radio-phosphorus accumulates in tissues where active chemical changes are taking place and in cellular elements rich in phosphatids.

I. BERTRAND and R. LÉCOQ: Peripheral nervous lesions observed in the course of polyneuritis in the pigeon induced by simple addition of lactic acid to diets rich in glucides, proteins or lipids, and containing high proportions of vitamin B.

Vienna

Academy of Sciences, January 26.

WILHELMINE POLACEK: X-ray absorption spectra of the *M* series of gold, thallium, lead, bismuth, thorium and uranium. The *M* absorption edges are found to have a width of between 8 and 36 volts. The observed wave-lengths are appreciably smaller than those calculated from the relation $L_{III} - L_{III} M_V$.

K. GRAFF: Photometric curve of the phase of the planet Mercury.

Forthcoming Events

[Meeting marked with an asterisk is open to the public.]

Wednesday, April 19

ROYAL MICROSCOPICAL SOCIETY, at 5.30.—Prof. L. C. Martin: "The Electron Microscope from the Optical Standpoint".

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Prof. E. J. Salisbury, F.R.S.: "Ecological Aspects of Meteorology" (Symons Memorial Lecture).

Thursday, April 20

LONDON MATHEMATICAL SOCIETY, at 5.—Discussion on "Mathematical Logic".

Friday, April 21

ROYAL INSTITUTION, at 9.—A. E. Dunstan: "The Utilization of Petroleum Gases".

Saturday, April 22

SOCIETY OF CHEMICAL INDUSTRY (FOOD GROUP) (at the London School of Hygiene and Tropical Medicine), at 10.30.—Conference on "Vitamin E" to be opened by W. A. S. Calder.*

APES CLUB (at St. Bride's Institute), at 2.30—Annual General Meeting.

Dr. M. Hertz: "Discrimination of Patterns and Colour Vision in Bees".

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group), April 20–21. Conference on "Safety in Chemical Works" to be held at the Royal School of Mines.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ASSISTANT ENGINEERING MASTER in the Aberlilly Mining and Technical Institute—The Director of Education, Higher Education Department, County Hall, Newport, Mon. (April 17).

SCIENTIFIC OFFICER (air defence) in the Directorate of Scientific Research, Air Ministry—The Under-Secretary of State, Air Ministry, S.2.D/B.8019, Berkeley Square House, London, W.1 (April 22. Quote B.191).

TECHNICAL OFFICER in the Meteorological Office—The Under-Secretary of State (S.2.B. (Met)), Air Ministry, Admiralty House, Kingsway, London, W.C.2 (April 25).

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

University of London Institute of Education. Studies and Reports, No. 7. Some Aspects of Indian Education Past and Present. Being three Joseph Payne Lectures for 1935–6 delivered in the Institute (with Supplementary Memoranda) by Sir Philip Hartog. (Published for the Institute of Education.) Pp. xv+110. (London: Oxford University Press.) [213]

Other Countries

Advisory Committee on Education. Staff Study No. 6: The Extent of Equalization secured through State School Funds. By Newton Edwards and Herman G. Richey. Pp. viii+55. 15 cents. Staff Study No. 14: Educational Activities of the Works Progress Administration. By Doak S. Campbell, Frederick H. Bair and Oswald L. Harvey. Pp. xiv+188. 25 cents. (Washington, D.C.: Government Printing Office.) [203]

U.S. Department of the Interior: Office of Education. Pamphlet No. 85: Salary and Education of Rural School Personnel; Status and Trends. By W. H. Gaumnitz. Pp. 20. (Washington, D.C.: Government Printing Office.) 5 cents. [203]

Fifty-fifth Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution, 1937–1938. Pp. 8. (Washington, D.C.: Government Printing Office.) [203]

Survey of India. Professional Paper No. 29: Magnetic Anomalies. By B. L. Gulatee. Pp. vi+12+11 plates. (Dehra Dun: Survey of India.) 1.8 rupees; 1s. 6d. [203]

Bulletins of the Zoological Society of San Diego. No. 14: Studies of Reptile Life in the Arid Southwest. By L. M. Klaubner. Pp. 100. (San Diego, Calif.: Zoological Society of San Diego.) [203]

Unione Astronomica Internazionale. Immagini spettroscopiche de bordo solare osservate a Catania, Madrid e Zurigo negli anni 1933 e 1934. Pp. h+24 plates. (Asterici: R. Osservatorio Astrofisico.) [203]

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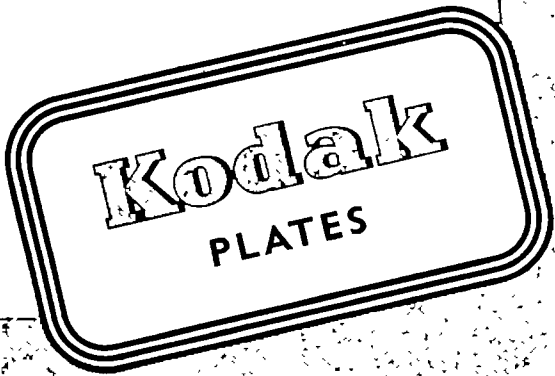
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Vol. 143

SATURDAY, APRIL 22, 1939

No. 3625

Research in Africa

IN June next the generous grants of the Rockefeller Foundation to the International Institute of African Languages and Cultures for the promotion of linguistic and anthropological research in Africa will cease ; and the Council of the Institute, it is stated in its annual report for 1938 (*Africa*, 12, 1 ; 1939), being fully aware of the urgent need not merely of continuing, but also of extending and strengthening this work in every way, now has under consideration its arrangements for the future. These must necessarily depend upon the funds available ; but the wide interests implicated in the vast field to be covered, and the gravity of the issues to which the researches of the Institute contribute understanding, should ensure that financial considerations will not be allowed to cramp its work.

Since 1931, when the scheme of research which is now nearing its final stages was first formulated by the Institute, sixteen full-time research fellowships have been awarded. Of the holders of these, three are still in the field, completing their investigations in Uganda, Nyasaland and Bechuanaland respectively. The remainder, having finished their field work, either have reported or are completing the preparation of their material for publication. These investigators have covered a wide field and have recorded observations of the culture of markedly diverse peoples. Research among African peoples has so vast a range that it may be said that even this organized scheme of investigation has done little more than pass beyond the fringe. Nevertheless, substantial progress has been made. Cultural records have been made among peoples in such widely distributed areas as the Anglo-Egyptian Sudan, Algeria, the Gold

Coast, Sierra Leone and Nigeria, Uganda, Kenya, Tanganyika, Nyasaland, Rhodesia, the Transvaal and South Africa.

Further to, and arising out of, these activities in research, discussion among the research fellows and other experts has led to the preparation by the Institute of a symposium on African political organization. This will be edited by Dr. M. Forrester, research fellow, and Dr. E. E. Evans-Pritchard.

Obviously, discussion of political organization raises many questions with wide ramifications in their bearing on the future of the African. For some time there have been indications here and there of a certain mistrust among the native populations—confined in the main, no doubt, to the more advanced and sophisticated—of both scientific investigation of native institutions and of the relation of indirect rule to such research. It has been alleged, with no small show of confidence, that the aim herein of the white man is “to keep the native in his place”—to stereotype his institutions and to fix his status once for all. If as the result of any discussion or research it should be possible to indicate the lines of a progressive policy of institutional development, adaptable to changing conditions of the day, while avoiding disintegration, it would placate discontent by eliminating ambiguities in the present position.

The linguistic side of research, which has always been a major interest of the Institute, has not been neglected. At the moment, two important works dealing with African languages are in the press ; one on the languages of the Sudan by Dr. A. N. Tucker, based partly on material collected on an expedition financed jointly by the Institute and the School of Oriental Studies of the

University of London, and one on the phonetic structure of the Kikuyu language by the late Miss L. E. Armstrong; while three other linguistic studies are either ready in manuscript form or are in course of preparation.

A further significant development of the Institute's research work, of wider scope than its application to the African field, is concerned with the nutrition of backward peoples—one of the most important subjects to which the attention of research fellows has been directed, if the trend of recent investigation is to be accepted in all its implications. Not only has this matter been under observation by Dr. Audrey Richards among the Bemba of Northern Rhodesia and is now being examined by Dr. Margaret Read among the peoples of Nyasaland; but also the plans for a nutritional field survey, which were drawn up by the Institute with a view to the needs of Africa, have been adopted, with revision and expansion, by an organization set up under the aegis of the Medical Research Council, of which the purpose is the co-ordination of nutritional research work throughout the British Colonial Empire. The nutritional investigation which Dr. Read is carrying out in Nyasaland now forms part of this scheme, which is being conducted under the direction of Dr. B. S. Platt, senior member of the staff for the co-ordination of the research. An ecological survey of Nyasaland is being carried out, in conjunction with the work on nutrition, by an agricultural officer, assisted by forestry and veterinary experts where necessary, the anthropological and sociological side of the investigation being entrusted to Dr. Read. As this is the first survey of the kind under the new organization, it is of particular importance for the development of technique, with a view to future research; while it is of no less notable significance that the socio-anthropological side of this very important question receives due recognition. The Government of Nyasaland has shown that it is fully alive to the value of the inquiry, and has granted every facility to the members of the expedition for their work.

Research such as is too briefly outlined above cannot be financed on a parsimonious scale; and the more closely the problems of Africa are scrutinized, the more evident does it become that future research must be extended to the limits of capacity in resources and personnel. When the results achieved by those who have worked in Africa during the last five or six years on behalf

of the Institute of African Languages and Cultures are more fully available, confidence in its competence to continue to direct this work will be more than doubly assured. Further, the methods of investigation which have been followed by many, if not all, of its research fellows have been such that their results not only have conduced notably to the advancement of scientific knowledge, but they are also readily adaptable to the needs of administration, or other provinces of practical affairs. Nor have they failed on occasion to probe weak points in administrative methods, even under indirect rule, where a failure in the understanding, which the anthropologist alone could discern, has led to misinterpretation of custom, mistrust and even friction.

It is further to be noted that both the administration of the Institute's scheme of research and the selection of research fellows have had a marked effect in promoting that international co-operation which, in the eyes of those most competent to judge, is one of the essentials in the future guidance of development in Africa along right lines.

Meanwhile, a word of warning may not be out of place. The interest of African problems at the moment is so insistent, and at the same time so widespread, that there is a very real danger of a dissipation and waste of energy and resources, which could, and should, be concentrated in a single direction of effort to African research. The number of appeals for funds for purposes of research of widely varied character is growing apace, as is the number of organizations, some already in existence, others projected, on behalf of which these appeals are being made. As each one comes forward, it might indeed be considered to strengthen the argument for centralization and the concentration of effort in a single African institute, of which the purpose would be to co-ordinate and direct inquiry, as well as to pool information, and thereby the better to direct suggestion for the application of the results of research to practical ends, while at the same time advancing scientific studies. Not the least of the advantages of such an institute would be the greater weight it would carry, when urging upon authority that the benefits accruing to administration from the results of its researches, and more especially of such anthropological investigations as have been carried out by the Institute of African Languages and Cultures, were of a nature to merit a liberal subvention from public funds, as a return for services rendered or to come.

Fifty Years Growth of London

History of the London County Council, 1889-1939

By Sir Gwilym Gibbon and Reginald W. Bell. Pp. xxi+696+33 plates. (London: Macmillan and Co., Ltd., 1939.) 21s. net.

AT first sight, this comprehensive history of the growth and development of the work of the London County Council to commemorate its jubilee would seem to be an authentic record of significant progress of social and political value. It is not directly concerned with Nature, or the knowledge of Nature commonly called science. Yet much of its nearly 700 pages affords a striking example of the application of science—social science, educational, physical, even biological. We usually associate the familiar name of our local government authority in the Metropolis with the early chairmanship of Lord Rosebery and the enthusiastic band of public-spirited men who gathered round him in 1889, and their not less enthusiastic successors over the fifty years of its history—with their personalities and social ideals, with their programmes and policies and battle-alogans, with an improved London and a rising rate. But here is the actual history of their doings and the vast organization which has grown up under their hands.

The size and variety of the activities of the London County Council are in themselves almost bewildering. Two million electors appoint 124 Councillors every three years; eighteen standing committees consist of a dozen to fifty members to deal with the education of 750,000 children and grown-ups in 1,400 schools, with general purposes, with hospitals and medical services, with housing and highways, and parks and open spaces, with public assistance, public control and supplies, with fire brigades, ambulances and main drainage, even with entertainments and recreation. The powers and duties cover all that concerns the life and labour of five million people, living in a metropolitan area which has grown to nearly 116 square miles. Little wonder that its official staff numbers 78,000 persons and its expenditure amounts to £37,000,000 a year. Yet from this vast undertaking there is excluded the control of transport, the provision of water-supply, electricity and gas, and the governance of the port of London, all of which have separate authorities.

When we turn to the application of science, we shall discover many signs of growth and extension. The old London School Board did great things in

its day, but after the Education Acts of 1902 and 1903, the whole subject of education fell to the duty of the local authority, and something of a revolution took place. In the first place, all forms and grades of education, elementary, secondary, technical, came under one body, and they were made subservient to each other; then the quality of the teaching has been reformed by particular training of the teacher, and the provision of modern plant and equipment; the physical and mental state of the children has also been greatly improved, by medical and physical care; the special schools have been extended and reformed for defective children; continued education beyond fourteen years of age has been developed, in trade schools, junior technical classes, and evening classes for 260,000 students; the infant schools have been radically amended, and nursery schools for the pre-school child have been established. Particularly has there been great progress in the school medical service, under 20 whole-time medical officers, and 56 part-time officers, with 77 school dentists, added to which there are 250 medical men and 112 dentists at the school clinics and 420 school nurses. There are 18 hospitals in the Council's scheme, and 81 school clinics, treating 315,000 children, and some 900 voluntary care committees with 5,000 members. It is the largest organization of a school medical service in the world, and comprises inspection, treatment, after-care, open-air education, physical training, special schools, child guidance, residential schools and institutions, and indeed everything medical that a sick, or healthy, child can require.

A new departure was made a few years ago in the field of research. The provision made by the Council was so wide that it recognized that the improvement of medical education and research could be facilitated by the better use for scientific purposes of its institutions and laboratories. With the co-operation of the Ministry of Health and the University of London, the Council established a post-graduate medical school at Hammer-smith which was opened by King George V in 1935—the first instance of a medical institution created by co-operation between the Government, the county council and the university, which has proved an invaluable service to medical education at the heart of the Empire. Further, Sir Frederick Menzies, the eminent medical officer, has organized a scheme of research work among the hospitals, units, maternity hospitals and special institutions under his charge, and the four special reports on

the work accomplished in 1934-37 indicate an immense sphere of valuable clinical and laboratory research. This also is a unique undertaking for a municipal authority, and reveals an unexpected source of new knowledge. Yet another scientific adaptation has been put into practice in medical education in respect of the training of students in the fever hospitals, for smallpox, and for mental diseases; in the last named, substantial advance has been made in diagnosis and treatment. The mental services of the Council, with 35,000 beds, offer unrivalled opportunities, and these are now being more widely used than has hitherto been the case, in public institutions under local authorities, and especially under the London County Council. Hence new therapeutic, and even preventive methods, are being undertaken in place of mere custodial care.

The application of scientific knowledge by the skilled advisers of the Council has extended even more widely than the sphere of medicine and surgery. This book contains a variety of examples in unexpected quarters, as in the development of the methods of the fire-brigade, the building of the bridges over the Thames, street improvements, the provision of open spaces, slum clearance, the housing estates, main drainage and sewage treatment, flood prevention, even in the unlikely direction of poor relief and public assistance: dietaries, classification and the training and employment of the able-bodied. When science, particularly the scientific method, is applied with knowledge, discrimination and imagination, it is really wonderful what can be achieved to make the public services a scientific, constructive and enduring agency of social reform. G. N.

Modern Aspects of Spectroscopy

(1) Kontinuierliche Spektren

Von Dr. Wolfgang Finkelburg. (Struktur und Eigenschaften der Materie: eine Monographiensammlung, begründet von M. Born und J. Franck, Herausgegeben von F. Hund und H. Mark, Band 20.) Pp. xi+368. (Berlin: Julius Springer, 1938.) 34.80 gold marks.

(2) Der Smekal-Raman Effekt

Ergänzungsband 1931-1937. Von Prof. Dr. K. W. F. Kohlrausch. (Struktur und Eigenschaften der Materie: eine Monographiensammlung, begründet von M. Born und J. Franck, herausgegeben von F. Hund und H. Mark, Band 19.) Pp. x+288. (Berlin: Julius Springer, 1938.) 25.60 gold marks.

THE series of distinctive yellow-backed volumes published under the general title of "Struktur und Eigenschaften der Materie" have long been known to physicists and physical chemists. The volumes are written by a series of distinguished specialists, and are valuable for their clarity and detailed reference to original papers. The subject of spectroscopy has been well represented in earlier volumes by the work of Stuart, Sponer, Back, Matossi, and Hund. Of the two volumes under review, that of Finkelburg is an entirely new contribution, that of Kohlrausch being a volume supplementary to vol. 12 of the series. These books reflect, in fact, two important aspects of present-day spectroscopy.

(1) The best-known examples of continuous spectra are those of hot bodies, and Planck's inception of the quantum theory as a result of his work on

their radiation properties has perhaps by its very completeness led indirectly to a neglect of other interesting problems in this field. With Dr. Finkelburg's volume we welcome a book on continuous spectra that is a landmark of its kind, for it is the first volume to treat of continuous spectra as met with in a wide variety of physical and chemical problems. The importance of continuous spectra in such subjects as astrophysics, photochemistry, luminescence, and the technology of lighting is sufficient to give us high hopes of a volume ranging over such widely different fields. One of the pleasing features of the author's treatment is the way in which various items are brought together. We are in the habit of dealing, for example, with such problems as the line spectrum of iron vapour and the continuous spectrum of a hot iron rod as entirely separate; we thus do not easily realize that a study of highly compressed iron vapour would be of particular interest as something intermediate between these two extremes.

"Kontinuierliche Spektren" contains fifteen chapters, the first of which is an introduction to the study of the continuum as it appears in physical and chemical problems, together with some theoretical groundwork. There follows a useful account of the general theory of the electron-continuum, and a chapter on absorption edge continua, and photo-ionization. Five chapters are given up to continua associated with molecules, and good use is made of potential energy diagrams to make clear the various types of absorption and emission continua such as predissociation and

recombination spectra. Chapter x, on the continuous spectra of particular diatomic molecules, including hydrogen, halogens, silver halides, van der Waals molecules (Hg_2 , Cd_2 , Zn_2), is specially valuable. A good account is also given of line-broadening, and temperature radiation receives due attention. Chapter xiii, on liquids, solutions, and crystals, is the least satisfactory; it is disappointing to find virtually no mention of fluorescence continua in solids. The book concludes with more than seventeen hundred references and a comprehensive index.

(2) Prof. Kohlrausch's book is supplementary to vol. 12 of the series published in 1931. It is divided into eleven chapters, the first five of which form an introduction to the study of the Raman effect. It is, however, for the accumulation of data to be

found in the succeeding pages that the book is chiefly valuable. There are sections on molecules containing from two to five atoms, and highly symmetrical molecules with more than five atoms (such as O_3 , N_2O , and SnCl_4) are also dealt with. Hydrocarbon chain and ring compounds are treated separately.

The indexing of a volume of this nature is of great importance. The literature references (more than eight hundred) follow on numerically from those of the earlier volume, and it is possible to search for any compound either under an alphabetically arranged substance index, or under a chemically classified index. In conclusion, one may perhaps express the doubt as to whether it is wise to try and fuse together a text-book and a mass of data in this way. J. T. RANDALL.

Vitamins

(1) Vitamins and Vitamin Deficiencies

By Dr. Leslie J. Harris. Vol. 1: Introductory and Historical. Vitamin B₁ and Beri-Beri. Pp. xiv + 204. (London: J. and A. Churchill, 1938.) 8s. 6d.

(2) Ergebnisse der Vitamin- und Hormonforschung

Herausgegeben von L. Ruzicka und W. Stepp. Band 1. Pp. xvi + 470. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1938.) 34 gold marks.

(3) Vitamins in Theory and Practice

By Dr. Leslie J. Harris. Third edition. Pp. xix + 242. (Cambridge: At the University Press, 1938.) 8s. 6d. net.

THESE three books typify well the existing state of our knowledge in the field of vitamin science and in its applications. The comprehensive and co-ordinated survey of existing knowledge, useful alike to specialist and general practitioner, to chemist, physiologist and medical man, is represented by this, the first volume of Dr. Harris's series of seven projected monographs. At the opposite extreme we have the new edition of the same author's now well-known popular exposition, one of the best examples of a difficult but important technique—that of making scientific facts and hypotheses understood by the layman without sacrifice of truth or clarity.

Perhaps the least successful type of book is that represented by vol. 1 of the new "Ergebnisse". Some of the contributions to it are of a high order, but there seems to have been little planning either in the selection of subjects or in the methods of

their presentation. In spite of this criticism—maybe rather a hypercriticism—the book is of considerable value, apart from reference purposes.

(1) If the remaining volumes of this series—a further six are promised in the near future, covering vitamin C and scurvy; vitamin D and rickets; vitamins A and E; pellagra and vitamin B₁₂ complex; other vitamins; applications and dietetics—reach the level of the first, they will inevitably become the standard works of reference on their subjects, especially as Dr. Harris is one of those compilers who seem anaphylactic to out-of-date editions, and will therefore feel the urge to keep all seven volumes in a state of constant revision. It is to be hoped that his publishers will be able to show the same sensibility.

The present volume is an excellent example of what Dr. Harris has set out to do by way of "comprehensive synopsis"—to use his own phrase. In reading it—and it is so readable that the reviewer found not the least difficulty in proceeding 'from cover to cover' in a time of about three hours spread over two days—one has the impression that the author himself has read, and read critically, every paper that has been published on his subject, has evaluated them all and selected for his readers information from those papers only that have contributed significantly to our knowledge. It may be arguable whether this first volume could or could not have more successfully achieved its object; what is beyond dispute is that no one could have made a better job of it than Dr. Harris. Its readers will eagerly await all six of its companions.

(2) The names of the contributors to this volume give it an air of great erudition—and great erudition is to be found in its pages, as well as much speculation of the kind rather more usual in certain parts of Europe than in Great Britain and the United States, at any rate in books of this type. The contrast can be well observed by comparing the authoritative articles of Dr. C. A. Elvehjem (the B-vitamins, apart from aneurine and flavin), of Prof. R. R. Williams (aneurine or thiamin) and of Prof. G. F. Marrian (the oestrogenic hormones) with those of their Continental colleagues. Here, though, one must make the reservation that Dr. T. Reichstein's contribution (the chemistry of 'Cortin') puts him among the English-speaking contributors, in method if not in tongue. The other authors whose names add distinction to the "Ergebnisse" are Profs. von Euler and Glanzmann and Drs. Giroud, Stehle, Berblinger, Guggisberg and Goldberg.

Besides the subjects mentioned above, this volume includes forewords by Sir Frederick Gowland Hopkins and by the editors, Profs. L. Ruzicka and W. Setpp, and articles on vitamin problems in relation to the growing child, vitamin C and its distribution in the living (animal) organism, the hormones of the posterior pituitary gland, 'ergones' and similar constituents of the living cell, the connexion between the pituitary and the reproductive glands, vitamins and reproduction, and the chemistry of the male sex hormones. Authors have been left free to write in English (four contributions), German (six contributions) or French (one contribution).

It is pleasant to welcome so cosmopolitan a volume, especially as it is rumoured that this feature is to be maintained in future volumes of the series. The chief difficulty of the new venture as a whole—new volumes are promised at roughly annual intervals—lies in the rather artificial association of vitamins and hormones, for chemically the connexion is only striking and well established for vitamin D and the steroid hormones of the gonads and the adrenal gland. The natural association, at least for the water-soluble vitamins, seems to be much more with the cellular enzymes, but they have their own "Ergebnisse" already.

The volume is not expensive, considering its size and country of origin, and is well produced, with abundant bibliographical references and an author index. Whatever its defects of conception or execution, it must be on the shelves and in the hands of all workers in the fields covered.

(3) In the gestatory throes of producing "Vitamins and Vitamin Deficiencies", reviewed above, Dr. Harris has yet had time to revise this admirable popular exposition. As well as expressing our astonishment at his energy and its resultant output, we may compliment him on this particular book as symbolizing his realization that science cannot flourish continuously without public support, and that public support depends on public understanding. This little treatise, revised in a few passages to bring the last edition (1937) up to date, can play a valuable part in keeping the public informed and sympathetic.

A. L. BACHARACH.

Group Phenomena

Collective Behavior

By Prof. Richard T. LaPiere. (McGraw-Hill Publications in Sociology.) Pp. xiii + 577. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 24s.

THIS work is a fairly comprehensive study of most social interactions in small and large groups. It is equally a contribution to social psychology as to sociology. A large amount of material is discussed that has never hitherto been introduced in books of this type, and the treatment throughout is objective and scientific.

The book is divided into five parts, the first being a general introduction to collective behaviour, the second dealing with cultural types of interaction, the third with recreational types of interaction, the fourth with control types of

interaction and the fifth with escape types of interaction. There are copious examples of these various types of social interactions; of institutional, conventional, regimental, formal, nomothetic rebellious behaviour, etc.

Each chapter is, broadly speaking, patterned on the same lines. First there is a qualitative discussion of the specific kind of behaviour concerned, then an analysis in terms of ideologies, membership, overt and covert aspects, and leadership. Moreover, each chapter has a very valuable appendix, giving a critique of sources and bibliography. Indeed, these appendixes are in many ways the most important contribution of the book.

One is particularly struck by the judicious use the author makes of such sources of information and illustration as those provided by newspapers and popular periodicals. This imparts a living,

organic touch to the work as a whole; the subject and treatment never become academic or remote from familiar events.

The method, although the author seems to hope otherwise, is clearly phenomenological, that is, simply descriptive of the phenomena of social life. It has been used most fruitfully by Prof. Katz in animal psychology and human needs and by Prof. Aveling in the study of volitional processes. There is thus no real attempt at a presentation of underlying principles. This is unfortunate and perhaps the chief criticism one has to make. One feels compelled to admit that the subject is still at the descriptive level. But science is far more than a collection of interesting facts sensibly grouped and classified. It requires an economy of explanation, so that much variation is reduced to the workings of few causal forces. In this connexion, one has to deplore the fact that the author nowhere makes any explicit use of psycho-analytic findings, in spite of the fact that psycho-analysis has made notable contributions to this field of study in the works of Freud, Ernest

Jones and others. The one reference to the psycho-analytic technique is deprecatory—the meaning of 'symbolism' as used in psycho-analysis "is not clear to any but the disciples of this cult". One reason for this absence of psycho-analytic theory suggests itself, namely, that if the author once commenced with such an approach he would find himself bound to sustain it throughout the work, which would entail acceptance of unconscious processes as fundamental determinants of social behaviour.

Sociologists with an eye for the part of economic conditions controlling the patterns of human behaviour, will find this factor somewhat neglected.

A specific instance where the author takes an extreme position unwarranted by experimental data is in connexion with collective thinking. There is quite inadequate evidence for the statement: "collective solving of any problem is *per se* a socio-psychological absurdity" (p. 378).

In spite of these defects, the work will be of much use to the student as an introduction to the phenomena of social life. J. I. COHEN.

The Present Position of Botany

Principles of Paleobotany

By William C. Darrah. (Plant Science Books, Vol. 3.) Pp. vi + 239. (Leyden: Chronica Botanica Co., 1939.) 7 guilders; 15s.

THEY say the trouble with palaeobotany is the number and plasticity of its theories; but these are only symptoms. The real trouble is its facts. To be sure, there are lots which are clearly enough established, but nearly all are incomplete; of the 60,000 fossil plant species which Darrah says have been described, perhaps not more than a dozen or two are known as fully as the fossil botanist can expect to know his material. The result is that nearly everything that can be said in a palaeobotanical discussion is of doubtful relevance or equivocal. It is a situation offering splendid opportunities and rewards for research; but for the writing of a fairly short book it is beset with difficulties. However, Dr. Darrah believes in his task, for he writes near the beginning: "From 1885 to 1915 paleobotany underwent its modernization chiefly because of the appearance of the textbooks and reference books".

This book is called in the prospectus "an integrated summary of the present status of Paleobotany" and that does indeed describe it. In a book of this modest length much must be left out,

and although every palaeobotanist will regret the suppression of some favourite line, the book must be conceded to be well balanced. It appears best when on fairly general topics which fall nearest the title "Principles of Palaeobotany" and is certainly least good when it describes, as in the chapters on the Devonian, genus after genus after the manner of an extremely condensed text-book. There are some pleasant little line drawings which help but only illustrate a few of the plants described.

Somewhat more space is given to morphology (and resultant ideas of phylogeny) than to floristics (and ideas of plant migration); but both are dealt with, as also more limited topics like the formation and structure of coal; palaeobotanical technique and history.

It should be made clear that this book was written for the unspecialized botanical reader. It is in no way, however, a popularized account; on the contrary the reader is assumed to be painstaking, and the list of relevant literature at the end of each chapter offers him the possibility of weeks of further study. It is a lot to hope for, but the author's enthusiasm is so evident that it may go a long way to inspire equal keenness.

T. M. HARRIS.

The Sun:

its Phenomena and Physical Features. By Giorgio Abetti. Translated by Alexandre Zimmermann and Frans Borghouts. Pp. 360. (London: Crosby Lockwood and Son, Ltd., 1938.) 20s. net.

IT is a commonplace to refer to the sun as the nearest star, unique in presenting a disk for detailed study and thus deserving the closest of observation. In this book, Dr. Abetti, the director of the Arcetri Solar Observatory at Florence, surveys our knowledge of solar phenomena gained from the rather restricted direct telescopic observations to those embraced by the extensive field of spectroscopy. How rich the results have been may be quickly appreciated by looking through the numerous illustrations. Behind some of these lie years of devoted research and great inventive ability, as in the case of a spectroheliogram of beautiful definition, the detection and measurement of the magnetic field of a sunspot, or the recording of the sun's inner corona without a total eclipse.

Of astronomical readers of the book, the solar observer will perhaps derive the greatest profit and pleasure, because the book is written from his point of view. To the theoretical worker, however, this comprehensive survey will be of use as a reminder (to quote from the prefatory note) "of the existence of a large body of observational material which cries out for investigation by the inductive theorist". During the last few years, there has been a growing body of wireless research workers and others who require information of the sun's behaviour during its 11-year cycle of activity. To these also, Abetti's book can be recommended to answer their questions. It will be surprising if nothing more than a transitory interest is felt after this introduction to a star in action.

Du pétrole

Par Victor Forbin. (Ce qu'il faut connaître, 28). Pp. 158. (Paris: Boivin et Cie., 1938.) 8 francs.

THERE is no doubt that M. Victor Forbin in his book "Ce qu'il faut connaître du pétrole" has satisfied a long-felt desire of the French layman. Every intelligent person at some time or other is driven by an urge to find out more about petroleum, that commodity which in an unbelievably short time revolutionized modern standards of living and which is used in some form or other every day by the poorest and richest alike. The development of the petroleum industry has been, and still is, romantic, and there is no reason why its romance should be buried and lost amid chemical formulae and statistics of text-books comprehensible only to technologists and others directly concerned with the industry.

M. Forbin has written an easily assimilated story of petroleum, but at the same time there are included in it much authentic information and a number of judiciously inserted statistics. There is so much information in this small paper-covered book that it should provide a satisfactory answer to practically all non-technical queries about petroleum and a great many technical ones, whether concerning origin, production, refining or commercial distribution.

Mosquitoes of the Ethiopian Region

2: Anophelini; Adults and Early Stages. By the late Dr. Alwen M. Evans. Pp. x+404. (London: British Museum (Natural History), 1938.) 20s.

A SHORT time before her death in August 1937 Dr. Alwen Evans brought to London the MS. and drawings for a monograph on the Anophelini of the Ethiopian region. This work was, happily, nearly complete, and has been seen through the press by Dr. F. W. Edwards of the British Museum (Natural History). In rather less than twelve years the number of Anopheline mosquitoes known from the region in question has become about doubled. This increase in knowledge has made the present monograph one of great value and necessity. *Anopheles*, it may be added, is the only genus of these mosquitoes that occurs in Africa, and is represented by the two subgenera *Anopheles sens. str.* and *Myzomyia*. Wherever possible there is included, under each species, a description of the adult insect, the pupa, larva and egg. There follow accounts of the larval habits and breeding places; habits of the adults; relation to malaria; and, finally, distribution.

We have nothing but praise for this comprehensive and scholarly work, which is admirably arranged and clearly illustrated. In every respect it forms a worthy memorial to its author, whose decease, in the midst of an active and scientific life, was a great loss to workers in medical entomology. A. D. I.

Chemie und Technik der Gegenwart

Herausgegeben von Dr. H. Carlssohn. Band 18: Feuerfeste Baustoffe: silikatischer und silikathaltiger Massen. Von Dr. Claus Koeppel. Pp. xvi+206. (Leipzig: S. Hirzel, 1938.) 17 gold marks.

THE first part of this book deals with the various modifications of silica (quartz, tridymite and cristobalite) in a very clear and satisfactory manner, the quantitative data being summarized in tables and curves. In the second part, the system silica-alumina is described, followed by the system silica-alumina-lime. The changes of state of silica in refractories owing to changes of temperature and the effects of various other substances are systematically described. The remaining part of the book deals with the effects of silica in other refractories, namely, magnesite, dolomite, natural magnesium silicates, chromite and zirconia.

Domestic Pests:

What they Are and How to Remove Them. By L. Hunter. Pp. xii+235. (London: John Bale, Sons and Curnow, Ltd., 1938.) 7s. 6d. net.

THIS little book is intended to give information regarding the various kinds of animals—from mites and insects to rats and mice—which invade human dwellings. Besides giving accounts of preventive and remedial measures, something is also said about the life-histories of the various creatures likely to be met with. In addition to animal invaders, a short account of the common domestic moulds is also included. The book has been well planned, and its subject-matter is scientifically accurate and well adapted for the purposes intended.

Structure of Proteins*

By Prof. J. D. Bernal, F.R.S.

THE structure of proteins is the major unsolved problem on the boundary of chemistry and biology to-day. We have not yet found the key to the problem, but in recent years a mass of new evidence and new lines of attack have enabled us to see it in a far more concrete and precise form, and to have some hope that we are near to solving it.

The problem of protein structure is twofold: the first is that of the form and properties of the protein molecule, and the second that of its internal structure. Owing to the extreme instability of the protein molecule, only the gentlest physical methods can be used; nevertheless three lines of attack—centrifugal, electrical, and X-ray—have already led to great success. The most fundamental has been the ultra-centrifuge, particularly the work of Svedberg and his school¹. Protein molecules will sediment in sufficiently high centrifugal fields, and from their sedimentation constant it is possible to arrive at a fairly accurate value for the weight of the molecule, though there is some doubt as to whether what is measured is that of the complete protein molecule, because of its inevitable association with the solution in which it is suspended.

The most striking discovery of Svedberg was that the weights thus obtained seemed to fall into definite classes which were multiples of each other. This suggests very strongly that all proteins are built from some common unit. What that unit is is more difficult to determine. Originally taken as 35,000, proteins are now found of 17,000 and even of 10,000 molecular weight. Critical examination of the data, moreover, shows that there is no exact correspondence to certain weights, but rather a scattering of weights concentrated in certain regions. There is no doubt that in closely related proteins there are simple relationships. Both haemoglobins and haemocyanins can, for example, be split reversibly into 2, 4, or 8 parts. But whether these relationships hold for all proteins is more doubtful; particularly as studies of viscosity have shown that proteins belonging to the same weight class such as insulin and gliadin may differ enormously in shape, the first being a flattened sphere and the other an elongated rod, and it is difficult to see what common physical structure they can have.

It has been claimed that this variation of weight of proteins of the same Svedberg class is to be expected on account of the known difference in amino-acid content. On the basis of existing analytical figures, it is as yet impossible to say whether this is or is not sufficient to account for the observed discrepancy. The figure of 288 amino-acid residues in a 35,000 molecular weight class protein cannot be taken at present as more than an inspired guess.

The second approach to protein structure comes from the electric properties of their molecules. The work of Cohn, Tiselius, and others gives us a picture of a protein molecule in solution as a particle covered with positive and negative charges due to the acid and basic nature of the amino-acid side-chains. The number of these groups depends on the condition of the medium. The protein molecule is, therefore, in its external relationship an essentially ionic structure, and probably carries with it an ionic atmosphere stretching out into the water in which it is dissolved.

The third line of attack is that of X-ray study. The beautiful crystalline forms exhibited by proteins, which have been known for at least a hundred years, were always a powerful attraction to X-ray crystallographers, but until the last five years the instability of protein crystals and their small size had defeated their efforts. Since 1934, however, it has been possible to examine a number of typical protein crystals². This has been done by mounting them in small tubes in their mother liquor, for most, if not all, proteins suffer considerable breakdown if examined dry. From the beginning, the results of this examination revealed important new facts. In the first place, the pictures yielded by protein crystals were of exceptional perfection. They showed large unit cells with a great wealth of reflections (see accompanying illustration), and these reflections were found even at comparatively high angles corresponding to such low spacings as 2 Å. This indicated that not only were the molecules of the proteins substantially identical in shape and size, but also that they had identical and regular internal structures right down to atomic dimensions.

From the size of the unit cells and their densities it was possible to compute the weight of matter in each repeat unit. This, however, does not immediately give the molecular weight, for two reasons. In the first place, the number of molecules

* From a Friday evening discourse delivered at the Royal Institution on January 27.

in the cell is not known, and in the second it is difficult to determine how much of the cell weight is due to the protein and how much to the water in the cell. By measuring the loss of water on drying it is, however, possible to arrive at a figure for the—possibly fictitious—dry weight, which can be compared with those obtained by the centrifuge or by chemical means. Here it is found that there is excellent agreement on the assumption that there are only a few, 2, 4, or 8, such molecules per cell². Thus the X-ray method furnishes an extremely accurate measure for the basic molecular weight of proteins though it cannot determine its multiplicity. It may well be that many proteins are built of sub-units, which though of approximately equal weight are not chemically identical, and are more properly to be called molecular compounds than molecules.

The most striking feature of the cell measurements of crystalline proteins is the considerable change which occurs on drying, where in many cases shrinkage of nearly 50 per cent occurs. But what is more remarkable is that the shrinkage is often confined to one or two directions in the cell. There are two possible explanations of this fact. First, that the molecules of the protein are linked together in extremely loose aggregates which collapse on the removal of water, leaving the skeleton of molecules in a now more closely packed array. The other explanation is that the molecules are held apart by their ionic atmospheres due to the charges on them, and contain, therefore, sheets of free water. It may be that both explanations hold, one more markedly for some crystals and the other for others. Thus for haemoglobin, where there is a marked shrinkage from 55 Å to 38 Å in one direction, it is difficult to imagine an ionic atmosphere, as the crystals are practically salt-free and at an isoelectric point of pH 6.8. On the other hand, it is difficult to explain the remarkable properties of tobacco mosaic virus on any other hypothesis. This virus has long thin particles which have a tendency to set equidistant and parallel, even down to concentrations of 13 per cent, and probably down to 1.5 per cent. It is difficult to imagine what force other than that of ionic atmospheres can preserve this regularity. Quite recently we have shown that the equilibrium distance between the particles depends on pH and salt concentrations, varying, for example, between 320 Å at pH 7; and 206 Å at pH 3.4. It should be possible to find a quantitative theory to explain these changes and, indeed, the beginning of such a theory has been made by Langmuir⁴ and Levine⁵.

The general picture of the external character of protein molecules is beginning to be definite. The molecules are spheroidal bodies of dimensions

varying from 30 Å. to 100 Å., are covered with hydrophil groups bearing charges of both signs, and probably carry with them in solution an atmosphere of ions.

The problem of the internal structure of protein molecules is one of enormously greater difficulty. Any effective picture of protein structure must provide at the same time for the common character of all proteins as exemplified by their many chemical and physical similarities, and for the highly specific nature of each protein type. It is reasonable to believe, though impossible to prove, that the first of these depends on some common arrangement of the amino-acids. The first hint of this comes from a study of the fibrous proteins. Here, owing to their technical importance and their much greater ease of handling, a very considerable advance has been made, due largely to the well-planned and persistent researches of Astbury⁶.

The fully extended β -keratin fibre has a strong repeat at every 3.5 Å., corresponding to the length of one amino-acid residue, and two other repeats at 10 Å. and 4.5 Å. respectively, corresponding to periodicities at right angles to the chain length. One of the most significant of Astbury's discoveries was that these two periodicities are also at right angles to each other. In other words, that the repeat unit of the fully extended protein has distinct characters in three dimensions. The significance of these repeats seems also beyond doubt, the 10 Å. spacing corresponding to the length of the side-chains of the amino-acid residues, and the 4.5 Å. to the so-called backbone spacing between the main chains themselves, which are held together by the CO and NH groups. In the shorter α form, the 10 Å. spacing remains, while the 4.5 Å. disappears, and this indicates that the chains are folded, but folded definitely in a plane and not as in rubber in two dimensions. What the precise mechanism of this folding is remains obscure, but it is of fundamental importance because it is probably very closely associated with the kind of folding that occurs in the corpuscular proteins.

The significance of these findings for the general protein problem is, first, that all soluble proteins hitherto examined give on denaturation a fibrous material which can be oriented and seems identical in basic structure with β -keratin, and secondly, that the actual change which a crystalline protein undergoes on denaturation must be very slight. This is shown by the close resemblance of powder photographs of crystalline proteins before and after denaturation, and also by the observations of Astbury, Dickinson, and Bailey⁷ that a single crystal of exocelsin gives on partial denaturation fibres orientated in the direction of the crystal

axes. Further, recent work by Perutz* has shown by an entirely different method, namely, the study of the absorption spectra in different directions in crystals, that the position of the prosthetic group in haemoglobin is not altered by denaturation.

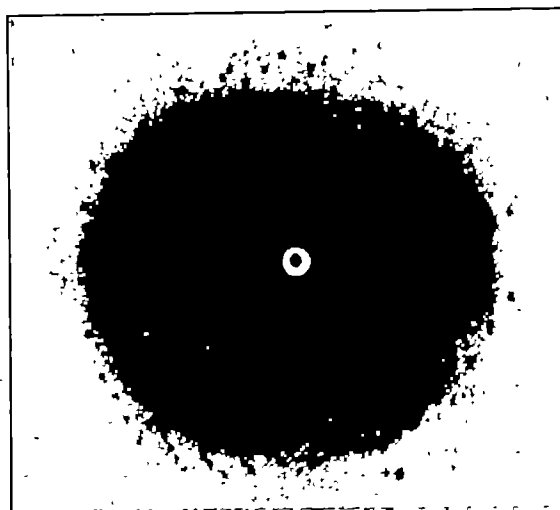
The evidence that the X-ray study of the crystalline proteins themselves provides for the elucidation of their structure is abundant, but it is extremely difficult to interpret. Photographs of crystalline proteins (see illustration) show hundreds of spots and marked differences of intensities stretching right out to reflections corresponding to inter-atomic distances. Unfortunately, however, direct analysis of these photographs is rendered impossible by the fact that we can never know the phases of the reflections corresponding to the different spots. The ambiguity introduced in this way can only be removed by some physical artifice, such as the introduction of a heavy atom, or the observation of intensity changes on dehydration, which have not hitherto been carried out in practice. For all but one of the proteins examined, the task is made still more difficult by the presence of more than one Svedberg unit in the cell.

The resulting X-ray pattern in such cases depends both on the position of the molecules in the cell and on their internal structure. Fortunately the one exception, insulin, has only one molecule per cell. An X-ray study of dry insulin crystals has been made by D. Crowfoot* and the intensities of the reflecting planes determined. It is to be regretted that it was not possible to examine the crystals wet because in the dry crystals no planes of spacing less than 8 Å. are observed, and consequently no evidence exists as to the fine structure of the molecule. The evidence on the coarse structure is, however, striking enough; it can most easily be seen from a study of the Patterson projections and Patterson-Harker sections which Miss Crowfoot has computed for insulin.

It should be explained that these projections do not represent the distribution of the density of scattering matter in the cell, but merely the product of the densities at points separated by a constant vector. It is not surprising, therefore, that the interpretation of these diagrams has already given rise to acute controversy. It seems natural to assume, though it is in fact an arbitrary simplification, that the peaks in the Patterson projection correspond to distances between a small number of high concentrations of scattering matter. Attempts have been made to reduce the analysis of the pattern to that of finding a pattern of points in space that will give maxima at the places observed. All these attempts have in fact failed. It is easy to find a large number of point patterns which will give the correct basal plane projection, but none of these will at the same time

fit the sections. The claims to have done so¹² are based on the arbitrary selection of a certain number of vectors, and the agreement disappears if all the vectors are taken¹³. The failure to find a point solution suggests that we are dealing with groups of size of the same order as their distance apart, and that the appearance of the enhancement of reflections at spacings 10 Å. and 4.5 Å. corresponds to an arrangement of side-chains or backbone spacings similar to those occurring in the fibrous proteins.

On the basis of present X-ray knowledge, it is clearly impossible to arrive at any detailed picture of protein structure. Indeed, up to now the chief value of the X-ray method has been to disprove



HORSE MOUTH HAEMOGLOBIN, *b*. AXIS, OSCILLATION PHOTOGRAPH, THE RING COMING THROUGH CENTRAL SPOT SHOWING (450) ZONE.

such hypothetical structures as have been put forward. It is, however, possible to formulate in a broad way some of the possible modes of arrangement and to suggest working hypotheses as a guide to future work.

The formal problems of structure of the protein molecule are:

(a) What is the nature of the link between amino-acid residues?

(b) Does the linkage run through the whole of the molecule or only through parts of it? In other words, is the protein one unit held together by primary valence forces, or is it made of sub-units held together in some different way?

(c) If such sub-units exist, what is the nature of the link between them?

As to the first question, the difficulty of accounting for the structure of spherical molecules out of a linear peptide chain has led to the idea of an alternate mode of linkage in which each amino-acid residue can be linked to four others and not

merely to two. While this hypothesis at first sight has a theoretical attractiveness, it still lacks any chemical support, and has been subjected to serious criticism on chemical grounds¹². There are enough unknown factors in protein structure already without employing doubtful chemical assumptions.

The question of the unitary nature of the protein molecule arises whether the inter-residue linkage is peptide or not. With a multiple link it is easy to construct models either of the cage or solid type, but as has already been pointed out, it is difficult to reconcile such continuous structures with the definite 10 Å discontinuities revealed by the X-ray analysis. With a peptide chain, however, the unitary solution becomes more difficult. It is difficult to imagine any kind of fold or coil by which a single chain can occupy the observable space and at the same time not be so intricate that its formation by any natural process would be enormously improbable. There is, however, much evidence that at least the larger protein molecules are not unitary in structure. In the first place, some of them can be split in solution down to particles of molecular weight of the order of 10,000, and this is probably not the lower limit, as smaller particles are difficult to isolate or measure.

Two lines of X-ray evidence also point to sub-units, the high symmetry of protein crystals and the 10 Å repetitions. The symmetry of protein crystals is much higher than would be expected statistically from compounds of such great complexity. This would seem to indicate that each molecule is built of sub-units themselves unsymmetrical but arranged in a symmetrical way. The size of the sub-units must lie between that of the smallest protein observed, that is, one with a molecular weight 9,000, and that of a single amino-acid of molecular weight averaging 120, that is, it must contain some sub-multiple of probably 72 amino-acid residues. The uncertainty arises from the fact that it is not necessary for all the sub-units to be the same, though some must be to account for the symmetry. The presence of trigonal symmetry suggests that the asymmetrical unit must be a third or less of this number, that is, it must contain 24, 12, or 8 amino-acid residues.

The question of the structure of the sub-unit would seem to raise at first sight the same difficulties as the structure of the molecule itself. Actually, however, with the smaller number of residues the difficulties and the improbabilities of the coiling become much less, particularly if we postulate—which is not unreasonable—that the sub-units are closed peptide rings. Such rings would necessarily curl up owing to the mutual attraction of the positive and negative charged amino and keto groups

in the chain, and models of such coiled chains can be constructed which preserve the distances between such groups that have been found in other compounds. The difficulty is, however, that there is a very large number of such possible models, and as yet nothing to choose between them. The method of folding in the chains in the sub-units may well be similar to that of the contracted form of the fibrous proteins mentioned above, and indeed a more detailed study of these may give us a clue to the whole arrangement.

The postulation of sub-units, however, raises further questions in the molecular structure, for they must be bound together sufficiently tightly to hold the molecule together in aqueous and ionic solutions. For this purpose a limited number of bonds are available. Ionic bonds are plainly out of the question, as they would certainly hydrate. There remains the possibility of amino-carboxy links between the ends of side-chains, but this is somewhat liable to the same criticism. It seems more probable that the links are either or both of two kinds, S-S linkages and association of hydrophobe groups. With the small number of sub-units, the number of S-S linkages needed to hold the molecule together is for all proteins hitherto examined sufficiently provided for by the amount of sulphur present, and the extreme changes in activity that proteins undergo when S-S bonds are broken indicate that they may have this fundamental part to play. Whether this is so or not, however, the behaviour of the hydrophobe groups of the protein must be such as to hold it together. As Danielli¹³ and Langmuir¹⁴ have pointed out, on the basis of surface-film work, the protein molecule in solution must have its hydrophobe groups out of contact with water, that is, in contact with each other, whereas on the surface the molecule is broken up into a film of 10 Å thickness in which the hydrophobe groups are driven out of contact with the water. In this way a force of association is provided which is not so much that of attraction between hydrophobe groups, which is always weak, but that of repulsion of the groups out of the water medium.

Langmuir has used this picture as a justification of the cyclol cage hypothesis, but it is strictly quite independent of it, and the model outlined above has the advantage of accounting very satisfactorily for the phenomenon of denaturation, particularly on a surface. Once the sub-units come to the surface, their rings are brought into a plane and different rings can interact according to the familiar ring-chain polymerization process, which will result in the formation of the fibres which Astbury has shown to exist in such films. This polymerization process takes measurable time as Danielli's work has shown.

The picture thus presented is far from being a finished or even a satisfactory one. The crucial fact that requires elucidation is the precise mode of folding or coiling of the peptide chains, and for this we may have to wait for some considerable time, until the technique of X-ray and other methods have been advanced much further than at present. The problem of the protein structure is now a definite and not unattainable goal, but for success it requires a degree of collaboration between research workers which has not yet been reached. Most of the work on proteins at present is unco-ordinated; different workers examine different proteins by different techniques, whereas a

concentrated and planned attack would probably save much effort which is now wasted, and lead to an immediate clarifying of the problem.

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Dr. William Thomson, F.R.S., a Forgotten English Mineralogist, 1761 - c.1806

By Dr. R. T. Gunther

WILLIAM THOMSON led two lives which seem never to have been correlated, certainly not in England. The first life culminated in his appointment as Dr. Lee's lecturer in anatomy at Oxford and his election into the Royal Society on March 16, 1786. The signatories to his certificate of candidature were the Hon. Charles Greville, Prof. R. Kirwan, John Hunter, S. F. Simmons, W. Pitcairn, Sir J. E. Smith, D. Pitcairn and Prof. T. Hornsby of Oxford. In 1790, he resigned all appointments, including the fellowship for which he had compounded on election. His second life was mostly spent in Naples during that pregnant period when Nelson and the British fleet featured so largely in all histories of Europe. There Thomson made a profounder study of volcanic phenomena than any Englishman, even counting Sir William Hamilton, had ever made before him.

That bibliographers have failed to connect the two lives is explained by Thomson's early death, and by his adoption of the name Guglielmo, and the signature "G. Thomson" for the few short articles that he published in Italian. Indeed he appears to have abandoned the use of his native tongue altogether. He was often addressed as "Dr. G. Thompson", and his only known address was "chez M. Heigelin" at the Danish Consulate in Naples.

My discovery of the identity of these two persons was due to the finding, in a contemporary collection of minerals, many fine specimens marked "Dr. T.", including a pet of Vesuvian lava moulded as a

commemorative medal to Diodato Dolomieu, with the name "G. THOMSON ANGLUS 1805" impressed on the back. Prof. Lacroix confirmed this by finding in Paris a letter addressed by G. Thomson to Cuvier from Naples in 1801, in which he is described as "già Professore di Anatomia a Oxford". With these clues the rest was simple.

William Thomson's father was a well-known physician of the same name in practice in Worcester. In 1776, at fifteen years of age, the son came up to Queen's College, Oxford, but migrated to Christ Church in 1780 as a 'Canoneer' student. In 1781 he appears to have assisted Gough in connexion with the latter's work on a new edition of Camden's "Britannia"; and in October, "to complete his medical studies", he went to Edinburgh, but returned to Oxford to take his M.A. in 1783, B.Med. in 1785 and D.Med. in 1786. As Lee's reader he gave two courses a year in the Anatomy School.

Dr. Gibson, who has traced his career as physician to the Radcliffe Infirmary from June 12, 1786 onwards, has found that one morning in the spring of 1790 two murderers were hanged. In the same afternoon "their bodies were conveyed in a cart to the Anatomy School at Christ Church where Dr. Thomson next day gave a public lecture on the two bodies, to which the neighbouring faculty as well as those of the place were invited, together with the gentlemen of the University, and many of the principal inhabitants. The bodies were also publicly exhibited the day following". Some forgotten event must have occurred, for in the

following autumn he resigned all his appointments! Christ Church paid him £240 for the anatomical preparations he had made for the School, and Oxford knew him no more.

Thomson's new scientific life abroad probably began with a visit to Prof. Dolomieu in Paris. He spent the autumn and winter of 1791 in Tuscany, there making his first discovery of a new mineral, a beautiful pearl-like opal, on the old volcano of Santa Fiora; to which he gave the name of 'florite'. In Siena he made the acquaintance of Prof. Soldani, who in after years doubtless secured the publication of his last paper, on the Pallas meteorite, in the *Atti* of the Siena Academy. His engraving of its crystalline structure shows an anticipation of Widmanstätten figures of 1808. While spending the winter in Florence he received closely related specimens from other localities; and it was there that he found that by grinding certain quartz crystals with an emery wheel, he could demonstrate the existence of minute drops of naphtha enclosed in the crystals. Several mineral specimens in his collection were obtained from Tuscan localities. On reaching Naples he was certainly influenced by the great interest of the vicinity and began to observe and collect seriously. Scipio Breislack, the manager of the alum and sulphur works at the Solfatara, was doubtless one of his early friends and guide to the extinct volcanoes of the Phlegraean Fields.

On an excursion to Castellamare, Thomson noted the successive changes produced in the burning of limestone in a lime-kiln, and compared them with those in limestone blocks cast up by Vesuvius. In 1794 he visited the volcanic island of Ischia, where upon the Lacco rock he discovered siliceous deposits comparable to florite: and so, too, in the Solfatara.

On June 12, 1794, on the anniversary of Thomson's appointment at the Oxford Infirmary, Vesuvius broke out in violent eruption. A few days later molten lava, bursting the ash walls of the volcano, flowed down to the sea, overwhelming with fire and rock the greater part of the town of Torre del Greco on its way. It being impossible to approach the mountain by land, Thomson and Breislack witnessed the spectacle from a boat, in which, like the elder Pliny, they spent the night together but a few yards from the shore. Their observation that there was no great local disturbance of the water supported Breislack's belief that the sea had no direct access to the volcano.

By July 1795 the lava had cooled sufficiently for Thomson to visit the vent from which the lava had issued. The sand near by was covered with his siliceous stalaotite. At a church at Torre del Greco against which the hot lava had come, he found crystals of pyroxene sublimed on the walls.

From pits where quarreymen were uncovering their buried city, he made a special collection of objects that had been buried in the flowing lava, and mineralized by its heat and gaseous emanations. He was thus able to study in detail the chemical and physical changes in bronze, copper, silver, lead and iron in Nature's own laboratory, all described in detail by Breislack from specimens in the Thomson collection. His long series of altered marbles and limestones provided by Monte Somma has been specially praised. The new name, 'sarcollite', for a variety of analcime from Monte Somma was due to him. Other words of his coinage were 'glastein' and 'glastenised' for glass or obsidian that had undergone divitrification; 'mère-pierre' for the rock whence lava has come.

Thomson, trained both as a chemist and as a mineralogist, brought together the most scientifically collected series of minerals and rocks that had perhaps ever been made in a volcanic region. Its importance was repeatedly mentioned by Breislack and by Faujas de St. Fond: indeed the chapters in Breislack's book are entirely based upon Thomson's ideas and classification. Alexander von Humboldt and von Buch, who witnessed the eruption of 1804, visited him in 1805 and were enthusiastic in their praise of his collection: Gay-Lussac was also one of the party. By the time of Poulett Scrope's visit to Naples, he appears to have been forgotten.

Beyond a few contributions to the *Giornale Letteraria di Napoli* (not to be found in England), there is little else known of Thomson. He seems to have been an accomplished artist, for he drew his own illustrations: one was engraved for Breislack's book. In 1801 he was writing to Cuvier. About 1807 Faujas deplored his recent and premature death, and in the same year the whole, or a large part of his volcanic minerals reached Lady Hippiisley, the wife of Sir John Hippiisley, fellow of the Royal Society, and one of the first managers of the Royal Institution, at her country home at Ston Easton near Bath; and as labelled by her on arrival, it is largely in its original state. It has led to this first sketch for a biography: the date and place of his death still remain unknown.

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Dundee Meeting of the British Association

THE meeting of the British Association in Dundee, which will run from August 30 until September 6, will be the third to be held in that city. The preliminary programme has just been issued. It is stated that for Dundee the present year is one of civic jubilee, for the town "attained the dignity of a city" in 1889: this coincidence with the meeting of the Association will not be overlooked. In referring to the previous meetings, mention is made of that in 1912 as "the occasion of a splendid act of generosity by a citizen of Dundee, the late Sir James Caird, whose gift of £11,000 to the funds of the Association enabled it to commemorate his name in the Caird Fund" for research.

The requirements of the Association in the way of accommodation for meetings and other functions will be more easily met this year than they were in 1912. The great hall which bears Caird's name has been built since that date: it will amply house the inaugural meeting on August 30, at which the president, Sir Albert Seward, will give his address on "The Western Isles through the Mists of Ages." The same hall will be the scene of a civic reception in the evening of August 31, of a graduation at which the University of St. Andrews will confer honorary degrees, on September 4, and of other items in the programme. The Reception Room and offices will be located in the Training College; the Victoria Art Galleries, which provided the Reception Room in 1912, will on the present occasion house a special exhibition of pictures, some from the city's permanent collection, others on loan from private collections in the district. The sections of the Association will be conveniently established, mostly in the University College, which immediately adjoins the Training College, and some in other buildings not far away.

The subjects of the presidential addresses in the sections, so far as they are announced, are as follows: Section A: Mr. R. S. Whipple on "Instruments in Science and Industry"; Section B: Prof. E. K. Rideal on "Film Reactions as a New Approach to Biology"; Section C: Prof. H. H. Read on "Metamorphism and Igneous Activity"; Section D: Prof. J. Ritchie on "Perspectives in Evolution"; Section G: Mr. H. E. Wimperis on "The Future of Flight"; Section H: Prof. W. E. Le Gros Clark on "The Scope and Limitations of Physical Anthropology"; Section I: Prof. D. Burns on "The Assessment of Physical Fitness"; Section J: Mr. R. J. Bartlett

on "Measurement in Psychology"; Section K: Prof. D. Thoday on "The Interpretation of Plant Structure"; Section L: Dr. A. P. M. Fleming on "Education in Industry"; Section M: Sir Thomas Middleton on "Practice with Science. The Farmer's Position and the Scientific Worker's Programme".

Among other subjects announced for discussion in the sections are: In Section A, television, problems of high-speed flight, the surface temperature of stars and high-temperature problems. Sections A and B will join in a discussion on artificial radio elements. Section B will deal with light alloys and with intramolecular changes, and will join with Section I in discussing tissue respiration. Section C will deal, as usual at an opening meeting, with local geology, and in this connexion it may be mentioned that a sectional excursion will be held after the meeting during September 7-11, covering Edinburgh and a district from the coast to the north-east, to the hills to the south-west of that city. Section C will deal also with the raised beaches of Forth and Tay, and with the Old Red Sandstone - Carboniferous boundary. Section D will discuss the natural history of salmon and trout, and there will be an exhibition of biological films. Another subject to be dealt with by this section is problems of freshwater biology. Section E will discuss the national atlas which is at present under the consideration of a committee of the Section. Speakers from other sections concerned will take part in the discussion. Section F will deal with various Scottish economic problems. The programme of Section G includes problems of transatlantic aviation and air conditioning. Section H will return to the subject of the teaching of anthropology and will join with Section I in the discussion of nutrition and physique. In Section I this last topic will be associated with that of the assessment of physical fitness, and the Section will also deal with the problem of pain. This Section will hold a day's session at St. Andrews. Section L announces discussions on education as a preparation for industry, on educational research in Scotland, and on the Spens Report. Section M will review the subjects of grass conservation and seed potato growing.

Two special sessions under the auspices of the appropriate sections jointly, and a local committee, will deal with scientific aspects of the cultivation and treatment of jute and with problems associated with the jute industry.

The Conference of Delegates of Corresponding Societies will be presided over by Prof. H. L. Hawkins, who will give an address on "Local Scientific Societies and the Community".

The new Division for the Social and International Relations of Science, established last year at the Cambridge meeting, announces an afternoon session for papers and discussion on the co-ordination of scientific research, and on population, and it is understood that the possibility of a discussion on international co-operation in science is also under consideration. An evening meeting on Sunday, September 3, will hear an address from Sir Richard Gregory, chairman of the Division, on science and social ethics, and on Wednesday morning, September 6, a session of the Division will be devoted to a discussion on nutrition, which will form a complement to sectional discussions in this field already mentioned.

A new feature of British Association meetings will be the delivery by Dr. Isaiah Bowman, president of Johns Hopkins University, of the first of the lectures to be given under the arrangement concluded last year with the American Association for the Advancement of Science, by which, in alternate years, a speaker from America is to be invited by the British Association, and one from Great Britain by the American Association. Dr. Bowman has chosen as his subject "Science and Social Pioneering". A number of public lectures will be given not only in Dundee, but also in neighbouring towns. In this connexion it is of interest to recall that it was at the Dundee meeting in 1867 that the first lecture to the 'operative classes' was given, an annual series out of which the present public lectures developed: moreover, it was at the Dundee meeting in 1912 that for the first time, in response to public demand, more than one such lecture was given, a practice which has become common since that time.

The customary full list of excursions is announced—those on Saturday will include Blair Atholl, Dunfermline, St. Andrews, Braemar and other places, and there will be many visits to works and places and institutions of special interest to individual sections. Garden parties and a dance are announced, and the Dundee Horticultural Society will hold its flower show during the period of the meeting; the president of the Association will perform the opening ceremony.

The paragraph on accommodation for visitors begins with the frank statement that hotel accommodation in Dundee is rather limited, but a local committee is actively at work on the whole question of meeting visiting members' requirements, and there need be no fear of any difficulty if members will make known their wishes in accordance with the directions in the programme.

The programme includes a list of all hotels and boarding-houses in Dundee and neighbouring places, and a list of lodging houses is in preparation. There will be a limited amount of accommodation in the hostels attached to University College, and the Medical School, and it should be specially observed that students' residence halls of the University of St. Andrews will be open to receive visitors; it is hoped that a service of special trains will be worked for the convenience of members staying in that town.

The announcements concerning publications include a reference to an important change decided upon at the Cambridge meeting. As from October 1939, the Reports of the Association will be published quarterly under the title of "The Advancement of Science" and the annual volume hitherto issued will be discontinued. So also will the collection of presidential addresses which have been issued at the time of the meeting under the title of "The Advancement of Science", which title will now be transferred to the new quarterly. It is stated, however, that individual addresses will be on sale separately during the meeting.

The preliminary programme is accompanied by an appeal from the general treasurer for an extension of membership of the Association. It is common knowledge that any person can, and very many do, take up membership only for the year of a particular meeting at which it is intended to be present: in particular, special efforts are always made to ensure that all interested residents in the locality of the annual meeting are given the opportunity to do this. But it is rather startling to learn from the present appeal that "of those who attend the annual meetings (apart from life members) only a small proportion—about one-quarter—are regular annual subscribers". The Association deserves a wider basis of permanent support than that, by a largely increased number whether of regular annual subscribers or of life members. It is pointed out in the appeal that "during the past few years the British Association has not hesitated to extend in fresh directions its activities for the advancement of science". Examples are given. In a reference to the new Division for the Social and International Relations of Science, established last year, it is stated that "the fields of activity already opened to view indicate that with more ample resources the Association will be able to undertake, through the Division, new work of national and international importance". Reference is made to the recent scientific delegation to India, an example likely to be followed elsewhere; to the arrangement for exchange of lecturers between the British and American Associations, made last year, and to various other opportunities which the Association

now possesses, within the framework of its constitution, to advance science, provided only that increased financial support is forthcoming. "These wide potentialities", the appeal states, "have all emerged in recent years; but there must always be borne in mind the field of scientific research and inquiry in which the Association has honourably laboured almost since its foundation. The ability to make grants for research is of the

essence of its being, and to maintain and strengthen this activity is one of the first tasks of every successive General Treasurer."

The appeal deserves success, and it is to be hoped that it will achieve it. Its professed object, as has been said, is the extension of membership; but well-disposed persons will not overlook the possibility of strengthening the financial foundations of the Association by other means.

Obituary Notices

Prof. C. M. Jessop

CHARLES MINSHALL JESSOP, who died on March 9, was born on June 13, 1861. His father was vice-principal of Cheshunt Theological College, and it may be to this that he owed his strong religious views. Jessop was educated at King's College School, London, and Clare College, Cambridge. He was bracketed seventh wrangler in the mathematical tripos of 1885 along with James Harkness and Henry Stroud. Harkness was afterwards the joint author of Harkness and Morley's "Theory of Functions", and Stroud became, later, as professor of physics, Jessop's colleague in the Newcastle Division of the University of Durham. In the same year (1885) Jessop was elected a fellow of Clare.

After holding various teaching posts in schools, Jessop was in 1893 appointed lecturer in mathematics at the Durham College of Science, Newcastle-upon-Tyne, now King's College; in 1903 he was advanced to be professor of mathematics in the same College, a post which he held until his retirement in 1928.

Jessop's main mathematical interest was in geometry, and he frequently deplored the diversion of interest in Great Britain from geometry to other branches of mathematics. His contribution to the subject was his two books. The first, published in 1903, was a "Treatise on the Line Complex". Apart from J. H. Grace's account of the subject in the tenth edition of the "Encyclopædia Britannica", this was the first full treatment in English. It gave a complete discussion of the development of the subject at that time.

The second book was on "Quartic Surfaces with Singular Points", which appeared in 1912. This was welcomed as a valuable introduction to some of the latest results obtained by geometers and at once took its place among the standard English treatises.

Jessop also published several smaller books, of which the most popular was the "Elementary Treatise on Trigonometry" which appeared in 1893, a joint work with E. W. Hobson.

Jessop had a fine appreciation of good mathematical style. He valued the subject for its own sake and was somewhat contemptuous of mathematics as a handmaid to the sciences. He was an inspiring teacher, especially to advanced students, and many hundreds owe their interest in mathematics to his able presentation.

Dr. Alexander Hetherwick, C.B.E.

We regret to record the death of the Rev. Alexander Hetherwick, for many years prominent as a missionary in Central Africa, which took place in Aberdeen on April 3 in his seventy-ninth year.

Alexander Hetherwick was born on April 12, 1860, and graduated from the University of Aberdeen with high honours in classics, mathematics, and theology, winning the Arnot Prize for experimental physics, and being Simpson mathematical prizeman.

At twenty-three years of age, Hetherwick volunteered for work with the mission of the Church of Scotland in Central Africa under Dr. Clement Scott at Blantyre. Five years later, in 1888, he succeeded Scott as head of the mission, a position he retained until his retirement in 1928. On his arrival in Central Africa the country, which afterwards became Nyasaland, was inhabited by pagan tribes dominated by the warlike Angoni, an intrusive immigrant offshoot of the Zulu stock; but his influence soon made itself felt. On his retirement he was Moderator of the Synod of Central Africa, in which the Presbyteries of Blantyre and Livingstonia, with those of the Dutch Mission, comprised some 40,000 members drawn from these pagan tribes.

It was not, however, for its Christianizing influence in the narrower sense that Hetherwick's work was remarkable. Under his guidance the Scottish Mission was conspicuous for its endeavour in instructing the native in handiwork and agriculture, and for its work among them in medicine and hygiene. Dr. Hetherwick himself was the foremost authority on the languages of the country. He translated the New Testament into the language of the Yao and was chairman of the board for the translation of the Bible into Nyanja. He wrote handbooks of the principal languages, and on his return to Scotland took up the revision of Scott's great dictionary of Nyanja. His knowledge of native customs and institutions was no less profound than his knowledge of their languages; and he was in those early days one of the principal sources of knowledge of the subject, on which he was a contributor to the *Journal* of the Royal Anthropological Institute. Dr. Hetherwick was twice a member of the Legislative Council, and received the thanks of the Colonial Office and the C.B.E. for his services to native welfare.

News and Views

International Relations

IN a speech on April 14 to the board of the Pan-American Union, President Roosevelt emphasized the fact that the people of the Americas can no longer consider the Atlantic as a barrier shutting them off from affairs in Europe. The rapidity and efficiency of modern communications make the world, East and West, a vast unity, no part of which can be disorganized without dire results for the whole. Mr. Roosevelt followed up this address with a message, which will surely go down in history as one of the most remarkable and far-reaching documents of our time, addressed to the heads of the German and Italian Governments. After referring to recent events in Europe, Africa and the Far East, and to the anxiety and tension plainly evident throughout the world, Mr. Roosevelt continued, "Nothing has persuaded the peoples of the earth that any governing Power has any right or need to inflict the consequences of war on its own or any other people save in the cause of self-evident home defence. . . . It is still clear to me that international problems can be solved at the council table. It is therefore no answer to the plea for peaceful discussion for one side to plead that unless they receive assurances beforehand that the verdict will be theirs, they will not lay aside their arms".

As a necessary preliminary to such discussions, Mr. Roosevelt asks for an assurance that no attack by the armed forces of Germany or Italy shall be made on any of thirty-one independent States, large and small, in Europe, northern Africa and the Near East for a period of ten or, better, twenty-five years. Such assurances, if given, would be transmitted to the Governments concerned, which in turn would be asked to give similar assurances to Germany and Italy. In the more peaceful atmosphere thus created, discussions should be immediately begun, in which the United States would take part, to enable the peoples of the world to "obtain progressive relief from the crushing burden of armament", and to open up international trade so that "every nation of the world may be enabled to buy and sell on equal terms in the world's market as well as to possess assurances of obtaining the materials and products of peaceful economic life". World problems are complex, and "study and discussion of these must be held in an atmosphere of peace. Such an atmosphere of peace cannot exist if negotiations are overshadowed by the threat of force or by the fear of war." Mr. Roosevelt's eloquent appeal for calm and dispassionate study of the intricate affairs of this troubled world needs no commendation from us; it is an appeal for the use of scientific method in the approach to the problems of international relations which all men of science would wish to see implemented now and for all time.

Dr. Haakon Shetelig

THE award of the much prized gold medal of the Society of Antiquaries of London to Dr. Haakon Shetelig, keeper of the Bergen Museum and honorary fellow of the Society, is a fitting recognition of the work of Norway's most distinguished archaeologist, whose researches on the Viking Age have contributed much to the understanding of an important phase in the racial and cultural history of Britain before the Norman conquest. Dr. Shetelig was born in 1877, became keeper of the Bergen Museum in 1901, and in 1914 was appointed professor of archaeology. He was already well known to his English colleagues when his studies of the famous Viking ship of Oseberg were published. So long ago as 1906 he attended the York meeting of the British Association as a "distinguished foreign guest"; and he now has in the press a corpus, fully illustrated, of British Viking antiquities. Although Dr. Shetelig is best known for his work on the Viking period, it has by no means monopolized his studies. His work on Norway's prehistoric past is no less remarkable for its comprehensive breadth of view than for its lucidity of exposition. The presentation of the gold medal to Dr. Shetelig will be made at the anniversary meeting of the Society of Antiquaries to be held at Burlington House on April 27.

Cave Culture of Palaeolithic Age

A COLLECTION of objects of the smaller kind, mostly belonging to the class known to the French archaeologist as *art mobilier*, which illustrates the culture of the cave-dwellers of the Upper Palaeolithic Age, has been put on view for a short period in the prehistoric saloon of the British Museum (Bloomsbury). These objects, which are drawn from the collections in the Museum, are derived from the caves of the departments of the Dordogne and Tarn-et-Garonne of southern France. The phases of culture they specially illustrate are the Aurignacian and the Magdalenian. Among the specimens shown are the well-known design of two reindeer following one another on mammoth ivory, and a number of those heads of horses which are excellent examples of the skill of the palaeolithic artist in seizing the salient features of animal life. This characteristic is especially to be noted in the eight specimens shown of the finely engraved animal figures on pebbles. The familiar but much prized and rare female statuettes in ivory of gross and slender, are not represented in the original, but by casts. An exhibit previously unrecorded is a tally rod of bone of the Aurignacian period. Examples are shown of the various types of harpoons, many of which are of extreme delicacy, and of the bone perforated needles, these being accompanied by the flint implements with which they were made. Among the exhibits of characteristic, or outstanding

examples of flint implements from the caves, is a remarkable example of delicate workmanship in the form of a leaf-shaped Solutrean point, measuring about nine inches long.

Excavations on Pre-Roman Sites in Britain

DURING the past five years, land development at Ewell in Surrey has brought to light extensive evidence not only of Roman occupation, but also of a succession of pre-Roman settlements of considerable importance, some indeed dating so far back as the Mesolithic Age. A further find recently reported (*The Times*, April 14) lies west of the Epsom road, some two hundred yards west of the recently proved line of the Roman Stone Street. The discovery is due to Mr. A. W. G. Lowther. It includes relics of the Mesolithic Age, the Early Iron Age, dating at about 500 B.C. and of the Claudian and Hadrianic periods. The site is near that at Thaxley Hill, on which Roman and Saxon remains were found a few years ago. The attraction to settlers here, it has been pointed out, was the dry belt of Thanet sand, which runs through Ewell, and the plentiful supply of water available from the famous springs. Mr. Lowther has dug out at about two feet depth a Roman road, in part well preserved, of the standard width of twenty-one feet. It is constructed of chalk blocks overlying the sand, and a surface layer of flints, in which was Hadrianic and later pottery. A much-worn coin of Domitian was found in an underlying well. Below the road were first century Roman pottery and a domestic oven, two pre-Roman ditches, pre-Roman iron slag and part of an iron ingot and much pottery dating back to 500 B.C., as well as a big light brown pottery water-container of the late Early Iron Age. Some twenty yards to the west of the road were the remains of a Romano-British hut, with Roman debris. A detailed account of the find is to be communicated to the Society of Antiquaries of London by Mr. Lowther in due course.

A SITE from which it may be anticipated that pre-Roman material of no little interest will be obtained is that at Silchester, on which stands, or rather stood, the Roman city of Calleva Atrebatum. Systematic excavations are to be carried out there under the direction of the Office of Works and the Archaeological Institute. The Roman city was under excavation for a number of seasons around the beginning of this century by a Committee of the Society of Antiquaries of London under the direction of Mr. (afterwards Sir) W. H. St. John Hope, the assistant secretary of the Society. Much important material was then obtained from the site, which is now in the Reading Museum, and valuable detailed reports of the results of the excavation were issued. Attention was directed, however, exclusively to the remains of Roman date; but it is obvious that a position of geographical importance to attract the Romans must have invited prior settlement. In fact, it is believed that this is the site of a large early British settlement known as Caer Segont, and that this was surrounded by the mound and ditch, similar to that

at Avebury, which encloses a much larger area than the Roman walls, presumably erected at a later date. Trial excavations in the area between the mound and the walls were carried out last year by Dr. Mollie Cotton and a party of volunteers; but operations are to be resumed on a more extensive scale this year, the excavators being drawn from Reading and other universities.

The Science Museum: New Optical Instruments

THE Science Museum has recently received from Mr. Thomas H. Court a gift of a large number of early optical, mathematical and astronomical instruments, some of which are now displayed in a single group in the Optics Gallery. Mr. Court, who celebrated his seventieth birthday last year, has spent most of his life collecting early scientific instruments, and he is a foremost authority on the subject. For the last thirty years he has been presenting his best acquisitions to the nation, so that his gifts to the Science Museum now total more than nine hundred. The seventy objects which comprise Mr. Court's most recent benefaction include an Italian recipiangle of about 1600. This is an instrument used for measuring angles in surveying, and it is also marked with lines and scales which can be used for making calculations. There is an optometer invented by Thomas Young for testing eyesight and prescribing spectacles, there are early telescopes with vellum tubes, silver drawing instruments, a diagonal glass by means of which the visitor to the theatre or opera could observe his fellow spectators while appearing to be looking through his glass at the stage, and there are several fine astronomical reflecting telescopes by such noted eighteenth century opticians as James Short, John Bird and C. S. Passavant. Among the microscopes presented are several rare instruments of the seventeenth, eighteenth and early nineteenth centuries, notably a beautiful compound microscope of the Divini-Campani form with silver mounts, a number of very fine Culpeper-type microscopes and some of the earliest achromatic microscopes by English and Continental makers.

Gas Fuel for the Internal Combustion Engine

THE internal combustion engine began with gas as fuel, but the use of concentrated liquid fuel has determined its vast development in all fields of transport. Circumstances, too familiar to mention, have in recent years caused a renewed attention to the possibilities of reverting, in part at least, to the use of gaseous fuel from coal and even coal itself. In Continental countries this has been encouraged by fiscal and other forms of State aid. On March 27-28, the Institution of Mechanical Engineers held a conference at Swansea, when the position of the subject was reviewed. It was reported that in 1938 a producer-fed passenger bus had maintained for one year a regular service from Inverness covering 32,000 miles. Its fuel cost was £90—as against £253 for petrol and £136 for oil. There was a charge for cleaning and attention of £30. In all producer-fed vehicles one must reckon on a 30 per cent loss of power owing

to extra weight and cost due to the producer. On the Continent there are many gas-engined small vessels fed by producer gas. The position attained by engines fed by compressed gas was reviewed and it was considered that engines using injected fuel with high compression ratios will give performances equal to those of compression ignition engines operated with fuel oil. Progress with road vehicles has been determined by the use of thin walled containers of alloy steel capable of working at 3,500 lb. pressure. Dr. H. Wahl gave an optimistic account of the position and future of an engine running on coal dust.

National Smoke Abatement Society

For many years the National Smoke Abatement Society, from headquarters in Manchester, pursued its modest efforts to secure a purer air and for the last ten years it has issued a quarterly journal. Since its removal to London, its efforts have been accompanied by greater progress. Even Whitehall has almost gone over to smokeless fuel and the L.C.C. has become more active. The extensive rebuilding in progress all over Great Britain is providing an unusual opportunity to diminish atmospheric pollution. Even the coal industry, long indifferent to the manner in which its wares were consumed, is showing an increased desire to avoid the reproach of causing smoke. The Society has taken a further step by issuing its journal in a new form, larger, more ambitious and under the more attractive name of *Smokeless Air*. This will be issued quarterly at 1s. and for 2s. 6d. post free per annum. The first number of the new series is bright and well produced, containing news of the movement and interesting articles on the subject of atmospheric pollution. At its price it ought to receive a much wider circulation.

Telephone and Telegraph Statistics of the World

In *Electrical Communications* of October 1938, statistics of the telephone and telegraph services of the world are given. The telephone development of the world by countries is first discussed, the figures taken being for January 1937. North America possesses nearly 54 per cent of the total number of telephones in the world, the United States alone possessing nearly 50 per cent, and having 14.4 per cent per 100 of the population. South America possesses 2 per cent of the total and nearly 1 per cent per 100 of the population. The whole of Europe possesses 36.5 per cent of the total world number and has an average of 2.4 per 100 of the population. Great Britain and Northern Ireland, France, Germany, Italy and Russia have 7.5, 4.0, 9.25, 1.5 and 2.8 per cent of the total world telephones and 5.9, 3.5, 5.1, 1.3 and 0.6 per 100 of the population. Asia possesses nearly 4.6 per cent of the world's total, of which about three quarters belong to Japan. Africa possesses about 0.9 per cent of the world's total, of which more than half belong to the Union of South Africa. Oceania possesses nearly 2.3 per cent, Australia having 1.5 per cent. The number of telephones per 100 of the population is also given for

large cities. Washington and San Francisco head the list each with 37. Stockholm comes next with 35. Then New York with 22, London with 18, Paris with 15, Berlin with 13, Rome with 8, Tokyo with 3.9, Moscow with 3.5 and Shanghai with 3.4. In Canada, Montreal with more than a million inhabitants has 16 telephones per 100 of the population, and Toronto with more than three quarters of a million inhabitants has more than 25 telephones per hundred. In 1936, the total number of 'wire' communications, that is, of telephone conversations and telegrams per capita in Canada was 222, of which only 1 was a telegram. In the United States it was 211, 1 being a telegram, and in Great Britain and Northern Ireland it was 44, the number of telegrams sent per capita being a little greater than 1.

Meteorology in India

THE report on the Administration of the Meteorological Department of the Government of India in 1937-38 shows that certain undertakings that had been under consideration for a number of years were carried out. Of these the most important is considered to be the daily preparation of an afternoon synoptic weather chart at the Meteorological Office at Poona, which was begun on April 1, 1937. This has enabled that office to issue forecasts twice a day instead of only once. This afternoon synoptic chart is printed in the Indian Daily Weather Report, and adds greatly to the value of that report. Another important development was introduced on August 1, 1937, when the short-wave aeronautical wireless stations at Karachi and Calcutta began to issue regional broadcasts of synoptic data twice daily. The new Burma Meteorological Department followed this lead by beginning the broadcasting of data for stations in Burma from October 1, 1937. With the commencement by the Posts and Telegraphs Department of the construction of a short-wave wireless station at Poona, the time is approaching for the issue from headquarters of collective and regional synoptic issues. Further plans were made in accordance with recommendations made at a meteorological conference held in Delhi in December 1936. They included the reopening of a forecasting office at Delhi and the transfer of the Upper Air Office from Agra to Delhi. These plans were approved in principle by the Government of India, but sanction for putting them into effect had to be postponed owing to the unfavourable financial situation. Another new development was the introduction at the request of the Royal Indian Navy of an arrangement for broadcasting synoptic data and weather bulletins for the whole of the Indian waters from the Navy Wireless Station at Bombay, for the benefit of shipping. The new broadcasts are additional to those issued from the civil wireless stations at Bombay and Calcutta.

Osiris

VOL. 4, part 2 of *Osiris*, edited by Dr. G. Sarton, published in 1938, is a monograph on "Science, Technology and Society in Seventeenth Century England", by Robert K. Merton, and its content is

defined by the author as "an empirical examination of the genesis and development of some of the cultural values which underly the large-scale pursuit of science". The "Dictionary of National Biography" has been selected as the source of information of an occupational census and the data subjected to a tabulation process. On the basis of this information a further survey of discoveries based on Darmstaedter's "Handbuch zur Geschichte der Naturwissenschaften und Technik" was compiled. This indicated the particular interests which arose in different times in the period studied. The influence of religious movements such as Puritanism is considered. The influence of external factors is carefully examined. The whole study is very interesting and suggestive in many fields but suffers from the lack of a detailed table of contents, so that the intention of the work is not easy to grasp, and the author's conclusions are not easy to find in the mass of detail. Vol. 5 of *Osiris*, which now rejoices in a Latin title as *Commentationes de scientiarum et eruditionis historia rationeque volumen quintum Iulio Ruska oblatum*, is dated 1938, and is edited by Dr. Sarton assisted by Dr. Pogo. It contains some interesting and valuable papers on scientific incunabula (to which a recent volume of *Osiris* was devoted), on Arabic algebra (incidentally, the history of mathematics has occupied a prominent place in the journal so far), on Kopp, the historian of chemistry, on astronomy, on Michael Scot (a subject which has now been about worked to death), on animals in the Bible, and on other subjects. There is a biographical and bibliographical notice of Ruska and a portrait. These two volumes of *Osiris* maintain the high standard of scholarship of the publication, and are indispensable to students of the history of science.

Royal Cornwall Polytechnic Society

In its several ways the Royal Cornwall Polytechnic Society continues to stimulate interest in the traditions and archaeology of the county as well as in science. Lectures are given, prizes for essays awarded, excursions are made and much is done for meteorology by the maintenance of the Falmouth Observatory and the support of the Cornwall Rainfall Association. All these matters are referred to in the one hundred and fifth annual report, recently issued, which is accompanied by some of the original contributions to the Society. The Society was founded when the Cornish metalliferous mines were in full swing, and in a paper entitled "The Ancient Mining Districts of Cornwall" Mr. F. J. Stephens gives a review of the score or more of mines which existed within two miles of the coastline, in the parishes of Illogan, St. Agnes and Perranzabuloe. Another contribution, but in lighter vein, is an account of the opening of the railway to Falmouth in 1863, from which it was hoped the district would gain much by the re-opening of the port of Falmouth as a terminus for steamship lines, while in yet another Mr. E. Ohirwin treats of the dialect of Cornwall. As in other parts of Great Britain, the dialect "is speeding from the presence of compulsory instruction, the cinema, the motor coach, the daily paper and the thousands of visitors"

who flock to the district. As usual, Mr. W. T. Hooper gives a series of valuable meteorological notes, in which he shows that those discontented because perpetual sunshine is not to be enjoyed at Falmouth, have little about which to complain.

Japan Institute for Science of Labour

THE annual report of the director of the Japan Institute for Science of Labour for 1937 gives a brief account of the history of the Institute as well as of its divisions and functions (Tokyo: Japan Institute for Science of Labour, 1938. 70 sen). A programme of proposed investigations, including studies on nutrition and the prevention of industrial accidents and occupational disease, is also outlined which indicates how sadly warped the whole outlook of Japan has become under the demands of her policy of war and aggression. Brief notes are included on investigations completed in 1936-37, among which may be mentioned a study of dust in mail-cars and a survey of the labour conditions of railway postal workers. The first part of an investigation on gaseous metabolism in heavy muscular work has been completed, covering gaseous exchange in static effort, and a third report on occupational diseases of printers, especially lead poisoning, deals with the density of dust in the air and the window space in the printing shop. A statistical analysis has been made of the causes of death in different occupations, and other studies have included acute nicotine poisoning among land workers and water supply in an agricultural village.

The Lily Year-book

THE Royal Horticultural Society's Lily Year-book for 1938 (London: the Society's Office, Vincent Square, S.W.1. Pp. 181+35 plates. 5s. paper; 6s. cloth. 1938) contains an account by Messrs. A. B. Stout and W. M. Porterfield of "Seed Patterns and Incompatibilities in *Lilium candidum*". It is shown that incompatibilities may occur among sister plants of the same species. Such disabilities are physiological in nature, and are not to be confused with failures in hybridizing fertilizations. An ingenious method of estimating incompatibility by the examination of seeds has been used. The results are considered in relation to the practical promotion of fertility by late fertilization, when suitable stigmatic secretion is developed, and by artificial treatments of the stigma. The Year-book contains numerous papers about the horticultural treatment of lilies; Dr. Fred Stoker has a useful article upon the geographical origin and classification of the Carniolicum group of lilies; Mr. A. D. Cotton contributes a short biography of Père Armand David (1826-1900), the celebrated naturalist and explorer; and Mr. E. O. Clement describes various practices for the germination of lily seed in Ontario. The year's work upon lilies revealed by the volume indicates a lack of contributions of a fundamentally scientific nature. Reports of discussions at meetings of the Society's Lily Group, published in the present Year-book (pp. 42-79), and similar accounts in earlier

years, show that those whose interest in lilies is practical and aesthetic, need, and desire, the specialized help of the geneticist, the physiologist and the pathologist.

Scientia Genetica

WITH the object of stimulating the development of genetics in the Latin countries, a new journal, *Scientia Genetica*, is being launched under the direction of Prof. Carlo Jucci of the University of Pavia and with his colleague Prof. Adriano Buzzati-Traverso as its editor-in-chief. Though it is primarily intended to provide an appropriate medium for publication for geneticists in these particular countries, original papers from elsewhere will be welcomed so long as they are written in Italian, French, Spanish or Portuguese, and possess a strictly genetical interest. There is to be a special section for abstracts, reviews of recent books and for summaries of original papers dealing with animal and plant breeding (such papers will not be published in full). At the end of each year there will be given a complete bibliography of papers of genetical interest that have appeared in the scientific literature of the Latin countries, and from time to time there will be presented a critical review of some selected field. Geneticists will welcome this addition to the literature of their science. It undoubtedly supplies a need, and it may be expected to play a notable part in the inevitable advancement of genetics not only in the Latin countries but also in the world as a whole.

Beneficial Insects

IN 1922 the Ministry of Agriculture and Fisheries issued a small publication on "Beneficial Insects". It contained little-known information, written in a non-technical style, on those insects that are beneficial to the farmer, fruit-grower and gardener. During the sixteen years which have elapsed, this bulletin has passed through three editions and has been reprinted on five occasions. Knowledge of insects of this kind has greatly increased in the interval and the practical measures that can be taken to increase their usefulness have been extensively investigated. This new bulletin (No. 20; 1939) has been entirely re-written by Dr. W. R. Thompson and forms a useful non-technical introduction to the subject. It is obtainable from His Majesty's Stationery Office, or through any bookseller, price 9d. net.

Advanced Study at the University of Cambridge

THE University of Cambridge has recently published abstracts of ninety-one dissertations approved during the academic year 1937-38 for the Ph.D. (75), M.Sc. (11) and M.Litt (5) degrees. The abstracts are full enough (averaging about a page and a half) to give a fair idea of the substance of the dissertations. They may be roughly grouped as follows: the humanities 26, pure science 55, applied science 10. The actual distribution according to faculties is: divinity 2, moral science 2, classics 3, English 4, modern and medieval languages 6, history 3, economics and politics 3, archaeology and anthropo-

logy 2, geography 1, mineralogy and petrology 4, mathematics 8, physics 6, chemistry 14, botany and zoology 15, biochemistry and physiology 8, agriculture 3, engineering 7.

North Pacific Earthquake

AN earthquake of moderate intensity occurred on November 17, 1938, and its epicentre has been determined by the United States Coast and Geodetic Survey in co-operation with Science Service and the Jesuit Seismological Association as lat. 55° N., long. 158° W. It is estimated to have normal focal depth. This preliminary determination was made with the help of readings from the following stations: Georgetown, Fordham, Weston, Chicago, Ann Arbor, Ukiah, Victoria, San Juan, St. Louis, Tucson, Philadelphia, Williamstown, Butte, Bozeman, Honolulu, Manila, Sitka, Pasadena, College, Burlington, Huan-cayo and Kew. The epicentre is situated under the ocean bed to the south of the Alaska Peninsula, and is not far distant from the scene of the violent earthquake of November 10, which was lat. 56° N., long. 150° W.

National Physical Laboratory: Publications

THE demand for the first issue of the "National Physical Laboratory Abstracts", which covered papers contributed by the Laboratory to the scientific and technical press during the year 1938, has proved its value to industry and has justified the recent issue of a similar pamphlet for the year 1937. The abstracts of papers in the present issue cover sixty-seven pages and on the average an abstract occupies a little less than half a page. They are arranged in order of subject: engineering, metallurgy, electricity and heat and general physics abstracts occupying 7-11 pages each and other subjects less. Both author and subject indexes are provided. The pamphlet may be purchased directly from H.M. Stationery Office, price 1s.

Finney-Howell Research Fellowships

FINNEY-HOWELL RESEARCH FELLOWSHIPS have been renewed for the following: Dr. P. C. Aebersold, University of California, Berkeley; Margaret E. Boyland, Royal Cancer Hospital, London; Dr. Alma Howard, McGill University, Montreal; Dr. L. M. Joshel, Harvard University; Dr. L. W. Law, Jackson Laboratory for Cancer Research, Bar Harbor, Maine; Dr. H. Lisso, Johns Hopkins Hospital, Baltimore; Dr. C. S. McEuen, McGill University; Dr. W. O. Merkel, Union Memorial Hospital, Baltimore. Fellowships for 1939 have been awarded to the following: G. M. Badger, of Melbourne, Australia, to work at the Royal Cancer Hospital, London; Dr. A. Kirschbaum, to work at Yale University; Dr. J. L. Melnick, to work at Yale University; Dr. J. F. Menke, to work at Stanford University Hospital; Dr. J. L. Wood, to work at Harvard University; Dr. P. O. Zamecnik, to work under Dr. K. Linderstrom-Lang at the Carlsberg Laboratory, Copenhagen. Grants in aid have been awarded to Dr. R. D. Fowler and Dr. R. W.

Graham, jun., Johns Hopkins University, and Dr. G. O. Gey, Johns Hopkins Medical School. Applications for 1940 awards must reach the office of the Foundation (Medical and Chirurgical Faculty Building, 1211 Cathedral Street, Baltimore) by January 1, 1940.

A Large Sunspot

A LARGE sunspot of rapid development crossed the central meridian on April 18.1. When photographed at the Royal Observatory, Greenwich, on April 18, at 10 h. U.T., the spot had an area of 150 millionths of the sun's visible hemisphere; twenty-four hours later the spot, which had become of complex structure, had increased to 1,000 millionths. This is the largest spot seen during the past four months. Greenwich also reports a considerable magnetic disturbance recorded at Abinger as having begun suddenly on April 17 at 1^h 55^m. There would appear to be a definite association between the big sunspot and the terrestrial magnetic storm.

Announcements

M. JACQUES DUCLAUX, professor of general biology in the Collège de France, Paris, has been elected a free academician of the Paris Academy of Sciences, in succession to the late M. d'Ocagne.

DR. ALBERT SZENT-GYÖRGI, professor of medical chemistry at Szeged, Hungary, has been awarded the A. W. Hoffmann Memorial Medal by the German Chemical Society.

DR. T. MORAN, principal scientific officer at the Low Temperature Research Station, Cambridge, has been appointed director of research at the Laboratories at St. Albans of the Research Association of British Flour-Millers, in succession to Dr. E. A. Fisher. Dr. Moran will take up his duties on June 1.

COLONEL A. S. ANGWIN, deputy engineer-in-chief, has been appointed Engineer-in-Chief of the Post Office, on the retirement of Sir George Lee on May 31.

ON March 29, the Earl of Athlone, as president of the National Hospital for Nervous Diseases, Queen Square, formally accepted the Associated British Cinemas Laboratory for Biochemical Research and the Gaumont-British Laboratory for Histological Research.

A COURSE for those engaged in the training of mental defectives in occupation centres, institutions or mental hospitals and for home teachers has been arranged by the Central Association for Mental Welfare. Further information may be obtained from the Educational Secretary of the Association, 24 Buckingham Palace Road, London, S.W.1.

THE annual meeting of the U.S. National Academy of Sciences is to be held in Washington during April 24-25. The sessions for the presentation of scientific papers are open to the public. In the evening of April 24, the president of the Royal Society, Sir William Bragg, will deliver the second Pilgrim Trust

Lecture, which will be entitled "History in the Archives of the Royal Society".

THE Meyer Medal for distinguished services in plant introduction has been awarded by the American Genetic Association to Miss Kate O. Sessions, of San Diego, California. Miss Sessions, who is eighty-two years of age, has contributed greatly to the horticultural beauty of southern California through fifty years of active work spent there as a landscape gardener and horticulturist. The Meyer Medal is awarded periodically by the Council of the American Genetic Association.

A NATIONAL conference on the "Wider Aspects of Nutrition" will be held under the auspices of the British Medical Association in the B.M.A. House, Tavistock Square, London, W.C.1, during April 27-29. The inaugural address will be delivered by Sir Arthur Salter. The following sessions will be held: (1) Medical Aspects of Nutrition; (2) Means of Stimulating Production, (a) Home Agriculture, (b) Overseas Producers; (3) Means of Stimulating Consumption, (a) Family Allowances, Provision of Cheap or Free Milk or Meals in Necessitous Cases, (b) Education. On April 28, at 8.15, Prof. V. H. Mottram will deliver the Sir Charles Hastings Public Lecture entitled "Nutrition and the Public Health". Admission to the conference is by ticket obtainable from the secretary of the B.M.A.

THE following appointments and promotions in various branches of the Colonial Service have recently been made: T. F. Blood, inspector of produce, Nigeria; F. A. Leeds, inspector of plants and produce, Gold Coast; I. Sibson, inspector of plants and produce, Gold Coast; R. Johns (agricultural officer, Zanzibar), agricultural officer, Fiji; A. F. Nichols (assistant director of agriculture), director of agriculture, Seychelles; W. M. Robertson (conservator of forests, Sierra Leone), conservator of forests, Tanganyika Territory; F. B. Higgins (senior inspector of mines), chief inspector of mines, Gold Coast; R. L. Creery (veterinary officer), senior veterinary officer, Kenya; W. G. Emerson (veterinary officer), senior veterinary officer, Kenya; W. Fotheringham (veterinary research officer), senior veterinary research officer, Kenya.

WE have received from Messrs. Griffin and Tatlock, Ltd., Kemble Street, London, W.C.2, a copy of their new 1,150-page Catalogue No. 15 B of modern chemical apparatus. This has been entirely rewritten in the light of modern laboratory equipment and technique, and comprises a very wide range of apparatus for use in all branches of chemistry. It is planned in thirteen sections, in each of which the items are in alphabetical order, and there is a detailed general index. The apparatus is illustrated and in many cases there are adequate descriptive notes, so that the volume is much more than a mere catalogue of prices. In many cases the theory of the apparatus is briefly yet adequately described. This catalogue would be found of great value in any chemical laboratory.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 686.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

A New Type of 'X-Ray Microscope'

A STANDARD method of X-ray analysis consists in measuring the strength of the diffracted beams corresponding to a series of reflections around a crystal zone (for example, the reflections with indices $h0l$ around the b axis), and then forming a double Fourier series with the amplitudes F as coefficients.

$$\sum \sum F(h0l) \cos \left\{ \frac{2\pi h x}{a} + \frac{2\pi l z}{c} + \alpha(h0l) \right\}$$

The sum of this series gives the density of scattering matter at a point x, z when the contents of the unit cell are projected on the face (010). In the case of a centro-symmetrical projection $\alpha(h0l)$ is either 0 or π , and if there are sufficiently heavy atoms at the centre of symmetry, it is zero for all reflections. The present note describes a simple and rather striking optical method of effecting the summation for a case where $\alpha(h0l)$ is always zero.

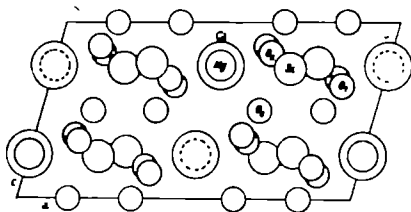


FIG. 1.

Holes are drilled in a thin plate of brass, one for each reflection $h0l$. The area of the hole is proportional to $F(h0l)$ and the holes are arranged in the positions of cross-grating spectra. The plate represents, in fact, a section through the reciprocal lattice containing all $h0l$ reflections. The plate is placed between a pair of good lenses, of about 6-ft. focal length. A point source of monochromatic light (a

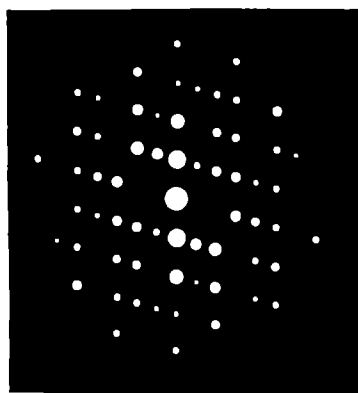


FIG. 2.

pin-hole in front of a mercury vapour lamp) is placed at the focus of one lens, and the image of the pin-hole at the focus of the other lens is viewed through a microscope. The diffraction of the light by the holes in the plate results in a very realistic image of the crystal structure being seen through the microscope. Each pair of holes $F(h0l)$ and $F(h0\bar{l})$ forms a set of parallel diffraction fringes, and these sets have the right amplitude, spacing and phase to build up the double Fourier series given above.

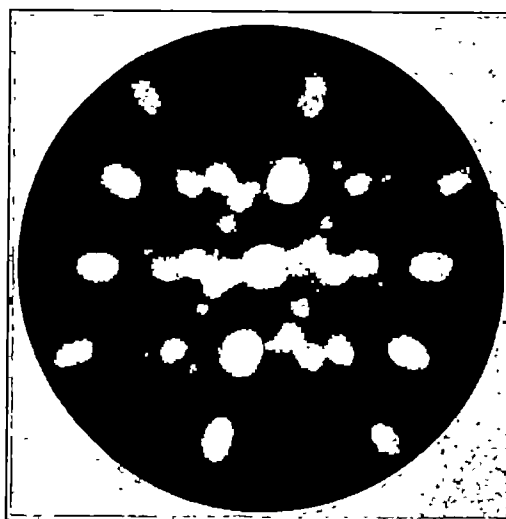


FIG. 3.

Fig. 1 shows the projection of diopside, $\text{CaMg}(\text{SiO}_3)_2$, on the plane (010). The largest circles represent superimposed Ca and Mg atoms at symmetry centres of the projection, these atoms being so heavy that $\alpha(h0l)$ is zero for all reflections. The intermediate circles are silicon, the smallest are oxygen. Fig. 2 is twice natural size and is from a contact print of a brass plate drilled with holes to correspond to the $h0l$ spectra given by the crystal (see Fig. 3b). Fig. 3 is a photograph of the diffraction image seen in the microscope when this plate is placed between the lenses as described above, and it will be seen that it is a faithful reproduction of the crystal structure shown in Fig. 1.

We are now searching for a device for dealing with the more general case of values of 0 or π for $\alpha(h0l)$, for example, a ready way of placing a film with a half-wave retardation over certain holes. If this can be found, the method may prove to be of practical use in crystal analysis.

Cavendish Laboratory,
Cambridge.

W. L. BRAGG.

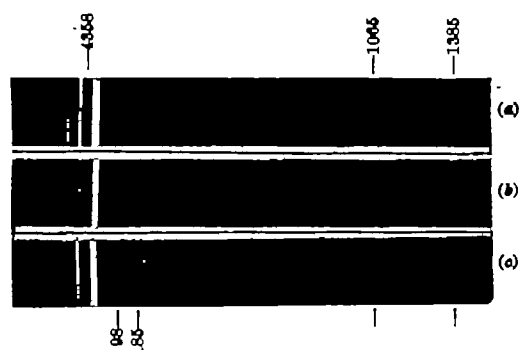
¹ S. Krist., 60, 106 (1928).

² S. Krist., 76, 475 (1929).

Lattice Oscillations in Crystals

THE ions or molecules occupying the cells of a crystal lattice are in general optically anisotropic, and should also be capable of executing small angular oscillations about their positions of equilibrium. If the crystal is illuminated by monochromatic light of frequency ν , the local fluctuations in optical polarization produced by such oscillations should result in scattered radiations appearing with altered frequency, and theory indicates that these should exhibit peculiar polarization characters.

Taking an individual ion or molecule to be optically an ellipsoid, its polarizability along three mutually perpendicular directions being A, B, C respectively, it is clear that if the light-vector E in the incident beam is parallel to an axis A of the ellipsoid and its angular oscillations are also about the same axis, there would be no fluctuations in optical polarization and therefore no radiations of altered frequency. If, however, the ion or molecule oscillates about a second axis B with an angular amplitude θ and frequency ν^* the optical polarization would fluctuate with frequencies $\nu \pm \nu^*$; the corresponding scattered radiations would arise from a Hertzian dipole which is parallel to the third axis C of the ellipsoid and has the strength $\frac{1}{2}(C-A)\theta E$, where $\theta = (\hbar/2\pi^2 I \nu^*)$, I is the moment of inertia and $\hbar$ is Planck's constant. The scattered radiations would thus be of maximum intensity in the plane containing the oscillation axis and the incident light-vector and would vanish in the direction perpendicular to this plane. In other words, the displaced lines in the spectrum due to these oscillations in the lattice would disappear in just the direction in which the displaced lines arising from the symmetric internal vibrations of the ion or molecule would be of maximum intensity.



EFFECT OF ORIENTATION OF CRYSTAL ON LIGHT SCATTERING IN SODIUM NITRATE.

(a), (b), and (c) illustrate the foregoing remarks; they are spectra of the 4358 Å. radiation of the mercury arc, transversely scattered by a sodium nitrate crystal, the incident light being plane polarized. The three spectra correspond to three mutually perpendicular settings of the crystal; the directions of the incident light-vector and of observation of the scattered light are normal to each other and remain unaltered throughout. It will be noticed that in (a), in which the optic axis of the crystal is parallel to the direction of observation, the lattice lines (98 cm^{-1} and 185 cm^{-1}) have disappeared, while in (b) and (c) they appear strongly. On the other hand, the internal oscillations (1065 cm^{-1} and 1385 cm^{-1}) of the NO_3 ion appear strongly in (a) and (b), while in (c) they are very weak. The latter

result is to be expected, as (c) corresponds to the case in which the incident light-vector is along the optic axis of the crystal, and the polarizability of the NO_3 ions is a minimum in this direction.

C. V. RAMAN.

Hebbal, Bangalore.

March 10.

T. M. K. NEDUNGADI.

Transmutation of Thorium by Neutrons

IN a previous letter we have proposed schemes for the disintegration of radioactive noble gases, formed by the bombardment of uranium with slow neutrons¹. We repeated these experiments, passing the active gases over absorbent carbon instead of through water, which resulted in appreciably higher activities. We were able to confirm our earlier measurements and found 33 minutes as a more accurate value for the longer caesium-period (instead of 80 minutes). It may be remarked that there is a satisfactory agreement between our results and those obtained by Hahn and Strassmann².

We have now studied the formation of radioactive noble gases by the splitting of thorium nuclei with neutrons in an analogous way. As this process requires fast neutrons, we used the following experimental arrangement. The neutrons were produced by the $(\text{Li} + \text{D})$ reaction. The neutron source was immersed in a concentrated solution of thorium nitrate. Thus, although the water slows down the neutrons, an appreciable part of those present in the liquid still have high energies. A fast stream of nitrogen was passed through the solution and, after being dried with phosphorus pentoxide, entered a U-shaped tube filled with active carbon and immersed in liquid nitrogen. The radio elements were extracted from the carbon with water containing caesium, rubidium, barium, strontium and lanthanum ions. This solution always contains thorium B and C originating from thoron absorbed by the active carbon. This fact made it necessary to carry out a lead precipitation before isolating the barium, and to purify as a perchlorate the caesium contained in the precipitate with antimony trichloride. The irradiations ranged from 5 minutes to 60 minutes.

Except for the 2-minute alkali period, our results were identical with those obtained in the investigation of uranium. We determined the same periods for rubidium (17 min.), barium (87 min.) and caesium (10 min. and 33 min.). Strontium was found to be inactive. It may be concluded that the splitting of uranium nuclei and of thorium nuclei leads to the same noble gases, and that the schemes suggested for uranium in our first communication hold for thorium too. As the time required for the preparation of the precipitates was longer in the case of thorium than it was in our investigation of uranium, it was impossible to search for the 2-min. alkali period.

A. H. W. ATEN, JUN.

C. J. BAKKER.

F. A. HEYN.

Natuurkundig Laboratorium,
N. V. Philips' Gloeilampenfabrieken,
Eindhoven.

April 5.

¹ Heyn, Aten, jun., and Bakker, *NATURE*, 143, 519 (1939).

² Hahn and Strassmann, *Naturwissenschaften*, 27, 133 (1939).

Number of Neutrons Liberated in the Nuclear Fission of Uranium

RECENT experiments have shown that neutrons are liberated in the nuclear fission of uranium induced by slow neutron bombardment: secondary neutrons have been observed which show spatial¹, energetic² or temporal³ properties different from those which primary neutrons possess or may acquire. Such observations give no information on the mean number of neutrons produced per nucleus split; this number ν may be very small (less than 1) and the result of the experiment will still be positive.

We are now able to give information on the value of ν . Let us consider the curve representing the density distribution of neutrons slowed down in an aqueous solution surrounding a primary neutron source⁴; the area S of this curve is proportional to $Q\tau$, Q being the number of neutrons per second emitted by the source or formed in the solution, and τ the mean time a neutron spends in the solution before being captured. Assuming that the solution contains only nuclei which absorb neutrons according to the $1/v$ law (the only exception to this rule will presently be dealt with), τ is proportional to $1/\Sigma\sigma_i c_i$, where c_i is the concentration (atom grams per litre) of an absorbing nucleus, σ_i its cross-section for the capture of neutrons of velocity 1 and the index i is extended to all kinds of neutron-absorbing reactions attributable to nuclei present in the solution. Substituting the symbol A_i for $\sigma_i c_i$ and A_{tot} for ΣA_i , we have identically:

$$\frac{\Delta S}{S} = \frac{\Delta Q}{Q} + \frac{\Delta A_{tot}}{A_{tot}}, \quad (1)$$

neglecting all terms of higher orders, such as those containing $(\Delta Q)^2$, $\Delta Q \cdot \Delta A_{tot}$, etc.

Let the symbol Δ stand for the differences observed between the two solutions (uranyl and ammonium) used in our previous experiment¹. Neglecting ΔA_{tot} before A_{tot} introduces an ambiguity in the definition of A_{tot} (uranyl *vs.* ammonium value) which is numerically unimportant and can be reduced by adopting the arithmetical mean $(A_{tot}(\text{amm.}) + \Delta A_{tot})/2$.

In the quantity ΔA_{tot} the uranium nuclei are represented by several separate terms standing for the different modes of neutron capture (see below); let A_f be the term for the capture leading to fission. Every neutron has the probability A_f/A_{tot} of causing a fission and, since one individual fission process liberates ν neutrons on the average, the total number

ΔQ of neutrons thus created is $Q \cdot \frac{A_f}{A_{tot}} \cdot \nu$, and the equation (1) can be rewritten as follows:

$$\nu = \frac{\Delta S}{S} \cdot \frac{A_{tot}}{A_f} + \frac{\Delta A_{tot}}{A_f}. \quad (2)$$

Let us estimate the values of all quantities necessary to calculate ν according to this formula. The area variation $\Delta S/S$ can be read from the graph given in our previous letter with an error of less than 20 per cent (due to the uncertainties of inter- and extrapolation; in order to facilitate the latter, we added to the curves a further experimental point for $r = 29$ cm.). The value of A_{tot} for the ammonium solution can be easily calculated from the known concentrations and capture cross-sections (hydrogen, nitrogen and oxygen). A_f is equal to σ_f (1.6 in our experiment), multiplied by the value of σ_f given in a recent paper by Anderson *et al.*⁵. ΔA_{tot} contains a term expressing the small difference of the hydrogen

content between the two solutions; and three terms relative to uranium, namely, the fission term A_f , already dealt with, the thermal capture term A_{σ} which can be calculated by using a recently found value for σ_{σ} ⁶ and finally the resonance capture term A_r which requires some explanation.

Our reasoning assumed that all neutrons introduced into the solution spend practically all their life, and are absorbed, in the thermal state. This is true in so far as the $1/v$ law is valid for absorption of neutrons in all nuclei concerned; and, therefore, not wholly true for uranium, which shows a pronounced resonance capture of neutrons of about 25 volts⁶. A certain proportion of neutrons entering the solution is bound to come within this resonance band and to be absorbed by resonance; therefore, it will never reach the thermal state. This proportion depends on the width of the resonance band and on the concentration c_U ; its value in our system of symbols is equal to A_r/A_{tot} and was numerically determined by an experiment reported elsewhere⁶.

Putting all numerical values in the formula (2) (with 10^{-24} cm.² as the unit of cross-section), that is: $\Delta S/S = 0.05 \pm 0.01$; $A_{tot} = 36 \pm 3$; $A_f = 1.6 \times 2 = 3.2$; $\Delta A_{tot} = 8.7 \pm 1.4$ decomposable into $\Delta A_H = 1.2 \pm 0.1$; $A_{\sigma} = 1.6 \times (1.3 \pm 0.45) = 2.1 \pm 0.7$, $A_r = 6.4 \pm 1.1$ and $A_f = 3.2$, we find:

$$\nu = 3.5 \pm 0.7.$$

We were not able to allow for an error in A_f , since the value of σ_f given by Anderson *et al.* contains no indication of probable error. Any error in σ_f will affect $\nu - 1$ in an inversely proportional way; in any case ν will remain greater than 1.

The interest of the phenomenon discussed here as a means of producing a chain of nuclear reactions was already mentioned in our previous letter. Some further conclusions can now be drawn from the results reported here. Let us imagine a medium containing only uranium and nuclei the total neutron absorption of which, as compared to that of uranium, may be neglected (containing, for example, only some hydrogen for slowing down purposes). In such a medium, if $\frac{A_f}{A_{tot}} \cdot \nu > 1$ (A_{tot} includes now only

uranium terms), the fission chain will perpetuate itself and break up only after reaching the walls limiting the medium. Our experimental results show that this condition will most probably be satisfied

(the quantity $\frac{A_f}{A_{tot}} \cdot \nu - 1$, though positive, will be, however, small), especially if one keeps in view that the term A_r , because of the self-reversal of the resonance absorption line, increases much more slowly than the other uranium terms when the uranium content of the medium is increased.

H. VON HALBAN, JUN.

F. JOLLOT.

L. KOWARSKI.

Laboratoire de Chimie Nucléaire,
Collège de France,
Paris.
April 7.

¹ von Halban, jun., H., Joliot, F., Kowarski, L., *NATURE*, 143, 470 (1939).

² Dodé, M., von Halban, jun., H., Joliot, F., Kowarski, L., *C.R.*, 208, 906 (1939).

³ Roberts, R., Meyer, R., Wang, P., *Phys. Rev.*, 55, 510 (1939).

⁴ Anderson, H., Booth, E., Dunning, J., Fermi, E., Glasoe, G., Slack, F., *Phys. Rev.*, 55, 511 (1939).

⁵ von Halban, jun., H., Kowarski, L., Savitch, P., *C.R.* (in the Press).

⁶ Metzner, L., Hahn, O., Straumann, F., *Z. Phys.*, 106, 249 (1937).

Radiobromine

Don C. De Vault and W. F. Libby¹ and E. Segrè, R. S. Halford and G. T. Seaborg² have shown that the 4.5-hr. radiobromine transforms into the 18-min. isotope which is β -active, by the emission of soft γ -rays. Le Roux, Lu and Sugden³ find that this is the method of disintegration of at least 90 per cent of 4.5-hr. radiobromine. Segrè, Halford and Seaborg² predicted that the γ -rays would be soft, and a large proportion would be internally converted.

These considerations are in agreement with observations made in a Wilson chamber of the disintegration of 4.5-hr. radiobromine. Measurement of tracks starting from thin foils which had been activated with radiobromine, and from active ethyl bromide introduced as a vapour into the chamber, show homogeneous energy groups of electrons due to the K and L conversion of this γ -ray, superimposed on a background of the continuous β -ray spectrum of the β -active isotope.

In those experiments in which tracks start in the gas of the chamber, half the electrons produced by the internal conversion of the γ -rays in the K level are accompanied by short tracks starting from the same atom and due to the Auger conversion of the K X-rays of bromine. The existence of these X-rays was reported by Philip Abelson at the December meeting of the American Physical Society at Los Angeles. The Auger electrons accompanying L conversion would not be observed.

These experiments show that the γ -rays have an energy of 43,000 electron volts. The coefficient of internal conversion in the K shell is of the order of 0.30, and that in the L shell much smaller.

Since Le Roux, Lu and Sugden effected a 90 per cent separation of the isotopes, the loosening of the bond discussed by Segrè, Halford and Seaborg must be due to this low-energy γ -ray alone.

In even so brief a summary as this, I would like to make twofold acknowledgments. For advice and discussion on the physical side I must thank Prof. P. M. S. Blackett, Prof. J. D. Bernal and Dr. L. Simons; I wish also to thank Prof. S. Sugden for help and advice, especially on chemical matters.

R. E. SIDAY.

Birkbeck College,
London, E.C.4.
March 21.

¹ *Phys. Rev.*, **55**, 322 (1939).

² *Phys. Rev.*, **55**, 331 (1939).

³ *NATURE* [143, 517 (1939)].

Formation of Helium of Mass 3 in an Excited State

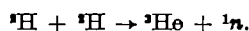
AN excited state of helium of mass 3 (^3He) has been previously suggested by me to explain a second low-energy group of neutrons from the deuterium-deuterium reaction¹. Since present theory does not predict such an excited state² in ^3He , it is important to establish definitely whether such a state actually exists. This note gives the results of some cloud chamber experiments which were made in order to investigate this point.

In the present experiments, the D-D reaction was studied with a cloud chamber filled with either methane or helium. The neutrons were detected by means of the recoil protons or recoil helium nuclei. The ranges of these recoil particles were measured

which were projected in the forward direction ($0-10^\circ$). Three series of experiments were made. In the first experiment methane was used in the cloud chamber and the neutrons were observed at 90° to the direction of the 0.9 Mv. deuterons. In the second experiment the conditions were the same except that helium was used in the cloud chamber. In the third experiment the neutrons were observed at an angle of 0° to the 0.5 Mv. deuterons. A summary of the results is given in the accompanying table.

Type of recoil	Deuteron energy (Mv.)	Angle of observation	Neutron energies (Mv.)	Relative intensity of recoil groups		Relative intensity of neutron groups	
				low energy	high energy	low energy	high energy
H	0.90	$90^\circ \pm 8^\circ$	1.5 : 2.8	0.28	1.00	0.17 $\pm$	1.00
He	0.90	$90^\circ \pm 15^\circ$	1.5 : 3.0	0.92	1.00	0.3-0.2	1.00
H	0.50	$0^\circ \pm 6^\circ$	1.25 : 3.55	0.19	1.00	0.13 $\pm$	1.00

In each of the experiments a second low-energy group of neutrons was observed as well as the high-energy group. A significant feature is the increase in the energy of the low-energy neutron group when the bombarding voltage was reduced to 0.5 Mv. and the neutrons were observed in the same direction as the deuterons ($0^\circ \pm 9^\circ$). In this case, although the maximum energy of the neutrons produced in the target is reduced from 4.07 Mv. to 3.55 Mv., the low-energy group of neutrons has more energy. This definitely shows that they are not produced by scattered neutrons. Furthermore, the increase in energy is just what one should expect from the reaction



The Q values of the reaction were calculated from the data obtained at 0.5 Mv. The disintegration values are $Q^0 = 3.32 \pm 0.04$ Mv. and $Q^1 = 1.48 \pm 0.04$ Mv. These agree within the experimental error with those I obtained previously with quite a different experimental arrangement. The relative intensities of the two neutron groups as given in the table were computed by means of the known relations between collision cross-section and energy, for neutrons³.

These experiments show that the ^3He nucleus is left in an excited state at 1.84 Mv. in approximately 15 per cent of the disintegrations. At the present time it is not clear what happens to the excited ^3He . Experiments on the gamma rays from this reaction seem to give too small an intensity⁴. However, the transition to the ground-state may be strongly forbidden as in the case of the 1.426 Mv. gamma ray of radium C', and so there may be a high internal conversion of the gamma rays. Another possibility is that the excited ^3He emits a positive electron with an energy of about 0.8 Mv.

A more complete description of these experiments will be published elsewhere.

T. W. BONNER.

Cavendish Laboratory,
Cambridge.

¹ Bonner, T. W., *Phys. Rev.*, **53**, 685 (1937); **53**, 711 (1938). Also see Baldinger, Huber, and Staub, *Helv. phys. Acta*, **11**, 245 (1938) and Hindmarsh, H., and Dunlap, H., *Phys. Rev.*, in the Press.

² Shera, S., *Phys. Rev.*, **53**, 875 (1938); Schiff, L. I., *Phys. Rev.*, **54**, 93 (1938).

³ Bothe and Baehar, *Rev. Mod. Phys.*, **8**, 117 (1936); Staub and Stephens, *Phys. Rev.*, **55**, 131 (1939).

⁴ Kallmann and Kuhn, *Naturwissenschaften*, **26**, 106 (1938); Buhlig, A. J., *Phys. Rev.*, **54**, 308 (1938); Kikuchi, S., and Aoki, H., *Proc. Physico-Math. Soc. Japan*, **51**, 30 (1939).

A Cosmic Ray Burst of a Hundred Particles

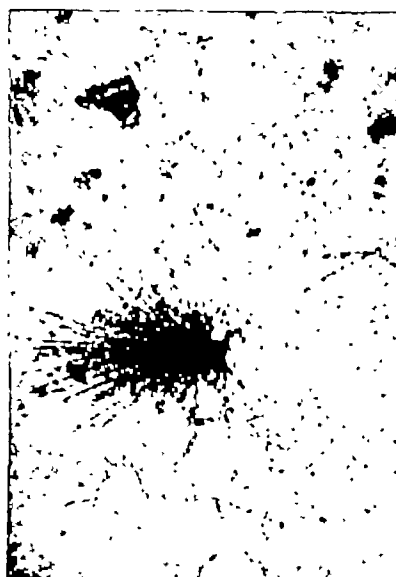
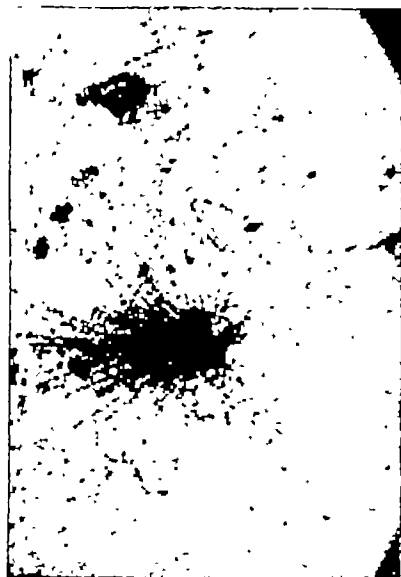
NUCLEAR disintegrations caused by cosmic rays can be observed only rarely in the Wilson cloud

As can be seen clearly in the reproduction, the burst is accompanied by a number of separate small disintegrations. Within the field of vision, which was of 0.4 mm. in radius, four disintegrations with three tracks, one disintegration with four particles, three disintegrations each with five particles and two showers of heavy particles were found. There were thus ten disintegrations of total energy 50 Mev. within an area of 0.4 mm.², a disintegration density which is seventy times greater than is ordinarily found on these plates.

It should be noted that there are also many disintegrations outside of the field of vision of the microscope.

A more detailed account will appear in the *C.R. Acad. USSR*.

A. Jdanoff.



chamber. We have developed in recent years¹ a more effective method of observing these nuclear disintegrations. In this method photographic plates coated with thick emulsions (thickness ~50 μ) are exposed to the action of cosmic rays and then developed.

I have recently² made experiments at sea-level and at an altitude of 9,000 metres with such plates placed horizontally with their emulsions downwards, and I have found that the number of disintegrations and heavy particles per disintegration increases rapidly with increasing altitude. One case, which is reproduced herewith, is a burst of a hundred heavy particles. The two pictures are stereoscopic microphotographs taken with a magnification of 190. More tracks can be seen by stereoscopic examination of the original plate than on the reproduction. It can also be seen that all the particles diverge from one centre which is within the emulsion. The centre is quite large and contains many unresolved tracks. The black centre may be caused not only by heavy particles but also by the electron stream accompanying the burst. (Separate electron tracks cannot be seen as the emulsion is insensitive to them.)

In this burst there are twelve tracks of length equivalent to 18 cm. normal air situated within a cone of 30°. Assuming that these are proton tracks, the total energy calculated from the range is 40 Mev. In addition to these there are thirty tracks each with a range of 12 cm. (in normal air) within a cone of 70°. The appearance of the tracks at their ends suggests that they may be due to α -particles. If the tracks are due to protons their total energy is approximately 50 Mev. There are also between fifty and sixty particles lying in a cone of wide angle with ranges of approximately 5 cm. Assuming that these particles are protons, their total energy must be 80–90 Mev. Thus the total energy of the whole burst must be at least 200 Mev.

Radium Institute,
Academy of Science,
Leningrad. Feb. 23.

¹ Mysowaky, L. and Tschischow, P., *Z. Phys.*, **44**, H.6/9, 408 (1927).
Deisenroth-Mysowaky, M., *Tras. Inst. du Radium de l'Etat (URSS)*, **1** (1930). Jdanoff, A., *Tras. Inst. du Radium de l'Etat (URSS)*, **2** (1933). Jdanoff, A., *J. Phys. et Is Rad.*, **6**, 233 (1935).

² Jdanoff, A., *C.R. Acad. USSR*, **30**, 641 (1938). Jdanoff, A., *C.R. Acad. USSR*, in the Press. Filippow, A., Jdanow, A., and Gurewicz, I., *C.R. Acad. USSR*, **18**, 181 (1938). Blau, M., and Wambacher, H., *Nature*, **140**, 535 (1937). Blau, M., and Wambacher, H., *Mit. d. Inst. f. Radiumforsch.*, No. 409 (1937). Wambacher, H., *Phys. Z.*, No. 23/24, 583 (1938). Schopper, H. M., and Schopper, H., *Phys. Z.*, No. 1, 22 (1939).

Optical Properties of Dental Enamel

It has been known for many years that dental enamel is birefringent; and its optical properties have been studied intensively by W. J. Schmidt and his pupils¹. In a recent paper², I have shown by X-ray examination that an enamel prism contains a multitude of regularly arranged crystallites of apatite, and have worked out in detail the orientation of these crystallites for human deciduous enamel. It was therefore felt to be of interest to determine whether the optical and X-ray results could be correlated.

The main feature of the structure suggested by X-rays is the presence in a single enamel prism of two groups of submicroscopic crystallites of hydroxy-apatite, the hexagonal axes of one group being inclined to the prism direction at about 5°, and those of the other group at about 40°. The intensity of the light transmitted by such an arrangement of crystallites, when the enamel is examined between crossed nicols, has been worked out; and it has been found that the calculated extinction phenomena, for both longitudinal and transverse sections of prisms, correspond closely with those actually observed by Schmidt, Keil and other workers.

The problem is essentially that of calculating the interference effects due to the superposition of two

differently oriented uniaxial crystal plates; a problem first attacked by Fresnel³ and discussed more recently by Schulz⁴. The formulae derived for the intensity of the transmitted beam may be applied directly to the case of a tooth section of known thickness, if the prisms are assumed to be parallel to each other, by making the thicknesses of the two crystal plates proportional to the numbers of crystal-lites belonging to the 5° and 40° groups referred to above.

The work forms part of an investigation being carried out for the Dental Disease Committee of the Medical Research Council, and will be published in full elsewhere.

J. THEWLLIS.

Physics Department,
National Physical Laboratory,
Teddington.
March 9.

¹ For a survey of this work, see Harders-Steinhilber, M., *Kolloid Z.* 83, 86 (1933).

² Thewllis, J., *Proc. Roy. Soc., B*, in the Press.

³ Fresnel, A., *Ann. Chim. Phys.*, A (3), 17, 107 (1831).

⁴ Schulz, H., "Wien-Harms Handb. exp. Physik", Leipzig, 18, 540 (1929).

Non-Euclidean Geometry in Microscopic Space

CONSIDERATIONS of Heitler, Nordheim and Teller¹, based on Heisenberg's uncertainty principle, show that Newtonian gravitation has only a macroscopic significance; further, in the theory of ultimate particles, it is necessary to introduce a finite length, a , of approximately 10^{-13} cm. (radius of electron or of light nuclei), which is not justified theoretically if we use Euclidean geometry or Einstein's gravitational curvature.

Consequently, it seems more convenient to use a non-Euclidean geometry, but one which is not connected with Einstein's gravitational theory; in the space occupied by the elementary particle, the square of the space-time interval is supposed to be defined by:

$$ds^2 = c^2 \left(1 - \frac{r^2}{a^2}\right) dt^2 - \frac{dr^2}{1 - r^2/a^2} - r^2(d\theta^2 + \sin^2 \theta d\phi^2) - c^2 r^2 d\tau^2 - d\sigma^2, \quad (1)$$

which is formally analogous with de Sitter's line element; the internal space is consequently spherical with a curvature $K = 1/a^2$, and the corpuscle is obviously stable, because the Einstein macroscopic relation $R = \kappa \rho$ between the world-curvature R , the density of matter ρ and the gravitational constant κ (which involves expanding space) is not verified.

Let the line element of the external space be defined by:

$$ds^2 = c^2 \left(1 - \frac{a^2}{r^2}\right) dt^2 - \frac{dr^2}{1 - a^2/r^2} - r^2(d\theta^2 + \sin^2 \theta d\phi^2); \quad (2)$$

therefore, there will be a nuclear attractive field, different from the Einstein or Newtonian field, which can be neglected if a tends to zero.

The spatial part of (1) represents a spherical or elliptic space² in which distance is not univocally defined; in the second case, a line element results from the Cayley relation:

$$\sigma = \frac{a}{2i} \log \chi, \quad (i = \sqrt{-1}) \quad (3)$$

where σ is the distance between two points A, B , χ the anharmonic ratio $AK/BK : AL/BL$, K and L the points of intersection of $\overline{AB}$ with the absolute

quadric³. The relation (3) is analogous to Schrödinger formula $S = \frac{h}{2\pi i} \log \psi$ between action function S and wave function ψ ; therefore, it is possible to quantize distance; χ is univocal and $\sigma = \sigma_0 + \pi n a$, where n is an integer; the quantum numbers are $\pm \frac{1}{2}$.

Metric notions are completely replaced by projective notions when we introduce for an angle V , Laguerre's formula:

$$V = \frac{1}{2i} \log \varphi \quad (i = \sqrt{-1}); \quad (4)$$

angular quantum numbers are spin quantum numbers $\pm \frac{1}{2}$; we specify that χ and φ have an immediate experimental significance, as ψ in quantum mechanics, while angles and distances lose their actual meaning.

Therefore, metric transformations T , which preserve V , are replaced by corresponding homographic transformations H which preserve the anharmonic ratio $\varphi = \frac{\lambda_2 - \lambda_1}{\lambda_3 - \lambda_2} \cdot \frac{\lambda - \lambda_2}{\lambda - \lambda_1}$; the projective parameter λ is changed by H in

$$\lambda' = \frac{\alpha\lambda + \beta}{\gamma\lambda + \delta}; \quad (5)$$

it is easy to prove that, in the usual cases, this transformation is identical with the unitary substitution of two variables of Van der Waerden⁴.

JEAN MARIANI.
Laboratoire de Physique Théorique,
Collège de France,
Paris.
March 15.

¹ From Gamow, *Phys. Z.*, 38, 800-814 (1937).

² Tolman, "Relativity, Thermodynamics and Cosmology" (Oxford, 1934), p. 346.

³ Von Lane, "La Théorie de la Relativité" (G. Villars, 1936), 2, 180.

⁴ Garnier, "Leçons d'Algèbre et d'Analyse" (G. Villars, 1936), 2, 90, 125.

Temporary Poikilothermy in Birds

It appears to be well known to aviculturists and collectors that humming-birds are capable of a physiological state somewhat resembling hibernation in mammals, but of short duration; however, the fact seems not to have been recorded in the scientific literature. We propose to refer to this peculiar condition as 'torpidity'. The observations here recorded were made partly in the field in Ecuador, partly in the Zoological Society's Gardens at Regent's Park.

In complete torpidity, the birds are quite rigid, with head drawn back and pointed up, flattened plumage and closed eyes, and exhibit no perceptible respiratory movements. The condition is reversible, recovery in captivity taking 10-15 minutes, at high altitudes and low temperatures in Ecuador up to 30-35 minutes.

Partial torpidity is also observed. In captive birds this is characterized by violent breathing, ruffled plumage and the loss of the power of flight. Recovery from this state takes 4-5 minutes. Partially or completely torpid birds on being touched emit a peculiar expiratory whistle, which, it is suggested, may be due to deflation of the air-sacs.

Torpidity is promoted by numerous factors: (1) low temperature; (2) lack of food; (3) poor condition; (4) a diurnal effect, birds being much more susceptible at night; (5) a seasonal rhythm, captive birds having proved much more susceptible in

November–December than at the same night temperatures in August or March; (6) a size effect, large species in captivity being in general less susceptible than small; (7) a climatic effect, lower temperatures being required to induce torpidity in species from high altitudes, but the resultant torpidity then being more extreme, with longer recovery period; (8) a specific effect, susceptibility varying in species of similar size and habitat; (9) an individual effect, individuals of the same species showing different susceptibility (this may in part be due to temporary differences in condition).

Torpidity appears to be a temporary poikilothermy, rather similar to that already described for bats¹. In birds, one of us (O. S. W.) has noted a similar but less specialized condition in colies (*Colius*). Torpidity of a rather different nature has also been noted in swallows², but here recovery is only possible before complete torpidity is reached.

Torpidity in the fully specialized condition seen in humming-birds appears to be an adaptation promoting the survival of these very small birds in conditions which temporarily make the maintenance of normal body-temperature difficult or impossible. The fact, however, that it occurs also in a related family (colies), and scarcely, if at all, elsewhere among birds, indicates a general preadaptive proneness to the condition.

Temperature measurements of birds in different stages of torpidity will be undertaken with a thermocouple next winter, and will be incorporated with a fuller account of avian torpidity in general.

Zoological Society of London,
Regent's Park,
N.W.8.
March 24.

J. S. HUXLEY.
C. S. WHBB.
A. T. BEST.

¹ Burbank, R. O., and Young, J. Z., *J. Physiol.*, **88**, 459 (1934).

² Lorenz, K., *Vogelzug*, **3**, 4 (1932). Dupond, C., *Le Gerfaut*, **87**, 220 (1932).

Segregation in Asexual (Apomictic) Offspring in *Rubus*

THE diploid species of *Rubus* we have examined always reproduce sexually. In the polyploid forms and species, however, reproduction may be (1) entirely sexual, (2) entirely non-sexual, apomictic, or (3) partly sexual and partly non-sexual.

The polyploids vary widely in the degree to which apomixis is developed, and a particular species used as female parent will show a variation in behaviour according to the species used as male in the pollination. The occurrence of segregation is not conclusive evidence of sexual reproduction, for we find that segregation occurs within the non-sexual offspring and has given rise to new and distinctive types, which in some cases breed true. For example, *R. nitidoides*, $2n = 28$, a species with comparatively small flowers and normal five-leaflet leaves, when crossed with *R. thyrsiger*, $2n = 28$, gave plants of three kinds, (1) a very small proportion of sexual hybrids, (2) a large proportion identical with the maternal parent *R. nitidoides*, and (3) a new true-breeding form with large flowers and seven-leaflet leaves, which shows no trace of the male parent. The dioecious species *R. vitifolius*, $2n = 56$, with three-lobed leaves, when crossed with the diploid *R. idaeus*, $2n = 14$, gives offspring all of sexual origin, and all are pentaploid, $2n = 35$. *R. vitifolius* crossed with the tetraploid form of *R. idaeus*, $2n = 28$,

however, gave a family consisting of plants of two kinds, with 42 and 56 chromosomes. The 42 chromosome plants are of sexual origin and have many of the characters of the male parent, such as hermaphrodite flowers and five-leaflet leaves. The 56 chromosome plants, on the other hand, show no trace of *R. idaeus*, and are evidently of apomictic origin. They all have three-lobed leaves and are identical with *R. vitifolius*; but approximately one half of the plants have female flowers and the other half male flowers. The progeny as a whole is dioecious like the female parental species. We therefore have segregation of characters even with an apomictic mode of reproduction. Evidently the apomictic embryo arises at a stage subsequent to the first division of meiosis, presumably by diploid parthenogenesis. This means that there are intermediate methods of reproduction which although superficially vegetative have certain of the properties of sexual reproduction, giving rise to genetical variation through crossing-over.

Incidentally, the results we have obtained with the American species *R. vitifolius* show that the conclusion of Gustafsson¹ that "all American species belonging to the *Rubus* subgenus *Eubatus* are sexual" is not of universal application.

The results are also significant in view of the difficult taxonomy of *Rubus*. They show not only how new forms and species can arise, but also how they are able to maintain themselves in Nature. Many of the species and micro-species of *Rubus* are evidently clones and sub-clones, produced by segregation and maintained by apomixis.

M. B. CRANE.
P. T. THOMAS.

John Innes Horticultural Institution,
Merton,
London, S.W.19.
March 28.

¹ Gustafsson, A., *Genetics*, **23**, 149–50 (1938).

A Difference in Response of Normal and Tumour Tissue

PREVIOUS papers have reported the effect of respiratory stimulating factors (*RSF*) prepared from yeast on the respiration of liver, skin and yeast^{1,2,3,4}. The object of the research here reported was to investigate the effect of a crude sample of *RSF* on transplantable tumour tissue.

In the present experiments, crude *RSF* was prepared from Fleischmann's bakers' yeast (*Saccharomyces cerevisiae*) by a method reported by Cook, Kreke and Nutini⁴. The preparation used in these experiments corresponds to sample A in the above work. The crude *RSF* was prepared by extracting yeast successively with 95 per cent and 50 per cent alcohol, combining the extracts and concentrating *in vacuo*. The concentrated extract was redissolved in distilled water and autoclaved at 15 lb. pressure for 15 minutes. The pH was adjusted to 7.8.

Preliminary experiments showed that this crude extract in a concentration of 13.9 mgm./c.c. stimulated the respiration of mouse liver 160 per cent and of mouse skin 50 per cent.

Employing Warburg direct manometric technique, the effect of the *RSF* was tested on the respiration of transplants of a spindle-cell carcinoma of the mammary gland. The transplantable tumour (15091a) was obtained from the Roscoe B. Jackson

Memorial Laboratory and transplants were made in mice 7-8 months old. The age of the transplants used ranged from 14 to 17 days.

There was no stimulation of respiration of the tumour tissue noted when this *RSF* was added in a concentration of 13.9 mgm./c.c. to the Ringer-glucose-phosphate (0.02 per cent glucose) solution in which the tumour tissue was suspended. The average *Q_O*, for a series of fourteen determinations was 5.2 (limits, 4.1-6.8) with *RSF* and 5.3 (limits, 4.0-7.4) without *RSF*. Certain other cell-free tissue extracts which stimulate the respiration of normal tissues have failed to stimulate tumour respiration. For example, a cell-free extract prepared from tumour increased the oxygen uptake of liver but not of tumour. Spleen extract was the only one used in our laboratory which stimulated the respiration of tumorous tissue, which confirms the earlier observation of Bungeler¹.

This difference in response of normal and tumour tissue to the *RSF* preparation under investigation might be interpreted as indicating a qualitative difference between normal and tumour metabolism. At present there is insufficient evidence to show whether this is true; indeed, the bulk of previous evidence has led to the belief, in Boyland's words², that "in the mechanism of tumour respiration there is no known qualitative difference between normal and tumour tissue". This work does affirm that there is damage to the oxidative mechanism in malignant tissue as has been found by Dickens³ from measurements of the respiratory quotient.

The crude *RSF* has been fractionated by different methods, and experiments are now being conducted to test the effect of these fractions on normal and tumour tissue. It is not impossible that prolonged application of *RSF* to tumour tissue, either *in vitro* in tissue culture or by injection, will have a favourable effect. These possibilities, together with the use of further autogenous preparations, are being studied. The effects of *RSF* on other phases of normal and tumour metabolism are under investigation.

MARY JORDAN CARROLL.

Rosary College Unit of the
Institutum Divi Thomae,
Rosary College,
River Forest,
Illinois.
March 6.

- ¹ Norris, B. J., and Buddy, Sr. M. Veronita, *Studies Inst. Divi Thomae*, 1, 53 (1937).
- ² Norris, B. J., and Hart, Sr. M. Jane, *ibid.*, 1, 165 (1937).
- ³ Buddy, Sr. M. Veronita, *Arch. exp. Zellforsch.*, 23, 599 (1939).
- ⁴ Cook, B. S., Kreke, O. W., and Nutini, L. G., *Studies Inst. Divi Thomae*, 2, 23 (1938).
- ⁵ Bungeler, W., *Frankfur. Z. Path.*, 43, 409 (1932-33).
- ⁶ Boyland, H., *Acta. Internat. Union Against Cancer*, 8, 3 (1938).
- ⁷ Dickens, F., and Bimer, F., *Biochem. J.*, 24, 1301 (1930); 26, 965 (1931).

Nutritive Spheres in *Amoeba proteus* Y

THE impetus given to the investigation of cytoplasmic inclusions by the ultra- and electric-centrifuge technique used in the recent work of Bronté Gatenby and his pupils has raised once more the controversy concerning the exact nature of the nutritive spheres in *Amoeba proteus* Y.

Dr. Singh¹ confirms the findings of Sister Carmela Hayes² that the nutritive spheres contain glycogen. I would direct attention to one significant remark at the end of Sister Carmela's paper which indicates the possible explanation of discrepancies in

descriptions of the reactions of living organisms to various reagents, namely, her conclusion that the exact chemical composition of the nutritive sphere depends upon its physiological condition at the time of the experiment.

Dr. Singh does not wholly agree with those who maintain that I confused nutritive spheres with agametes. I hope to publish elsewhere my renewed investigations on the life-history of *A. proteus* Y. My purpose in writing this note is to direct attention to a method of demonstrating the presence of glycogen and of making very instructive permanent preparations of *A. proteus* Y, which may be useful for busy teachers.

The amoebae after being allowed to 'expand' are fixed in Bouin's fluid, washed in alcohol, stained in a 1 per cent solution of chlorazol black³ in alcohol, dehydrated in 'Cellosolve'⁴, cleared in xylol and mounted in Canada balsam.

The glycogen can easily be detected around the nutritive spheres by its red colour⁵. The interior of the sphere stains a pale green.

Since 90 per cent alcohol can be used as a fixative for *A. proteus* Y, the amoebae can be fixed and stained simultaneously by treatment with a 90 per cent alcoholic solution of chlorazol black, thus limiting the remaining operations to dehydration in 'Cellosolve' and making permanent 'in Euperal'.

SISTER MONICA
(Monica Taylor).

Notre Dame Training College Laboratory,
Döwanhill, Glasgow, W.2.
March 7.

- ¹ Singh, B. N., "The Cytology of *Amoeba proteus* Y and the Effects of Large and Small Centrifugal Forces", *Quart. J. Micro. Sci.*, 80, 613, 631 (1938).
- ² Taylor, Monica, "*Amoeba proteus*: Some Observations on its Nucleus, Life History and Culture", *Quart. J. Micro. Sci.*, 83, Part 1 (1934). Appendix to same by Hayes, Carmela, Nutritive Spheres in *Amoeba*, p. 144.
- ³ Cannon, H. G., "A New Biological Stain for General Purposes", *NATURE*, 139, 549 (1937).
- ⁴ Watson's *Microscope Record*, No. 38, 22 (1936).
- ⁵ Dobell, C., "Researches on the Intestinal Protozoa of Monkeys and Man" (9), *Parasitology*, 30, No. 2, 196 (1938).

Sea Island Cotton and the Lamarckian Theory

PROF. MACBRIDE¹ cites Sea Island cotton as an example of a strain evolved in response to a particular environment (in this case the sea islands of South Carolina) which only retains its distinctive characteristics under those particular conditions. He has, unfortunately, been misinformed. The perennial ancestors of Sea Island cotton were introduced from the West Indies into Carolina in the latter half of the eighteenth century and there selected for the annual habit. The annual types were sent to the West Indies about thirty-five years ago and have retained unchanged the annual habit and very high quality characteristic of the Carolina type. A Barbados stock has been cultivated on a small scale in Fiji for fifteen years and has maintained not only the general Sea Island characteristics, but also the distinctive superfine quality of the Barbados strain. In the U.S.S.R. and in Sind also American stocks have been grown for a number of years without reversion.

J. B. HUTCHINSON.

Empire Cotton Growing Corporation,
Cotton Research Station,
Trinidad, B.W.I.
March 13.

- ¹ MacBride, E. W., *NATURE*, 143, 205 (1939).

A Chemical Method of Assay of Insulin

In a recent communication¹, Vogelenzang suggests the possibility of an iodometric method for estimating the physiological potency of insulin preparations. A similar suggestion was previously made by Brand and Sandberg². Jensen, Schook and Sollers³, however, pointed out that the success of an iodometric titration of insulin is dependent upon the amount of impurities which will react with iodine. Since iodine reacts upon certain chemical groupings which are by no means confined solely to the insulin molecule, it is doubtful whether the physiological potency of insulin preparations can be reliably determined by iodometric titration. Blatherwick and associates⁴ have arrived at the same conclusion.

The protein nature of insulin⁵ makes it improbable that a simple chemical method of assay will ever become practicable.

H. JENSEN.

Biochemical Laboratory,
Squibb Institute for Medical Research,
New Brunswick, N.J.
Feb. 21.

¹ Vogelenzang, M. H., *NATURE*, 143, 161 (1939).

² Brand, M., and Sandberg, M., *Proc. Soc. Exp. Biol. and Med.*, 33, 313 (1936).

³ Jensen, H., Schook, H., and Sollers, B., *J. Biol. Chem.*, 93, 93 (1933).

⁴ Blatherwick, M. B., Baschoff, F., Maxwell, L. C., Berger, J., and Sahyun, M., *J. Biol. Chem.*, 73, 57 (1927).

⁵ Jensen, H., "Insulin, Its Chemistry and Physiology". The Commonwealth Fund, New York, 1938.

Points from Foregoing Letters

W. L. BRAGG describes a direct method of converting the measurements of X-ray beams diffracted by a crystal into an optical image of the atomic arrangement as projected upon a given plane. Holes are drilled in a thin plate, arranged in the pattern of 'cross-spectra', and proportional in area to the amplitudes of the diffracted beams. If this plate is placed in front of the objective of a telescope focused on a point source of monochromatic light, the beam passing through the holes forms by interference an image of the crystal structure which can be seen through the eyepiece.

Photographs of spectra of light scattered by a crystal of sodium nitrate set successively in three mutually perpendicular directions to the incident monochromatic polarized light are submitted by Sir C. V. Raman and T. M. K. Nedungadi. They show that when the optic axis of the crystal is parallel to the direction of observation, the 'lattice lines' have disappeared; other lines which may be ascribed to the internal oscillations of the NO₃ ion appear strongly in this position and also in one of the positions perpendicular to it, but are very weak in the third position when the incident light-vector is along the optic axis.

It is stated by A. H. W. Aten, jun., C. J. Bakker and F. A. Heyn that radioactive noble gases arise from the bombardment of thorium with neutrons. At least one radioactive krypton and two radioactive xenons are formed, which are identical with those obtained from uranium irradiated with neutrons.

Discussing experimental results on the liberation of neutrons in the nuclear fission of uranium, H. von Halban, jun., F. Joliot and L. Kowarski estimate that an average of about 3.5 neutrons is liberated in every fission. They discuss the conditions of establishing a self-perpetuating reaction chain which seems to be theoretically possible.

R. E. Siday has observed in a Wilson chamber the K conversion electrons of γ -rays emitted when 4.5-hr. radiobromine transforms into the 18-min. isotope. The γ -rays appear to have 43,000 electron volts energy with a coefficient of internal conversion of roughly 0.3. The Auger electrons produced by the K X-rays accompanying the K conversion of these γ -rays were observed as short tracks starting at the origin of some of the γ -ray conversion tracks.

Cloud-chamber experiments are described by T. W. Bonner which show that there are two groups of neutrons from the nuclear reaction: $^1\text{H} + ^1\text{H} \rightarrow$

$^3\text{He} + \frac{1}{2}\text{n}$. The low-energy group is produced in about 15 per cent of the disintegrations. The interpretation of these experiments is that a low-energy neutron is emitted whenever an excited helium nucleus of mass 3 is formed.

Stereoscopic photomicrographs showing a cosmic ray burst of about a hundred particles on a photographic plate with thick emulsion exposed to the action of cosmic rays are submitted by A. Jdanoff. Assuming that the particles are protons, the energy of the burst would exceed 200 Mev.

The optical extinction phenomena, exhibited by the arrangement of hydroxyapatite crystallites in dental enamel suggested by X-ray examination, have been calculated by J. Thewlis; they correspond closely, for both longitudinal and transverse sections of prisms, with those actually observed.

J. Mariani presents an application of non-Euclidean geometry to microscopic space-time occupied by elementary particles as an explanation of their radius and spin.

J. S. Huxley, C. S. Webb and A. T. Best record the existence of a state of 'torpidity' or reversible poikilothermy in birds. Fully torpid humming-birds become completely rigid and apparently poikilothermous, with no perceptible respiratory movements. Recovery takes 10-35 minutes. Torpidity has been noted both in fresh-caught and captive humming-birds, and a similar but less specialized condition in colic (*Colinus*). It appears to be an adaptation promoting survival in unfavourable conditions.

M. B. Crane and P. T. Thomas report that diploid species of *Rubus* reproduce sexually; but in polyploid forms and species reproduction may be sexual, non-sexual (apomictic) or partly sexual and partly non-sexual, according to the species used as male in the pollination. They also report the occurrence of segregation within the apomictic progeny, and discuss these results in relation to the taxonomy of *Rubus*.

Mary J. Carroll finds that the respiratory stimulating factors obtained from Fleischmann's bakers' yeast, which stimulate the respiration of normal tissues, have no effect upon cancer tissue (spindle-cell carcinoma of the mammary gland). This difference in response may be due to a qualitative difference between normal and tumour tissue metabolism.

A method of demonstrating the presence of glycogen in *Amaba proteus* Y and of making useful permanent slides of this organism is described by Monica Taylor.

Research Items

Early Spread of Agriculture

H. J. E. PEAKS, having concluded that the cultivation of wheat (Emmer) first took place in Palestine (*Man*, March, 1939), now passes to consider the stages and directions of the diffusion of the cultivation of grain in the early world (*Man*, April, 1939). An early spread was to the south-west, where it is probable that the early Tasian civilization of the Nile cultivated grain, though there is no direct evidence; while their successors, the Badarians, were certainly cultivators. Both peoples were immigrants. From Palestine the cultivation of grain must have spread to Syria, where the people took to cultivating the inferior Einkorn, which apparently is associated with the Tell Halaf culture, extending from the neighbourhood of Aleppo to Arpachiyah on the outskirts of Nineveh. From this culture it may be assumed cultivation spread by way of Anatolia through the Troad to Thessaly, the Danube valley, the Rhine basin and ultimately to the lake villages of central Europe. From Palestine again, cultivation, passing along the Zagros range, appears early in Assyria, while in the early villages of the hills around Teheran, as early as Arpachiyah, it would seem that 'bread' wheat was produced by crossing. Thence it passed into Mesopotamia with the Al Ubaid culture, where it met the Emmer cultivation of Jemdet Nasr. From Persia, cultivation passed into Turkestan, where signs of wheat appear in a low level of Anau, and passing thence through Afghanistan it moved in two directions, on one hand appearing in the Indus civilization, on the other in the painted pottery culture of the early agricultural villages of China. The painted pottery culture of Tripolje of the south Russian 'black lands' has as yet produced no evidence, though it occurs in areas of derivative culture, reaching the Rhine and Switzerland. For western and northern Europe an origin is suggested, tracing it to a great maritime movement in the Early Minoan period which introduced agriculture along the coasts of western Europe and ultimately reached Denmark, which was also reached by bread wheat from the Ukraine through the Baltic.

Religion of the Serbian Gypsies

ALEXANDER PETROVIĆ, investigating the origin and character of the religion of the Serbian gypsies (*J. Gypsy-Lore Soc.*, Ser. 3, 18, 2-3; 1939), finds a clue in the gypsy language, differentiating the 'new' religion from the 'old', according as belief is that of those who do, or do not, speak Serb. The 'new' religion of the Serb-speaking gypsies has borrowed concepts from Serbian belief. Thus the *romani del*, by which the gypsy expresses everything that is above man, has come to be the equivalent of *Bog*, the Serbian popular concept of God as "an old man with white hair who lives above the clouds in heaven"; while *dži*, which to the gypsies originally meant the centre of everything, as, for example, the navel of the abdomen, or the heart of a fruit or a tree "most precious, most beautiful, most sweet", is used to translate the Serbian *duša* "the soul", which comes out of a man when he dies. *Kar*, however,

meaning both *penis*, and "man", or "male", in addition to its anatomical sense, in which a high or abnormal degree of development is thought to bring good luck in marriage and otherwise, is used of phallic emblems made of the protective blackthorn, or failing this of wood, which bring good luck when concealed in the roof of a house or in a bed, and are worshipped or addressed in prayer by women, asking for good luck. This emblem is also found among the Serbs, but for sorcery or a love spell. Old women alone know its use, and pass on the knowledge to one another. There is no connexion between the two beliefs, unless of a common Indo-European heritage; but the gypsy belief, in conjunction with the evidence of language, points to worship of the procreative principle as the original form of gypsy religion, formulated possibly in their original home in India, where the cult of the *lingam* is found.

A Spreading Factor in Snake Venoms

F. DURAN-RIVINALS (*J. Exp. Med.*, 69, 69; 1939) has carried out investigations to determine whether the venom of poisonous snakes contains a factor capable of increasing tissue and blood permeability. He found that the venom of various species of snakes differed considerably in the power to spread Indian ink through the skin and apparently did so independently of its toxicity. The spreading power was greatest in the Viperidae (rattlesnake) and relatively scanty in the venom of the Colubridae *proteroglyphus* (cobra). Extracts of the supralabial glands of harmless snakes contained only negligible amounts of the spreading factor. Rattlesnake venom heated at 65°-100° lost a large proportion of its toxicity but retained the ability to spread Indian ink. Antivenine serum inactivated both the toxic and spreading factors of venom.

Vertebrae in a Fossil Crossopterygian Fish

For some years the ancestors of the earliest amphibians (Stegocephalia) have been sought among the Devonian Crossopterygian fishes. The skull and limbs of Stegocephalia have been compared especially with those of the Crossopterygian *Eusthenopteron*, which is found well preserved in the Upper Devonian rocks of Saumeneau Bay, Province of Quebec, Canada. A newly described specimen of *Eusthenopteron* now permits satisfactory comparisons to be made also with the vertebrae (W. K. Gregory, H. Roodwell and F. G. Evans, *J. Paleontol.*, 13, No. 1, 126-129, Jan. 1939). In the earliest known Stegocephalia, each vertebral centrum consists of two successive bony rings, an intercentrum bearing the neural and haemal arches, and a pleurocentrum without arches (the 'ambolomerous' arrangement). It now appears that in *Eusthenopteron* the intercentrum occurs as a delicate bony ring consisting of separate right and left halves in contact above and below. This intercentrum is separated from the next by an equally wide vacant space, which is closed at the top by a very small bone. The alternating vacant space, therefore, was probably occupied by cartilage, and

if this became ossified it would form a pleurocentrum to complete a vertebra like that of the earliest Stegocephalia. The comparison is indeed interesting and may be significant.

Labradorite-Oranite

FELSPAR phenocrysts in the diabase-porphry of Mount Devon in Missouri contain large amounts of potash, and for this reason the mineral has been referred to oranite, an intergrowth of orthoclase and lime-rich plagioclase, while the rock itself has been distinguished from other diabasic rocks as devonite. Goldich and Muilenburg (*Amer. J. Sci.*, 237, 130; 1939) have made a detailed study of the rock and its minerals and they are able to show that the large phenocrysts represent labradorite which has been hydrothermally altered, with introduction of potash, to form sericite. It is pointed out that labradorite-oranites may exist as the result of normal crystallization from a magma, but that no good examples appear to be known. Chemical analysis alone is clearly not sufficient to establish the existence of oranite, unless it is definitely known that the mineral is unaltered. The authors reiterate their earlier conclusion that the use of the rock name 'devonite' should be discontinued. At its type locality the rock so-called is simply a hydrothermally altered diabase-porphry.

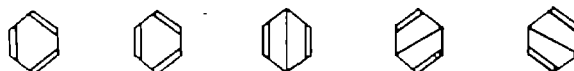
Structure of Iron Enneacarbonyl

ALTHOUGH some tentative structures have been proposed for the more complicated metal carbonyls, they have not been supported by any very convincing experimental evidence. The structure of $\text{Fe}_9(\text{CO})_9$ has now been determined by X-ray analysis by H. M. Powell and R. V. G. Ewens (*J. Chem. Soc.*, 286; 1939), and the result is quite different from that previously suggested. The molecular formula is $\text{Fe}_9(\text{CO})_9$. It is found that each iron atom is linked to three terminal carbonyl groups and the two iron atoms are joined by three carbonyl bridges (CO), $\text{Fe}(\text{CO})_3\text{Fe}(\text{CO})_3$. The ends of the molecule are formed by three $\text{Fe}-\text{C}\equiv\text{O}$ groups which are linear, but the three intermediate groups are not linear and function as $>\text{C}=\text{O}$, each carbon being attached to two iron atoms and attached to oxygen by a double bond. The two iron atoms are formally ferric and the substance might be expected to show a paramagnetism corresponding to two unpaired electrons. Actually it is diamagnetic. This is explained as due to the complete coupling of the electron spins (not necessarily by bond formation) owing to the close approach of the iron atoms, which are only 2.46 Å. apart.

The Structure of Benzene

LAST year's Bakerian Lecture by O. K. Ingold (*Proc. Roy. Soc.*, 169, 150) was devoted to recent work on the structure of benzene. Any solution to this problem must account for the great stability of benzene and for the approximately plane ring structure shown by X-rays and by electron diffraction. The electronic theory of valency explains chemical bonds in terms of the superposition of the wave functions of atoms, which may be expressed as the freedom of the electrons to exchange places. This freedom of exchange lowers the energy of the system and gives rise to binding forces. An extension

of the theory explains 'mesomerism'. When there are two differently bound forms of a molecule, the possibility of transition from one to the other is expressed by the superposition of two wave functions, and it may be shown that the mixed or 'mesomeric' state has a lower energy and a greater stability than either of the separate configurations. On this view, benzene is a mesomeric combination of



and has the full symmetry of the hexagon. Recent work has verified the symmetry by study of the infra-red and Raman spectra of benzene. In a molecule which has a centre of symmetry, there can be no lines common to the infra-red absorption and the Raman differences. The coincidences which had been reported for benzene vapour were found to be spurious, and due to liquid benzene in which the symmetry of the molecule is distorted by intermolecular forces. The vibrations of a benzene ring in which the symmetry of the molecule was modified by the substitution of deuterium for some of the hydrogen atoms were considered in detail, and found to agree well with the observed Raman and infra-red spectra.

Ozone in the Upper Atmosphere

AN account of observations of ozone in the upper atmosphere made in North-East Land (in latitude 80° 23' N.) at the base of the Oxford University Arctic Expedition, 1935-36, by R. A. Hamilton entitled "High Latitude Ozone Measurements", was read before the Royal Meteorological Society on March 15. The measurements involved the determination of the amount of absorption of ultra-violet light in the spectrum of the Pole Star, by examination with a photometer of the spectra obtained with a quartz spectrograph. The densities of the spectra for wave-lengths of 3290 Å. and 3092 Å. were compared with the same densities on an image on the plate of a source of light the intensity of which varied along the image in a known manner. The required constants for the actual computation of the amount of the ozone were obtained by carrying out a similar experiment at Oxford at night when the amount of ozone had been measured on the previous and following days by the standard method. Corrections had to be applied for the errors due to fogging of the plate by the light of the aurora borealis. The mean error of a determination was found to be of the order of magnitude of 30×10^{-8} cm., but the day-to-day fluctuations were much greater than this. The day-to-day fluctuations were, moreover, found to be very much larger than those observed in lower latitudes. A point of resemblance with what has been observed in all other latitudes was to be found in an autumnal decline in the amount of ozone. This continued throughout the winter, while there was a sudden rise in spring. A table of comparisons between the measurements made in January and February 1936 with similar measurements made by Dr. Tönnesberg at Tromsø (latitude 69° 50' N.) was shown. Observations were made on the same day at both places on only three occasions, but a large ozone figure was found on one of these occasions (January 17) at both places.

The State and Unemployment

THE report of the Commissioner for the Special Areas in England and Wales for the year ended September 30, 1938*, indicates that the activities of the Department have been devoted to continuing work previously begun and making extended efforts to attract new industries to the areas.

Very satisfactory progress appears to have been made with the trading estates at Team Valley and Treforest, and the Commissioner has also provided factories on other sites, including several which can accommodate many undertakings, such as the Solway Estate, Maryport, and the sites at Pallion, St. Helens, Auckland and Dowlais. Some sites were originally acquired for the clearance of industrial ruins, and at the end of September twenty factories were occupied or in preparation in certain districts outside the estates, where the problem of unemployment has been most intractable, including the Rhondda Valley, Dowlais, south-west Durham and Cleator, west Cumberland. In addition to the powers to provide factories and to offer inducements, the assistance which is available towards capital, either in the form of a loan or by taking up shares or debentures, has been of special value in establishing new industries. For this there are available the Nuffield Trust, the Special Areas Reconstruction Association and the Treasury Fund. The Commissioner considers that the time is too short to draw any final conclusions regarding the value of the provisions of the Special Areas (Amendment) Act, 1937, for the encouragement of new undertakings in the Special Areas, which have now been exercised for sixteen months. Even, however, if some help to the Special Areas is immediately forthcoming as a result of restrictions on the growth of London, he considers it would be a mistake to reduce the powers at present available for encouraging new industrial activity in these areas. They continue to present a serious working problem of a population in excess of the present employment capacity, which cannot be solved by short-term methods.

The report shows that between mid-1936 and mid-1937 the population of the Special Areas in England and Wales fell by 42,000 as compared with 38,000 in the preceding twelve months and 23,500 in 1934-5. The total fall in the three years was 3.6 per cent and this fall continues to be due wholly to migration from the Special Areas, although the natural increase in population, due to excess of births over deaths, is still steadily decreasing in rate, having fallen by 43 per cent in seven years, as compared with 25 per cent in the rest of the country. In the Durham and Tyneside Special Area the rate of decrease of population was not so great as in the previous year, but in the other two main Special Areas it was greater.

The Special Areas have been affected by the general trade recession to a slightly less degree than the rest of the country, the percentage of unemployment during the year increasing from 21.4 to 24.3, mainly in South Wales and Durham. Although the increase in the whole of Great Britain was two and one half times as great as in the Special Areas, the percentage

of unemployment in the latter remains nearly twice as high as it is for the country as a whole—24.3 as against 13.6. A striking feature of the present situation is the increase of 34 per cent in the number of men, aged 18-20 years, unemployed, between May, 1937 and May, 1938 as compared with a decrease of 42 per cent in this group between May, 1936 and May, 1937. This increase is attributed partly to a decline in transference. With regard to the prolonged unemployment which characterizes the Special Areas as compared with the rest of the country, although the position has improved since 1935, the proportion of long-unemployed men remains approximately as it was three years ago, three and one-half times as high as in the rest of the country.

The Commissioner points out that the main difficulty in solving the unemployment problem in the areas has been due to the fact that in the past the areas have been dependant largely on one or two heavy industries, such as coal-mining, iron and steel and shipbuilding. There has been comparatively little variety in the types of employment provided and the demand has been predominantly for male labour. A good deal of the new industrial development has been of the light industry type in which the proportion of female labour is higher, and accordingly it has not had quite the same effect in increasing the employment of men. The development of new industries has, however, also led to the provision of training facilities to assist unemployed persons to obtain work in their own districts in industries new to the locality.

The position of the local government services has also improved and when a number of hospital schemes have been completed, the health services should be substantially up to the level of the services in other parts of the country. Especially in the north-eastern area, progress has been made in clearing away the industrial ruins of past days. In regard to social work, the need for continuing the provision of holidays by the sea for children on the grounds of health is stressed, as well as for school camps and assisting the settlements. Once again special emphasis is laid on the importance of preventing demoralization among the young men, and of bringing them within range of useful occupation and opportunities of ordinary wage-earning employment. The Commissioner considers that the measures available to him under the Special Areas Act and the valuable training and transference facilities afforded by the Ministry of Labour are not wholly adequate to meet the need. In his view it would be reasonable in selected cases to require applications for unemployment assistance, as a condition of the receipt of a cash payment, to attend one of the instructional centres or physical fitness classes organized by the Ministry of Labour. Unless such an applicant could show good cause, he should be confronted with a choice between compliance with a reasonable condition if he is to continue to receive cash payments, and one form of assistance which would contain an element of deterrence. The Commissioner simultaneously, however, stresses the importance of further efforts to devise schemes to provide new

* Report of the Commissioner for the Special Areas in England and Wales for the Year ended 30th September 1938. (Cmd. 5306.) Pp. vii+120. (London: H.M. Stationery Office, 1938.) 2s. net.

openings for the able-bodied unemployed, particularly young men.

The Commissioner for the Special Areas in Scotland* also insists on the necessity for a long view. A boom in the heavy industries is little more than a temporary relief, and the object should be to change the unstable industrial equilibrium by introducing as many secondary industries as possible. He concludes that no solution which aims at getting the older men back into ordinary wage-earning employment can wholly succeed. Despite its inherent difficulty,

* Report of the Commissioner for the Special Areas in Scotland for the period 1st September 1937 to 30th September 1938. (Cmd. 5906.) Pp. viii+88. (London: H.M. Stationery Office, 1938.) 1s. 6d. net.

some form of sub-economic development must be provided. The absence of any serious attempt to co-ordinate the activities of the various social service organisations in Scotland is criticized, and the Commissioner considers that further expenditure from the Special Areas Fund would be fully justified if it welded into a strong national body the various organisations at present doing fine work in most difficult circumstances. In regard to industrial development, the Commissioner suggests that more might be done to help new and experimental processes, and that a scheme designed to foster new enterprise in the area should include encouragement of such processes, even if in the nature of things their ultimate success was bound to be problematical.

International Congress of Tropical and Sub-Tropical Agriculture

THE eighth International Congress of Tropical and Sub-Tropical Agriculture was held at Tripoli during March 13-17, under the presidency of Prof. Le Plae, honorary general director of agriculture to the Colonies' Ministry, Belgium, in the unavoidable absence of Prof. Franco Angelini, secretary-general of the International Federation of Technical Agriculturists (F.I.T.A.). Delegates from Italy, France, Belgium, Holland, Poland, Germany, Bulgaria and other countries attended the Congress, and Great Britain was represented by Sir John Russell, as chief Government delegate, and by Sir Arthur Hill.

The Congress was opened by H.E. Marshal Balbo, Governor-General of Libya, who also presided at the concluding meeting. At the opening meeting, papers were presented by Prof. Armando Mangini on "European Colonisation and Native Agriculture in Tropical and Sub-Tropical Countries", by Count Edmond de Warren on "Agricultural Production of the Warm Countries" and by Prof. Le Plae on the "Professional Preparation of Native Agriculturists through Compulsory Instruction". The Congress then broke up into five sections. The first dealt with the possibilities of agriculture in tropical and sub-tropical countries, Sir John Russell being one of the presidents of this section. In the second section papers were read on agricultural problems relating to ecology, meteorology, erosion, irrigation and dry culture; while the third section dealt with various economic problems such as credit, labour, co-operation and marketing.

The fourth section was in two parts, one devoted to vegetable products, of which Sir Arthur Hill was one of the presidents. Numerous papers dealing with cotton, sugar-cane, rubber, olives and vines in North Africa, citrus, etc., were presented, and also papers dealing with forestry. In the other subsection, papers relating to animal products were read.

The fifth section was devoted to insect and fungus pests of cultivated crops.

Visits were paid to the Agricultural and Zootechnical Experiment Station near Tripoli where fine new laboratories have just been completed; the grounds contain a very representative collection of citrus species and varieties, and of vines, almonds and other trees of economic value. The citrus, including grapefruit, were bearing large crops.

Of particular interest were the visits to the new villages of Crispi, Michele Bianchi and Oliveti, which have been recently built. Crispi, only some four months old, is situated in a seemingly desert plain and consists of some 333 farms with a civic centre where the church, town hall with cinema, hospital, school and co-operative store are arranged around a central square. The farms allotted to each colonist are 37-120 acres in extent according to the locality, part being irrigated for the growing of wheat, lucerne, cotton, etc., the rest being dry-farmed with olive and almond trees and vines.

Crispi with its new white houses in this sandy spot was not a prepossessing sight, but a visit to Bianchi and Oliveti, nearly three years old, was a revelation of the possibilities of irrigation and good cultivation, since at the start they were founded on sites as sandy and barren as Crispi.

At these two villages, the olive and almond trees were flourishing and beginning to bear, and the irrigated crops were in very good condition—a great tribute to the good work of the Italian colonists from the Venetian plain and to the foresight of the organizers of these remarkable developments. No doubt in Roman times much of this North African 'desert' country was fertile, else such magnificent cities as Leptis Magna and Sabratha would not have been founded.

The new colonist is provided with his house, sheds and farm on trust, together with the equipment and livestock. After a short time on a fixed salary, he is placed on a crop-sharing basis for about five years and in the sixth year he becomes full owner of the farm and assumes direct management. At the end of nine years, when he has paid one-third of his debt, the colonist becomes full owner of his farm. The whole debt is expected to be paid off before the end of the thirty-fifth year.

This eighth Congress was admirably organized by Dr. Gioacchino Dallari, colonial adviser of the Fascist Confederation of Land Workers, and his staff. The majority of delegates were conveyed from Genoa, Naples or Messina in the S.S. *Roma*, a fine cruiser of 30,000 tons which served as their headquarters during the Congress.

It was suggested that the Congress in 1941 might be held in England.

Localization of Activity in the Brain

IN his Ferrier Lecture to the Royal Society, Prof. E. D. Adrian (*Proc. Roy. Soc., B*, 126, 433; 1939) traces the development of the electro-physiological methods of investigation and analysis of the activities of the cerebral cortex from the discovery of the electrical excitability of the brain by Fritsch and Hitzig in 1870. This discovery led to Ferrier's classical work on cerebral localization, the main facts of which have never been seriously questioned, and, indirectly, to the modern method of study of cerebral function, the recording and analysis of the waves of electrical potential, which are the inevitable accompaniment of cortical activity.

Berger's observation that the electrical activity of the cortex could be detected through the unopened skull came at a time when the range of electrical technique was increasing enormously, and the result has been a great and sudden increase in the volume of work published on the subject. The great beauty of the method is that it allows a study of the activity of the whole cortex, and not merely in "the arrival and departure platforms"; but it has the inevitable difficulty of the interpretation of the records from an organ which, by its very nature, never responds twice in precisely the same way. Thus, the local electrical response, which has been shown to follow the arrival of sensory impulses, is related in size, not to the stimulus, but to the previous history of the cortical area on which it falls. In fact,

the mechanism of the various types of facilitation which are in constant evidence in the cortex is one of the most fascinating problems.

Some details of the spread of activity in the cortex can be studied in the response of the sleeping, or narcotized, brain to the arrival of a sensory message, but a simpler, because more easily controlled, method is the investigation of the response of the cortex to a direct electrical stimulus. Such a stimulus evokes a reaction locally, not unlike that in response to a sensory message. In the surrounding areas it has two distinct effects: the direct spread of the excited state and a diffuse general increase in excitability, which reveals itself, after repeated stimulation, in the wide spreading of waves of considerable electrical potential, very like those which occur in man during epileptiform convulsions.

It is evident that the cerebral cortex responds readily to sensory messages, and it is therefore difficult to define what is meant by the 'spontaneous' activity of the brain. It seems clear, however, that although the response is to some degree controlled by the character and size of the message reaching it, the final pattern of the cortical activity is determined by the structure of the particular region and by its history. However hopeless may seem the task of analysing the activity of the human brain, these new methods offer some hope, at least, of understanding the mechanisms which exist in it, and from which its behaviour is eventually synthesized.

The Spens Report and General Science

Discussion by the Association of Women Science Teachers

THE Association of Women Science Teachers held an extraordinary general meeting on March 4 at St. Paul's Girls' School, by kind permission of the Governors and the High Mistress, to consider: (1) the Spens Report in its relation to science in the curriculum; and (2) the Report on General Science, Part 2, recently published by the Science Masters' Association.

The Spens Report sees the value of "the natural sciences when vitally taught" and it emphasizes the need for general interest, but it indicates that this might require less time than a formal study. The idea that the wider study of science might require less time was questioned by the meeting, but members were in agreement that there is still room for pruning and taking stock of the topics which are included, so that the science teaching might instil the desire "to search for truth, goodness and beauty" and give some understanding of the part played in the modern world by the forces of science. Some felt that the emphasis on English subjects as the core of the curriculum might subordinate science, but all were agreed that all subjects had an important part to play in the teaching of English.

There was considerable variation in opinion as to the time which should be allowed to science, but it

was felt that the time suggested by the Spens Report is adequate for a general view, but where greater detail and depth of knowledge are desired, more time is necessary. There are, however, the 'pool periods' for which science specialists can make a claim. There was general agreement that specialization at an early age is not desirable. It was felt by many that the school child of to-day is over-taught, and that there is a definite need for leisure in school time so that there might be an opportunity for reading; for this to be of real value the school must possess a good library.

The Spens Report also emphasizes the need for good demonstrations as against excessive practical work on the part of the pupil. There was general agreement that, to produce such demonstrations, both time and good laboratory assistants are essential; it was also felt that demonstrations might be overdone at the expense of the pupil, who obtains satisfaction from the activity involved in practical work. Care is required to keep the balance between demonstration and individual work by the pupils.

The general feeling of the meeting on the Spens Report can be summed up in the words of a member, who said: "Here we have the core of something which is going to give the mass of our child population

something that will stay by them", and for this "we have to sacrifice things we think valuable". Surely the end which is desired makes this worth while.

In the discussion on general science which followed, the question of the teaching of general science by one mistress and as one subject, and not by individual specialists, was raised. Some members felt that in the two years preceding School Certificate the syllabus should be taught by specialists in the individual branches. The majority of the members present appeared to consider that more was gained when it is taught by one, and that freshness of outlook, saving of time and greater correlation between the branches might result.

Miss Casswell, headmistress of the Edgbaston High School for Girls, gave an interesting report on the minimum syllabus for general science, which is based on the minimum syllabus of the Association of Assistant Mistresses and of the Association of Women Science Teachers, and on the extended syllabus which is based on the Science Masters' Association's Report on General Science, Part 2. Both of these

new syllabuses have been drawn up by the Joint Matriculation Board of the Northern Universities. The minimum syllabus does not have a bias in any particular direction, and it tries to get a unity of science through a study of forms of energy, the material environment and the plants and animals of the environment. The syllabus is such that in ordinary circumstances there should be time for revision and for the introduction of other material which will give the individual teachers freedom of choice. The second paper naturally requires more time, and there would necessarily be opportunity for greater selection and deeper study of sections of the syllabus in which there might be greater interest, and this would involve effort to suit the work to the special circumstances and environment of the school.

Throughout the meeting it could be seen that there was a real and deep appreciation by science teachers of the need to make the teaching such that "it should reveal the influence of scientific thought and achievement in the evolution of our present-day civilisation, and that it should indicate its possibilities, for good and evil, in the future of the human race".

Petroleum and World Politics

THE importance of the geographical distribution of the heavy minerals around the North and South Atlantic Oceans was stressed in NATURE of January 28, p. 169. It is well to remember, however, that the world distribution of petroleum is also closely related both to the arts of peace and to the horrors of modern warfare. In the present temper of the world, any non-belligerent nation which possesses reserves of petroleum is in danger of finding itself involved in serious political complications. This is especially true of those States of South America which are believed to possess the world's largest reserves of petroleum. In this connection, some remarks of Dr. D. Rey Vercosi and Dr. Juan H. Caorsi of Montevideo, in a paper of recent date¹, seem worthy of wider attention.

The authors observe that it is the policy of the more advanced nations of the world to exploit for their own principal benefit the supplies of petroleum in the less-advanced countries of South America. Since 1936, also, it has become the policy of the United States, which is the largest producer as well as the largest consumer of petroleum, to conserve its own resources, which are calculated to be sufficient for about thirty years at the present rate of consumption, and to import large quantities of crude oil from foreign, mainly South American, sources. This attitude of the greater Powers is causing much searching of heart among South American peoples, who see their national resources being rapidly depleted and perhaps to some extent wasted elsewhere in the frantic rush of the modern world. Such stirrings of national spirit help to explain the recent happenings in Mexico and other States.

The authors place the world production of crude oil in 1937 at about two thousand million barrels, and give the following figures of production in the principal producing countries in thousands of barrels (each barrel = 42 gall.)

U.S.A. ..	1,278,000	Mexico ..	44,700
U.S.S.R. ..	800,000	Iraq ..	80,700
Venezuela ..	185,800	Colombia ..	20,200
Iran ..	78,100	Peru ..	17,700
Dutch Indies ..	54,900	Trinidad ..	15,000
Rumania ..	52,000	Argentina ..	15,900

They quote General Serrigny's recent estimate in round figures of exportation in tons from the four principal geographical producing regions:

North America ..	21,000,000
South America ..	28,000,000
East Mediterranean ..	12,000,000
Orient ..	14,000,000
Total ..	75,000,000

Of this total, about 33 million tons go to Europe.

The authors remark that since the necessities of a European war in which the United States might be involved would greatly increase the demand for petroleum and the non-belligerent countries would not diminish their consumption, it would be necessary to increase world production perhaps two or three times, and supposing that supplies from North America, the east Mediterranean and the Orient were for various reasons unobtainable or unreliable, on South America would fall from necessity or choice the principal charge of meeting the increased demand. The South American States, and especially Venezuela and Colombia, would thus be required to supply the demands of the belligerents.

It is clear that an international situation of great gravity might easily arise, and it is good to know that the younger and clearer minds in South America are already at work upon the problem. The authors urge the necessity of co-operation between the South American States themselves and collaboration in a spirit of peace and good will with the industrialized nations of the world for the general good of humanity.

J. D. FALCONER.

¹ "Política del Petróleo a seguirse por los países sudamericanos". A.N.O.A.P., Montevideo, 1938.

Seismology at Kew Observatory

THE most complete seismological equipment in the British Isles is at Kew Observatory, and thanks largely to the enterprise of its superintendent, Dr. F. J. W. Whipple, the performance of this has recently been vastly improved. Dr. A. W. Lee, the seismologist at Kew, has now written an account of the new installation (*Meteorological Office, Geophysical Memoirs No. 78, sixth number, 9. London: H.M. Stationery Office, 1939. 2s.*).

The three Galitzin seismographs, originally presented to Eskdalemuir Observatory by the late Sir Arthur Schuster, were, after transference to Kew, placed on a massive concrete pillar in the basement of the main building but isolated from it. These instruments were greatly influenced by the wind, and it was found by experiment with a Milne-Shaw instrument borrowed from the Science Museum, that the effect was not due to direct draughts on the instruments but to the rocking of the whole building and the surrounding subsoil by the wind; hence the entirely new building to house the seismographs, which was ready for occupation early in 1937. The two Wood-Anderson seismographs constructed at Kew (1933 and 1935) were transferred in February, the Galitzin horizontal pendulums in April, and the vertical Galitzin in September 1937.

The new building, which has two rooms at the same level, is situated about 100 yd. south-south-west of the main observatory building, and has its floor

5 ft. below the level of the surrounding paddock. The ceiling is covered by soil and turfed, the level of the turf being about 5 ft. above the surroundings. The whole is made to withstand the weather, and the temperature of the ventilated rooms is thermostatically controlled.

The south room, 20 ft. by 15 ft., contains the seismographs on concrete pillars built directly on the floor, and the north room, 10 ft. by 15 ft., contains the galvanometers and recording drum for the Galitzin pendulums on slate slabs cemented to concrete pillars. The timing is by a Hope Jones synchro-motor (No. 1901) standard clock which is arranged to give time breaks of 2 sec. at the minute and 4 sec. at the hour accurate to within a few tenths of a second, on recording paper fixed to an electrically driven drum. The rate is 15 mm. per minute. The small Wood-Anderson instruments have a static magnification of about 700:1 and the instruments at Kew are adjusted to have a free period of 2.5 sec. with a damping ratio of approximately 20:1. Both north-south and east-west components are made to register on the same drum in a similar manner to the three Galitzin instruments.

It is confidently expected that in addition to welcome minor improvements, the changes will have obtained for the Kew seismograms that freedom from wind effect and more uniform drum rate than with the separate clockwork drives which was so much desired.

The First Imperial Veterinary Conference

THE Imperial Agricultural Research Conference which was held in London in 1927 recommended that certain specialized imperial agricultural bureaux should be established, and as a result ten bureaux are now in operation. Two important events have since taken place. Following the Ottawa Conference of 1932, the Imperial Committee on Economic Consultation and Co-operation, in 1933, examined and reported on *inter alia* the work and functions of these bureaux; and in 1936 the British Commonwealth Scientific Conference met.

The First Imperial Veterinary Conference is one of the many important developments of the Imperial Agricultural Research Conference of 1927. It was held in London in August last and was attended by delegates from the United Kingdom, from each of the Dominions, and from Colonial Territories*.

The Conference was opened by Mr. F. L. McDougall, a former chairman of the Council of the Imperial Agricultural Bureau, who pointed out the economic importance of the livestock industry to the several territories of the British Empire, and directed attention to the results that have been achieved in the control of animal disease. The sessions of the Conference were devoted to consideration of the working of the Imperial Bureau of Animal Health and to discussion on certain disease subjects of outstanding interest. The deputy director read a report on the

work of the Bureau. At the present stage of its development, the maintenance of the indexing and abstracting services is the main activity. *Index Veterinarius*, issued half-yearly, is a classified subject and author catalogue dealing with about 10,000 references per annum. The *Veterinary Bulletin*, issued monthly, is devoted to abstracts, of which about 3,500 appear annually. The development of a review service is imminent. A special committee was appointed by the Conference to report on the Bureau.

At the sessions devoted to disease subjects, "Foot-and-Mouth Disease", "Gaseous Lymphadenitis of Sheep", "Virus Diseases of Animals", "Laryngotracheitis", "Infectious Bronchitis and Coryza of Poultry", "Blowflies of Sheep", "Fowl Paralysis", "Bovine Mastitis", "John's Disease" and "Chronic Bovine Haematuria" were discussed.

Resolutions were passed emphasising the importance of the Imperial Bureau of Animal Health and recommending certain developments in its activities, on the importance of work concerning a reliable diagnostic agent for John's disease, and on the danger of using certain prophylactic measures for the control of foot-and-mouth disease and some other virus diseases.

* Report of the First Imperial Veterinary Conference, 15th-18th August 1938. Pp. 97. (Weybridge: Imperial Bureau of Animal Health, 1938.) 5s.

Science News a Century Ago

Exploration of the White Nile by Steam Vessel

AMONG the papers read to the Royal Geographical Society on April 22, 1839, was one by A. T. Holroyd entitled "On the Practicability of Exploring the Sources of the White Nile with a Steam Vessel". In his recent journey to Sennar and Kordofan, said the author, his attention was directed to one of the great desiderata in African geography, namely, the exploring of the sources of the Bahr el Abyad. If a steam boat left Cairo in July, drawing not more than two feet of water, it might with care pass all cataracts between Cairo and Khartoum. "I mentioned the subject of passing the cataracts to Mr. Perring, an eminent civil engineer in the employ of Mohammed Ali Pasha who kindly made a drawing of a steamer calculated for a steam expedition." The proposal was to leave Cairo in July, get to Berber in September and remain there until the end of the rainy season. An express was to be sent ahead to Khartoum to prepare for the arrival of the boat. From that place, the steamer would proceed up the Bahr el Abyad and it would be probably found that six months would suffice to survey both branches of the river. The vessel would return to Berber and await the rising of the Nile before proceeding to Cairo.

Fossils and Shells from Canada

At a meeting of the Geological Society held on April 24, 1839, Lyell read some "Remarks on some Fossils and recent Shells collected by Capt. Bayfield, R.N., in Canada". Several eminent conchologists having observed that in the English crag there are certain shells which indicate a somewhat colder climate than that which prevails in our latitudes, and it having been supposed that a similar difference may be deduced, but with greater certainty, from shells found in the newer Pliocene strata in Scotland and Ireland, Lyell had been induced to examine with great care the collection sent home by Capt. Bayfield, which consisted partly of fossils procured from the most modern tertiary deposits bordering the Gulf of St. Lawrence, and partly of recent Testacea from the Gulf itself.

The Smithsonian Bequest

In a long communication on science, education and other matters to the *Athenaeum* of April 27, 1839, a United States correspondent said: "The topic now is the appropriation of Smithsonian's (English) bequest. The amount is half a million of dollars. Government have invited our distinguished men to offer plans for the proposed institution, and many have been given in. Some want a national university of the highest European order, in Washington on Jefferson's model. Others propose courses of lectures, and various other things. One of the most remarkable of these schemes is that of a German, who wishes for a grand national agricultural institute at the seat of government, of course, with the idea, I presume, that agriculture is the great interest of this nation, and yet one in which we are grossly deficient. . . . He would have a farm large enough for all experiments to be tried, and all systems exhibited."

James Smithsonian (1765-1829), F.R.S., at his death had left more than £100,000 to the United States for founding a Smithsonian Institution at Washington for the increase and diffusion of knowledge. The Institution was finally inaugurated in 1846.

Societies and Academies.

London

Royal Society (*Proc.*, A, 170, 300-450; 1939).

A. C. CUTHBERTSON, G. GEE and E. K. RIDGAL: Polymerization of vinyl acetate.

D. R. BATES, R. A. BUCKINGHAM, H. S. W. MASSEY and J. J. UNWIN: Dissociation, recombination and attachment processes in the upper atmosphere. (2) Rate of recombination.

D. SHONBERG: Magnetic properties of bismuth. (3) Further measurements on the de Haas-van Alphen effect.

A. WIGGLESWORTH: Flexure and torsion of an internally cracked shaft.

L. A. WIGGLESWORTH and A. C. STEVENSON: Flexure and torsion of cylinders with cross-sections bounded by orthogonal circular arcs.

E. L. MCBAIN: Diffusion of long-chain sulphonic acids.

J. G. DAUNT and K. MUNDLISCH: Transfer effect in liquid HeII. (1) The transfer phenomena. (2) Properties of the transfer film.

Paris

Academy of Sciences (*C.R.*, 208, 853-952, March 20, 1939).

A. LACROIX: Dacitic pumices floating on the ocean between the Fijis, the New Hebrides and New Caledonia.

L. LAPTOQUE: A so-called active principle of curare. Carneiro described results contradicting the classical findings; they were due to experimental mistakes.

F. GRANDJEAN: Asymmetric distribution of accessory organs.

R. FOSSE: Urogenesis and purine nitrogen metabolism in plants.

E. CHATTON and MILK. J. SEGUELA: Genetic continuity of the *cintome* in some ciliate Hypotriches.

J. FAVARD: Determination of some convex surfaces.

A. ROSENBLATT: Problems of the calculus of variations in the case of simple integrals in which the extremities of the line of integration are variable on some curves with singular points.

E. VISSOT: Reducibility of automorph systems of which the associated group is simply transitive.

S. BERGMANN and J. MARCINKIEWICZ: Limiting values of functions of two complex variables.

R. TREMBLOT: The spectroscopic triple star H.R. 6497.

MILK. P. FAVARD: Indiscernibility of co-puncles. Indiscernibility involves indeterminism.

G. BIEN: Characteristics of the equations of the photon.

A. PROCA and S. GOUDSMIT: Mass of the meson and other elementary particles.

F.-J. TABOURY: Polarographic study of polished unchangeable electrodes: analogy of structure of a Bellby surface and of a liquid mercury surface.

A. MARCELIN: Maximum distance of distinct visibility through a disturbed medium. Coloration of a liquid and intensity of light are without influence.

G. DESTRIAU and LOUDETTE: Influence of the electric field on the form of the emission bands in electro-photoluminescence.

A. GUINIER: Diffusion of X-rays by crystals and microcrystalline bodies.

J. SOLOMON: The notion of superficial tension in nuclear physics.

C. HANNY and A. ROSENBERG: Emission of neutrons during the experimental disruption of the rhenium nucleus: possibility of chain reaction. Each neutron absorbed can lead to the emission of several neutrons, and experimentally an increase of 20 per cent in the neutron effect on an ionization chamber has been produced.

T. URRANSKY and RYCHTER: Contact action of a heated metallic surface on some explosive substances.

G. WETZOFF: The equilibrium $P_4 \rightleftharpoons 2P_2$ in phosphorus vapour.

(To be continued.)

Moscow

Academy of Sciences (C.R., 20, Nos. 7-8, 1938).

N. G. TOUGANOFF: Lines on a surface, the geodetic version and the normal curvature of which are in a near relation.

W. TURKIN and P. DUBUQUE: Structure of simple groups.

P. DUBUQUE: A theorem, containing the theorems of Frobenius, of Weisner and of Turkin, on the number of elements of a given order in a group.

V. LUKCHIN: Deformation of closed and open station surfaces with negative curvature.

S. FINKOFF: Pair of surfaces in which the symplectes of one correspond to a conjugate system of another, and the homologous tangents intersect.

N. S. IVANOVA: (1) Soft bundle-producing constituent of cosmic radiation. (2) Hard constituent of cosmic radiation and the Rossi curve.

J. L. ZILMANOV: Liquefaction of helium by means of the Joule-Thomson effect.

A. T. DADAIAN and E. J. PUMPER: Measurement of the absorption of ultra-sonic waves in air and in argon.

I. KIRVALIDZE: Spectral distribution of the absorption coefficient in X-irradiated sodium chloride crystals in the case of disappearance of inner tensions.

F. A. KOBOLEV: Application of Töppler's method to the measurement of ultra-sound absorption in air.

V. KONDRATIEV: Absorption spectrum and lifetime of the carbon sulphide radical.

V. I. MALYSHEV: Investigation of the frequency of the OH-group in binary mixtures by means of combination dispersion.

A. MIGDAL: Scattering of neutrons in ferromagnetics.

M. A. ILJINSKY, L. G. GINDIN and V. A. KASANOVA: Oxidation of alkyl-anthracenes, alkyl-anthraquinones and their derivatives. (1) Oxidation with chromic anhydride of β -methyl-anthraquinone to anthraquinone- β -carboxylic acid. (2) Oxidation of methyl-anthraquinone with chromic anhydrides to anthraquinone- β -carboxylic acid as influenced by water.

L. G. GINDIN: Investigation of the corrosion of metals by non-electrolytes.

O. CH. SOABRE and A. E. BRODSKY: Concentration of the heavy isotope of oxygen and isotopic analysis of water.

V. I. NAKAROV and A. V. NIKOLAJEV: Application of Kurnakov's pyrometer in the investigation of the gelatinization of potato starch.

A. V. NIKOLAJEV: A study of stereoisomery and of the isomerization of some complex platinum compounds by the method of heating curves. Enlarging the crystals of metallic platinum.

A. M. RUBINSTEIN: Investigation of the complex components of platinum and α - and β -amino-pyridines.

B. M. MIKHAILOV and N. G. ČERNOVA: Synthesis of 10-alkyl derivatives of 9-methyl-1,2-benzanthracene.

O. M. ČERNTEOV: Reaction to distinguish levulose from glucose.

E. L. KIRKOV: Pavlodar stony meteorite.

V. N. KRESTOVNIKOV and D. M. RAUSER-ČERNOUŠOVA: Foraminifera from the transitional beds between the Devonian and the Carboniferous (Etroungt zone) of Kazakhstan, South Urals and Samarkaya Luka.

O. N. SOBOLEVA: Role of amphidiploids and other balanced types in crosses between widely separated forms.

M. GOLDHAUSEN: Interspecific hybrids in water-melons.

K. I. PANGALO: Living ancestors of cultivated water-melons.

F. E. RICHMONDS: (1) Stage-development in different biological groups of lettuce (*Lactuca sativa* var. *capitata*). (2) Change of the "sign of photoperiodic reaction" in turnips.

V. G. ALEXANDROV and O. G. ALEXANDROVA: Endosperm nucleus and its role in filling and ripening of grains of cereals.

V. J. RUDENSKAJA: Anatomical premises for breeding large-rooted forms of 'kok-saghyz'.

G. I. AZIMOV and A. D. ALTMAN: Various parts of the anterior lobe of the pituitary body and physiology of lactation.

A. V. RUMJANTSEV: Growth of embryonal tissue *in vitro* as influenced by an excess of chlorides (sodium, potassium, calcium).

A. A. WOITKOWITSCH: The action of the substance from various zones of the anterior hypophysis lobe in the chick.

Rome

National Academy of the Lincei (*Atti*, 23, 117-175; 1938).

G. ARMILLINI: Fundamental problems of the cosmogony and Newton's law (8).

G. SILVA: Keplerian motions and theory of the annual aberration of light.

Q. MAJORANA: (1) Further researches on the action of light on thin metallic films. (2) Action of periodically interrupted light on thin gold films.

G. GHERARDI: An observation on the linear complexes of spaces.

A. ROSENBLATT: Unequal single-valued functions in the unitary circle.

L. SOLAINI: Influence of internal orientation errors in photogrammetric restoring.

F. P. MAZZA and C. MIGLIARDI: Some *p*-amino-benzene sulphonyl- α -aminoacids and their derivatives.

C. ARNAUDI: Researches on the acidifying micro-organisms of ensilaged fodders.

A. CORRADINI: Attempt to reconstruct the general cycle of plasmodians in the vertebrate host.

G. MARTINO and A. ALIBRANDI: New observations on the conditional reflexes of blinking (for acoustic stimuli).

A. VATOVA: Hydrographic observations on the lakes of Italian East Africa.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Monday, April 24

VICTORIA INSTITUTE (at the Central Hall, Westminster, S.W.1), at 4.30.—Mrs. Walter Maunders: "The History of India, as Reflected in the Astronomy and Meteorology in the Hymns of the Rig Veda".

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—A. King: "The Imperial College Expedition to Jan Mayen, 1938".

Tuesday, April 25

ST. MARY'S HOSPITAL, LONDON, W.2, at 5.—Prof. Wilfred Trotter, F.R.S.: "Has the Intellect a Function?"

Wednesday, April 26

UNIVERSITY COLLEGE, LONDON, at 5.—Dr. A. Hrdlička: "The Present Status of our Views on Human Evolution".*

Thursday, April 27

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Prof. P. M. S. Blackett, F.R.S.: "Cosmic Rays" (Kelvin Lecture).

Friday, April 28

UNIVERSITY COLLEGE, LONDON, at 5.—Dr. A. Hrdlička: "The Racial Fallacies and Realities of European Peoples".

ROYAL INSTITUTE, at 9.—Sir James Jeans, O.M., F.R.S.: "Tone Colour and Electrical Music".

Saturday, April 29

GILBERT WHITE FELLOWSHIP (at the Art-workers' Guild, 6 Queen Square, Southampton Row, W.C.1), at 2.30.—Annual General Meeting.

R. A. Smith: "New Light on Pre-historic Monuments" (Presidential Address).

U.S. NATIONAL ACADEMY OF SCIENCES, April 24-25. Annual Meeting to be held at Washington.

April 24, at 8.30: Sir William Bragg, Pres.R.S.: "History in the Archives of the Royal Society" (Pilgrim Trust Lecture).*

BRITISH MEDICAL ASSOCIATION, April 27-29. National Conference on "Wider Aspects of Nutrition".

April 28, at 8.15.—Prof. V. H. Mottram: "Nutrition and the Public Health" (Sir Charles Hastings Public Lecture).*

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

LECTURER IN CHEMISTRY in the Newport Technical College—The Director of Education, Education Offices, Charles Street, Newport, Mon. (April 28).

ASSISTANT LECTURER IN ENGINEERING SUBJECTS in the West Hartlepool Technical College—The Chief Education Officer, Education Offices, West Hartlepool (April 28).

LECTURER IN HYGIENE AND PUBLIC HEALTH in the Battersea Polytechnic, London, S.W.11—The Principal (April 29).

JUNIOR INVESTIGATOR OF STRENGTH OF MATERIALS to the British Non-Ferrous Metals Research Association, Hurton Street, London, N.W.1—The Secretary (May 1).

RESEARCH OFFICER for the Technical Advisory Committee of the North-East Development Board, 162 Northumberland Street, Newcastle-on-Tyne (May 1).

LECTURER IN MECHANICAL ENGINEERING AND PHYSICS and LECTURER IN MECHANICAL ENGINEERING AND MATHEMATICS in the Constantine Technical College—The Director of Education, Education Offices, Middlesbrough (May 6).

ASSISTANT LECTURER IN BOTANY in University College, Swansea—The Registrar (May 16).

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Department of Scientific and Industrial Research. Index to Literature of Food Investigation. Vol. 10, No. 3, December 1938. Compiled by Agnes Elizabeth Glennie, assisted by Gwen Davies and Catherine Robson. Pp. v+180-200. (London: H.M. Stationery Office.) 4s. 6d. net.

Transactions of the Royal Society of Edinburgh. Vol. 69, Part No. 24: Scientific Results of the Voyage of S.Y. Scotia, 1902-03. The Ornithos. By Prof. C. Vaney and D. Dwyer John. Pp. 66 672+1 plate. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 2s.

Economic Advisory Council: Committee on Locust Control. The Locust Outbreak in Africa and Western Asia in 1937. Survey prepared by Dr. B. P. Uvarov and Miss W. Minthorpe. Pp. 64+9 maps. (London: H.M. Stationery Office.) 3s. net.

New Forest Association. Annual Report and Statement of Account 1938. Pp. 20+8 plates. (Brookhurst: New Forest Association.)

Department of Scientific and Industrial Research. Common Pests of Grain and other Stored Produce. Pp. iv+18 (8 plates). (London: H.M. Stationery Office.) 3d. net.

Other Countries

Suomen Geodettien Laitoksen Julkaisu. No. 27: Formeln u. Tabellen zur Berechnung der Nivellements Reduktion. Von T. Kukkamäki. Pp. 18. (Helsinki: Finnischen Geodätischen Institute.)

Dokumente der Schweizerischen Naturforschenden Gesellschaft. Band 78, Abh. 1: Central Himalaya: Geological Observations of the Swiss Expedition, 1936. By Arnold Heim and August Gansser. I xvi+246+20 plates. (Zürich: Gebrüder Fretz A.G.)

Svenska Hydrografik-Biologiska Kommissionen. Skriftser. Hydrograf. 14: On the Angular Distribution of Submarine Daylight and on the Total Submarine Illumination. By Nils G. Johnson and Gösta Liljequist. Pp. 16. Fyrauppsamlingar år 1936. Pp. 4. (Göteborg: Svenska Hydrografik-Biologiska Kommissionen.)

Field Museum of Natural History. Botanical Series. Vol. 20, No. 1: The Myxophytes of Maryland. By Francis Drouot. (Publication 489.) Pp. 14. (Chicago: Field Museum of Natural History.) cents.

University of Denver: Department of Anthropology. Archaeology Survey Series. Eleventh Report: Petroglyphs of North Central Mexico. By H. B. Renaud. Pp. 58+20 plates. (Denver, Colo: University of Denver.)

Annual Report of the American Telephone and Telegraph Company for 1938. Pp. ii+28. (New York and London: American Telephone and Telegraph Co.)

Ministry of Public Works, Egypt: Physical Department. The Nile Basin. By Dr. H. M. Hurst and Dr. P. Phillips. Supplement to V. 2: Measured Discharges of the Nile and its Tributaries from 1920 to 1932. (Physical Department Paper No. 23.) Pp. vii+736. (Cairo: Government Press.) P.T. 50, 10s.

U.S. Department of Commerce: Coast and Geodetic Survey Special Publication No. 216: The United States Coast and Geodetic Survey: its Work in Surveying and Charting the Waters of the United States and Possessions, Geodetic Control Surveys, and other Activities. Pp. 12+2 plates. (Washington, D.C.: Government Printing Office.)

Meddelelser om Grønland udgivne af Kommissionen for Videnskabelige Undersøgelser i Grønland. Bind 119, Nr. 9: Investigations on the Coepod Fauna in East Greenland Waters. By P. Jespersen. Pp. 106. 4.75 kr. Bind 121, Nr. 3: The Zoology of East Greenland-Coepoda. By P. Jespersen. Pp. 66. 3.00 kr. (København: C. Reinholds Forlag.)

Smithsonian Miscellaneous Collections. Vol. 98, No. 4: Five New Races of Birds from Venezuela. By Alexander Wetmore. (Publication 3628.) Pp. 8. (Washington, D.C.: Smithsonian Institution.)

Proceedings of the United States National Museum. Vol. 86, No. 3048: Revision of the Beetles of the Melolonthine Subgenus Phytob of the United States. By Lawrence W. Saylor. Pp. 157-168+plate 9-10. (Washington, D.C.: Government Printing Office.)

U.S. Department of the Interior: Office of Education. Bulletin 1937, No. 20: Education and the Civil Service in New York City. By Prof. Wallace S. Sayre and Milton Mandell. (Project in Research in Universities.) Pp. vii+79. (Washington, D.C.: Government Printing Office.) 16 cents.

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 21: Investigations on the Cold Storage of Mangoes. By Dr. G. Cheema, Dr. D. V. Karmarkar and B. M. Joshi. Pp. ii+60+5 plate 3.12 rupees; 6s. Miscellaneous Bulletin No. 23: The Cold Storage of Fruits and Vegetables. By Dr. G. S. Cheema and Dr. D. V. Karmarkar. Pp. ii+15+4 plates. 10 annas, 1s. (Delhi: Manager Publications.)

Catalogues, etc.

P. J. Kipp and Zonen Galvanometers. (List 'Galvo 38'). Pp. (London: W. Edwards and Co.)

Rare Books: including Rare English Works, Economics, Incunabula, Medical, Science, Transport, also Manuscripts and Autograph (Catalogue No. 637). Pp. 78. (London: Francis Edwards, Ltd.)

Calendar for 1939-40 ("Gid" Series). (Manchester: Metropolitan Vickers Electrical Co., Ltd.)

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Aeronautical Research in Australia

EARLY in 1937, the Australian Government invited Mr. H. E. Wimperis to advise on the inauguration of aeronautical research in the Australian Commonwealth. It could have made no better choice. Mr. Wimperis has been closely connected with aeronautical research practically from its beginnings in Great Britain. For twelve years until he retired in 1937 he was responsible, as director of scientific research, for the organization and development of research in the Air Ministry. Owing to his retirement he was free to apply his unrivalled experience to the problems of Australia. He spent six months in visiting the Royal Australian Air Force Stations in New South Wales, Victoria, and Western Australia, and the civil aerodromes in New South Wales, Victoria, Western Australia and Brisbane. He also visited the Munitions Supply Establishment at Maribyrnong, Victoria, and many engineering and industrial plants.

One of the principal recommendations made by Mr. Wimperis in his report* is that an engineering research establishment be organized for experimental work in aerodynamics, aircraft and automobile engines, and for the testing and development of aircraft instruments and other equipment. Mr. Wimperis estimates the initial capital cost of such an establishment to be £143,000, and the annual cost of its staff when completed to be of the order of £12,000 a year.

This recommendation has already been acted upon, and a start has been made in the building of the laboratory at Fishermen's Bend, a few miles from Melbourne. The laboratory is to be built close by the aerodrome belonging to the independent Commonwealth Aircraft Corporation,

which has agreed to give free use of its aerodrome to the laboratory and to co-operate fully with the research investigations. A short distance away are the works of the General Motors Company.

It is understood that the Commonwealth Government also intends to set up a Bureau of Standards at Sydney. The new Engineering Research Laboratory at Fishermen's Bend and the Bureau of Standards at Sydney will correspond together to the National Physical Laboratory in England. The aeronautical work at the new laboratory will be supervised by an Australian Aeronautical Research Committee; but the laboratory as a whole will be administered by the Council for Scientific and Industrial Research, the chief executive officer of which is Sir David Rivett.

Mr. Wimperis also recommends the establishment of a professorship of aeronautical engineering, and a readership in meteorology in Australian universities. Both these recommendations have already been given effect. A chair of aeronautical engineering has been established at the University of Sydney. The Commonwealth Government has made a grant of £20,000 for the building of an aerodynamics laboratory at the University, £12,000 for its equipment, and £3,000 a year for salaries and maintenance. The State Government has added £18,000 for building a hydrodynamics laboratory in conjunction with the aerodynamics laboratory. An assistant professorship of meteorology has been established at the University of Melbourne.

It may possibly be argued that the comparative remoteness of Australia, even in these days of rapid transport, the smallness of its population, and the relatively insignificant size of its industry, all combine to make the carrying out of aeronautical research both expensive and unnecessary, in view of the very large sums of money already

* Parliament of the Commonwealth of Australia. Report by H. E. Wimperis on the Inauguration of Aeronautical Research in Australia, dated 21st December 1937. Pp. 17. (Canberra: Government Printer, 1938) 1s.

devoted to the subject in other countries in Europe and America. Would it not be possible for Australia to get all the information it needs by studying the results of work in Great Britain and in America without attempting to duplicate it on what would appear in these countries to be an inadequate scale? Such views have been expressed, but we believe them to be entirely wrong. In the first place, no one can appreciate fully and apply the results of scientific investigations unless they themselves are engaged on similar work. It does not matter in the least that Australia may not be in a position for many years to contribute anything of first-class importance to the science of aeronautics. If no start is made, there never will be such contributions. Now that the start has been made, Australian contributions to the science will depend upon whether men of first-rate ability can be attracted to the country. In the meantime, the presence and active work of a trained staff will undoubtedly lead to a fuller comprehension and application of the results of work in other countries.

In the second place, Australia is committed to a policy of developing its manufacturing industries, as well as the older and more valuable industries of agriculture and mining. If Australia seeks, as it undoubtedly does, to attain a high state of efficiency in its manufacturing industries, it certainly needs a central institution of the first rank in engineering research. In the particular

case of the aeronautical industry, it is essential for the defence of Australia, and not merely of Australia but also of the British Commonwealth of Nations, that the manufacture of aircraft on a large scale should be undertaken in Australia. A start has been made and the industry is in the hands of capable and enthusiastic leaders. That it is bound to expand, and expand very greatly, in the near future is scarcely open to doubt, and its expansion must be facilitated by the new creation of a Government Aeronautical Research Laboratory. In aeronautics, as in every other branch of applied science, research and manufacture react on each other. Neither can be fully efficient unless it is in close contact with the other. Aircraft manufacture in Australia cannot exist in a healthy state if it merely relies on information and advice from other countries; nor will Australian aeronautical research be much more than academic and second rate if it is not carried out in the closest contact and with the enthusiastic support of Australian aircraft manufacturers.

The organization starts under the happiest auspices. The Australian Council for Scientific and Industrial Research, presided over by Sir George Julius, and administered by Sir David Rivett, has the complete confidence of the Australian Government, and scientific workers in Great Britain as well as those in Australia will feel that the development of aeronautical research in that continent is in safe hands.

The Modern Approach to Indian Problems

(1) Social Service in India:

an Introduction to some Social and Economic Problems of the Indian People. Written by Six Contributors. Edited by Sir Edward Blunt. Pp. xxiii+447+16 plates. (London: H.M. Stationery Office, 1938.) 10s. 6d. net.

(2) Health and Nutrition in India

By N. Gangulee. Pp. viii+337+13 plates. (London: Faber and Faber, Ltd., 1939.) 15s. net.

(1) **W**HATEVER may have been the ideas of the founders of the British Empire, the purpose always before the best of the modern administrators is to develop each part so as to give to its inhabitants the fullest and richest life possible for them. This purpose is particularly clearly shown in the volume called, appropriately enough, "Social Service in India" published by

H.M. Stationery Office, and edited by Sir Edward Blunt, with the collaboration of six colleagues, including some of the most distinguished Indian civil servants. The volume grew out of a proposal made by Sir Atul C. Chatterjee's Committee set up in 1936 to inquire into the system of probation for the Indian Civil Service: the proposal was that lectures should be given to the probationers on social welfare in India, and that a book should be prepared for use in connexion therewith. The first course was given in 1938 and the chapters were issued in typescript; they were then revised and expanded and are now printed in book form.

Contributors and editors alike have done their work well, and we know of no account of modern India so complete and concise as this. Sir Edward opens with two chapters on the environment and the people, showing, in the manner of the modern

geographer, how each has reacted on the other. Then follows a chapter by Mr. C. G. Cherevix-French on the rural community, giving a clear statement of its complex structure, of the *ryotwari* and the *zamindari* systems of land tenure and management, and of the land revenue and settlement problems.

Mr. R. G. Allan contributes two chapters on agriculture, the first giving a well-balanced account of the actual position, and the second showing the steps which the various departments are taking to effect improvements. These include the provision of better seed, better manures and implements, better methods of cultivation and of water supply, better livestock and better marketing facilities. There is also a section on the cultivation of fruit and vegetables, now recognized as of growing importance as sources of vitamins and mineral substances in the people's dietary. Cattle are of particular significance in the life of the village: usually the males are favoured as supplying power to the farmer, while the females have a less important position, receiving less food and of poorer quality, excepting only when they have special value for milk production. Broadly speaking, the poorest types are found in the areas around the head of the Bay of Bengal—regions of high rainfall and lateritic soils; the better types are found in the drier tracts of the Central Provinces, Bombay and northern India. Mr. Allan accepts the necessity for burning the farmyard manure, this being a cheaper fuel than coal or charcoal: but the peasant is being made to realize that green manures, composts and earth soaked with the urine of animals, are all good manures. Green manuring is found to be the most practicable, and it is now most common (1) before sugar-cane, where the ground was formerly left as open fallow, (2) before irrigated wheat, (3) before rice, if rain or irrigation permit of the establishment of a leguminous crop before transplanting begins. Night soil is but little used, as only very low castes will handle it.

Closely associated with agriculture come public health and nutrition, ably dealt with by Sir John Megaw. Famine and pestilence have in the past taken a terrific toll of Indian life: Sir John shows how they were gradually controlled, and describes in some detail the public health services of the Central Government and of the Provincial Governments. Systematic efforts are made in some provinces to bring medical aid within reach of every village. In Madras, 428 medical men receive a subsidy on condition that they reside in certain villages and provide medical relief for the sick poor. In the Punjab, 360 small dispensaries have been built, each in charge of a subsidized practitioner—these are in addition to the older hospitals and

dispensaries. Some £3,000,000 has been spent on hospitals in British India, and nearly 12,000 students are being trained in the medical schools and colleges. There are, however, nearly half a million villages in British India alone, exclusive of Burma and the Indian States, and they contain nearly 90 per cent of the total population of 270 millions. The birth-rate in British India is high; in 1935 it was 35 per mille (this included Burma) against 15 in England: the death-rate was 24 against 12 in England: the infant mortality-rate was 154 against 57 in England. The most significant fact brought out by these figures is that the annual number of births in British India and Burma averaged 4½ millions between 1881 and 1890, but was more than 9½ millions in 1935. This great growth of population is, of course, putting considerable pressure on the land, and Sir John recognizes that human nutrition is the most important and most difficult of all Indian problems. Experts differ as to whether the total food production in India is, or is not, adequate, but all agree that the great majority of the people are poorly nourished through lack of certain vitamins and mineral substances, and by reason of the poor biological value of much of the protein eaten. But this is no reason to think that the problems are insoluble. Accounts are given of the deficiency diseases that prove the lack of essential foodstuffs, and of the well-planned investigations on human nutrition now in hand by Dr. W. R. Aykroyd and others.

Sir George Anderson deals with the vexed question of education, and sets out clearly the disadvantages of a system which has undeniably turned out a considerable number of unemployed. An important chapter by Sir Frank Noyce deals with industrial labour and the many difficulties that have arisen in the development of a factory system in India. Finally, Mr. C. F. Strickland discusses co-operation, a method which, if it could but develop in India, would go far to solve many of the peasant's difficulties.

Altogether the volume can be strongly recommended, not only to those about to proceed to India, but also to all who are interested in knowing something of the way in which modern administrators tackle the problems that daily confront them there. We suggest to the editor the desirability of giving a short list of the more important of the many reports that have been issued on the various great problems discussed in the book, or alternatively, that they should be quoted as sources of fuller information should this be desired. Some of these reports are of special value but they run the risk of being overlooked, and few men have either time or the courage to attack, without guidance, the great mass of official literature that has now accumulated. Another improvement

would be the inclusion of an appendix summarizing the more important of the statistics discussed in the book.

(2) Prof. Gangulee's book deals entirely with health and nutrition in India, which he, too, regards as the most important problem there. He is unusually well equipped among Indian writers for his task: his early training under Tagore gave him a wide humanitarian outlook; his subsequent career in the United States, at Calcutta and at Rothamsted showed what was practicable in the way of agricultural improvement; his membership of the great Linlithgow Commission in 1926-28 furnished him with full details of the Indian problems; finally, his recent long months of reflection and writing have enabled him to put his ideas into shape.

In a significant dedication to Pandit Nehru, Prof. Gangulee quotes the old saying about India that "for every three mouths there are only two rice bowls" and so aligns himself with those who regard even the total production of food in India as inadequate, quite apart from the recognized inadequacy of vitamins and mineral substances. His suggested remedies are interesting. First and

foremost, to overcome the fatalism, even defeatism, which he finds so prominent in Indian life; then, the reorganization of the land system so as to abolish the tendencies to over-fragmentation of holdings in some regions, and over-large holdings in others; and the reorientation of agriculture so that human nutrition becomes its main purpose.

This question of the proper feeding of India is admittedly difficult, but it is now being faced courageously and we may still hope for a successful outcome of the many efforts now being made. One of the most hopeful features in the situation is the keen desire of the leaders of India, the Viceroy, the great social and political leaders, and the administrators, that the standard of life in the villages should be raised. It is now widely recognized that the prime purpose of Indian agriculture should be to produce food in the necessary quantity and of the proper quality, and that for this purpose special efforts must be made to bridge the present gap between the agricultural experiment station and the small cultivator, so as to bring the benefits of science within the reach of the villages of India.

E. J. RUSSELL.

Combinatory Topology

Topologie der Polyeder und kombinatorische Topologie der Komplexe

Von Prof. Dr. K. Reidemeister. (Mathematik und ihre Anwendungen in Monographien und Lehrbüchern, herausgegeben von E. Kamke, Band 17) Pp. ix+196. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1938.) 14.80 gold marks.

THE first systematic exposition of combinatory topology was made by Dehn and Heegaard in a section of the "Enzyklopädie der mathematischen Wissenschaften", in which the exact concepts involved are only developed as far as the third dimension. The extension of the theory to complexes of higher dimensions was fraught with considerable difficulties; and it was due to the work of M. A. H. Newman that the gap was finally bridged. In the section of the encyclopædia referred to above, he showed that combinatory topology was one of the most primitive branches of geometry, in which the concept of limiting values had as yet no place. In fact, as Prof. Reidemeister describes in detail in the present treatise, combinatory topology turns out to be a well-defined partial domain of the theory of polyhedra—a fact well calculated to demonstrate the elementary character of the subject and to justify Prof. Reidemeister in providing a new and systematic presentation of it.

In Euclidean geometry, a number of geometrical figures known as polygons or polyhedra—triangles, rectangles, cubes, etc.—are both familiar and indispensable. But the general concept of a two- or three-dimensional polyhedron has no part whatsoever in the definitions of these figures. Triangles and cubes are obtained directly from geometrical axioms; and even the more comprehensive class of convex polyhedra is treated as a special convex domain, as a section of a finite number of semi-spaces for example, and not as polyhedra having the additional property of convexity. Although, by virtue of numerous elementary examples, we may be familiar with the abstract idea of the polyhedron, an exact and unequivocal concept such as is essential for any systematic investigation, is lacking. Thus, at the outset, we are, as Prof. Reidemeister says, confronted with a decision the consequences of which present considerable difficulties for further developments.

By Prof. Reidemeister's fundamental definition, in which only the axioms of connexion and order of linear geometry and no continuous properties whatsoever, are assumed, a polyhedron P is an aggregate of points of a linear space R^n . It is in fact an extension of the definition of convex polyhedra given above. The totality of the polyhedra of an R^n is once more a polyhedron, and is,

moreover, the smallest aggregate-ring which contains the totality of the semi-spaces and linear sub-spaces of the R^n .

A polyhedron P can be obtained in two different ways; and the task which follows from Prof. Reidemeister's definition is a twofold one. On one hand, to obtain the connexion between the different methods of representation of P ; and on

the other, to obtain those properties of P which are independent of the method of representation, from a single representation. This task is accomplished by Prof. Reidemeister in two stages, and forms the substance of the present work, which does not assume much previous knowledge on the part of the reader, of either linear algebra or linear geometry.

The "Handbuch der Zoologie"

Handbuch Der Zoologie :

eine Naturgeschichte der Stämme des Tierreiches.
Gegründet von Prof. Dr. Willy Kükenthal.
Herausgegeben von Dr. Thilo Krumbach.

Band 4, Hälfte 2 : Insecta 2. Lieferung 9. Pp. 128.
16 gold marks.

Band 4, Hälfte 2 : Insecta 2 Lieferung 10.
Pp. 96. 12 gold marks.

Band 4, Hälfte 2 : Insecta 2. Lieferung 11.
Pp. 160. 20 gold marks.

Band 4, Hälfte 2 : Insecta 2. Lieferung 12.
Pp. 160. 20 gold marks.

Band 4, Hälfte 2 : Insecta 3. Lieferung 13.
Pp. 144+xiv. 20 gold marks.

Band 4, Hälfte 2 : Insecta 3. Bearbeitet von Dr.
Max Beier und Dr. Friedr. Hendel. Lieferung 14.
Pp. 312+xvi. 48 gold marks. (Berlin : Walter
de Gruyter und Co., 1938.)

THE parts of this publication now under review complete the three volumes devoted to the Insecta, which comprise 2,756 pages of text and additional pages, and 2,785 figures, all of high merit. The various orders, of which thirty-three are recognized, are dealt with in a remarkably uniform manner considering the different authors involved. Each starts with a short general account including a definition and a historical note. Then follows the morphology of imagoes, larvae and pupae, after which comes the detailed anatomy, with some reference to the physiology of the various systems, commencing with the integument and ending with the reproductive system. Problems of general interest such as the biology, phylogeny, geographical distribution, palaeontology, etc., precede the concluding and often most extensive part, the classification. In the latter, extensive and practical keys are provided. These are most useful since they cover the order as an entirety as it is now known and hence avoid the pitfalls of keys that are drawn up for a particular region where an order may be incompletely represented.

The whole of the first two *Lieferungen* here considered and the first sixteen pages of the third,

that is, *Lieferung* 11, are concerned with Diptera, the account of which had been commenced in *Lieferung* 8. It is by Dr. F. Hendel and Dr. Max Beier. There are 296 illustrations and while none of them is original, a large number are taken from the works of the former authority. It would, of course, have been impossible to include a complete list of all the literature of so large and important a group. The difficulty is met by giving a list of ten works each of which has an extensive bibliography. This is supplemented by a selected list of the more important works of the last twenty years, which occupies five and a half pages.

The remainder of *Lieferung* 11 and the first sixty-four pages of *Lieferung* 12 contain Dr. Max Beier's account of the Heteroptera. Of the 105 illustrations with which it is furnished none is original, a number being taken from the works of Handlirsch and of Weber. The last seven pages are devoted to a bibliography.

The same author's account of the Homoptera occupies the remainder of this *Lieferung*, the whole of the next and the first twelve pages of *Lieferung* 14, the last six of which contain the bibliography. Illustrating it are 317 figures; one photograph and one diagram are original, and of the remainder a number come directly or indirectly from the classical work of Weber.

At the end of *Lieferung* 13 are title-pages, list of contents, etc., for the volumes Insecta 1 and 2.

Lieferung 14 with its 312+xvi pages is by far the largest individual part. In a work like the present, the publication of which has extended over a period of years, it is inevitable that important works and even fundamental contributions to our knowledge of various orders should have been made during the interval: forty-four pages with thirty-one figures have wisely been devoted to remedying this. In such an extensive work also it is to be expected that slips and misprints should occur and these too, few in most orders, have been corrected. It is rather a surprise to find that in the Lepidoptera it should have been found necessary to provide a page and a half of corrections for 171 original pages; this rather suggests faulty

staff work somewhere. The greater part of *Lieferung* 14, 266 pages of it, is devoted to a closely printed index arranged in three columns. This is a most remarkable piece of work, for it contains many thousands of entries which, by means of contractions, signs and full cross references give ready access to the enormous mass of information in the books. To take an example chosen purely at random, under "Sternite" there are more than 100 separate entries referring to the different sternites, their occurrence in the larvae and the imagines of the various orders where they are mentioned. These entries in turn are cross-referenced.

In the table of contents in *Lieferung* 14 it is stated that *Insecta* 3 commences on page 1729 and it finishes on page 2756, that is 1028 pages. Yet on the covers of the parts, *Insecta* 3 does not appear until page 2301, and on the inside of the back cover of the past part it states that *Insecta* 3 contains "xvi + 1112 Seiten". Such discrepancies are difficult to excuse and provide unnecessary trouble when it comes to binding the volumes. So also will the fact that following the title-page for *Insecta* 2 we find in the table of contents a complete survey of *Insecta* 1 as well as *Insecta* 2 arranged continuously so that they cannot be separated.

By now this well-known general "Handbuch der Zoologie" has made a very definite place for itself in zoological libraries throughout the world. It is practically indispensable in the general library, for no other publication at present available can be regarded as a serious rival. The specialist library naturally depends upon the individual memoirs and researches in its own field appearing in scientific periodicals. But even here the "Handbuch" will prove of value since its full summaries of the fundamental work in each group up to date will furnish satisfactory stepping-off places. Indeed some specialists would do well to consult the volumes so as to orientate their particular studies to knowledge of a wider field and not get entirely lost in one small corner. It is the greater pity, therefore, that its price puts it beyond the reach of many who would wish to have more constant access to its pages. The three volumes devoted to *Insecta* have a total cost of Rm. 379 which, even allowing for a possible rebate of 25 per cent, represents at the present rate of exchange an outlay of more than £25 0s. 0d. This is more than the average worker in university or research station, or indeed a small general department, can contemplate spending on such a book, good though it may be.

Wireless Direction Finding

Wireless Direction Finding

By R. Keen. Third and enlarged edition. Pp. xi+803. (London: Hiffe and Sons, Ltd., 1938.) 25s. net.

WHEN the first edition of this book appeared in 1922, interest in wireless direction-finding was confined to a comparatively few individuals who were engaged either in the practice of the art for navigational purposes or in its application to a scientific study of the propagation of radio waves. Since the second edition appeared more than ten years ago (see review in *NATURE*, March 10, 1928), the scope and application of wireless direction-finding have increased considerably. Its use in connexion with marine navigation has become more widespread and has acquired greater reliability, while more recently it has become a very important aid to the navigation of aircraft. The appearance of the third edition, dealing in a comprehensive manner with the most up-to-date aspects of the subject, definitely establishes Keen's book as a standard work, which should be in the hands of all those engaged in the design, manufacture and installation of direction-finders, or in

the study and application of the results obtained therewith.

On the research side, this instrument continues to be a very useful tool in connexion with scientific investigations of the propagation of electric waves, including those unwanted waves of natural origin known as atmospherics. In a foreword to the edition under review, Mr. T. L. Eckersley stresses this aspect of the subject and directs attention to the efficient manner in which the scientific and technical sides of the art have advanced hand in hand.

In order to make room for new material, the author has had to delete the portions of the second edition dealing with the use of directive aerial systems for communication purposes only. Even so, the book has increased in size from less than 500 to more than eight hundred pages. After a brief historical introduction an explanation is given of the principles of the various types of directive aeriels and the manner in which they are influenced by electric waves. Detailed descriptions follow of the types of direction-finding apparatus used for shore, ship and aircraft installations, and of the various phenomena

encountered in these three spheres of application. The limitations imposed on the various types of instrument by vagaries in the propagation of waves are described in some detail, together with the manner in which these limitations have been overcome or reduced in importance. A chapter on systems of direction-finding which do not yet appear to have earned 'commercial' success includes the instrument giving a visual indication of bearing by the aid of a cathode ray tube. Recent

developments in connexion with this instrument indicate that it may soon be expected to emerge from its experimental shell, in which it has for so many years proved a most invaluable tool for the scientific investigator.

A well-arranged bibliography of selected papers is included in the book, and this will prove very useful to the student or research worker who wishes to delve deeper into the subject.

R. L. SMITH-ROSE.

Molluscs of the Great Barrier Reef

Great Barrier Reef Expedition, 1928-29
Scientific Reports, Vol. 5, No. 6: Mollusca,
Part 1. By Tom Iredale. Pp. 209-426 + 7 plates.
(London: British Museum (Natural History),
1939.) 15s.

THIS volume deals with the Lamellibranchia, excluding the Eulamellibranchia. The Barrier Reef Collection was augmented by dredgings around the Low Islands, with a few from the Queensland mainland. These regions the author names the Solanderian and Banksian divisions of the Australian fauna. A short history of reef exploration in the area, from Captain Cook to Hedley and his collaborators, is followed by a discussion of the criteria providing a basis for the classification of lamellibranchs. The author's scheme of classification is given, and the remainder of the book is devoted to a description of families, genera and species. More than two hundred species or sub-species are described and of these more than half are new. The six half-tone plates from drawings by Miss Joyce K. Allan and the photographs of oysters by Mr. Clutton are clear and adequate for identification of the shells. No index is provided, not even page references to families—an omission that may be rectified, perhaps, in the next part. A list of literature is also needed.

The study of this large class has been in the hands of three types of specialist, the geologist, the conchologist and the anatomist. Each has attempted to elucidate the evolution and relationships of the members of the Lamellibranchia from his own particular studies and is inclined to believe that the characters of a hinge, a gill or some other structure are sufficient for the purpose. The study of the dead shell, whether fossil or recent, has either tended to over-emphasize features which may be convergent, or, as Morley Davies pointed out (*Proc. Malac. Soc.*, p. 322; 1933) to divide orders and genera *horizontally* instead of *vertically*, so that their polyphyletic origin is masked.

We are, in fact, driven back to two important tenets in scientific philosophy. First, the specialists must pool their knowledge in order that a sound judgment can be made; no one of the three mentioned is competent to do it alone. Secondly, the features indicating affinity are likely to be those deep-seated characters that are little affected by the environment. Thus the conchologist has often been at fault because he has been too insistent on his own infallibility, the anatomist has rarely been also a geologist and conchologist and so has not obtained the full benefit of his anatomical studies. Moreover, the work on fossils and recent shells is far greater than that on the bodies of the animals themselves, and until this disproportion is corrected, the classification of any of the Molluscan classes must be regarded as unsatisfactory.

Mr. Iredale has clarified the issue considerably by attempting to combine the results of the geologists and conchologists with some anatomy. But his dogmatic and scornful attacks on other workers are unwise, since his own classification is not invulnerable, and in any case acerbity is dying out in scientific literature and may well be allowed to perish. He is to be commended for raising the anomalous Trigonias to ordinal rank, a position to which their deep anatomy also entitles them. Family rank for Watson's sub-families among the Pectiniformes is also sound, but the grouping of the Malletiidae with the Nuculidae can be questioned, since anatomically, especially as regards the pericardial complex, their relations are with the Solemyidae. Unfortunately, no Malletiids are described, so we do not know why the author arranged them thus.

Iredale is critical of the specialist in Europe who names the Australian fauna, and he stresses the importance of the local worker, who alone can study the variability of a species in its own home. He is quite right and the remedy is in his hands. Let him encourage Australian naturalists to carry on the work he has begun.

The Cycle of Weathering

By Prof. B. B. Polynov. Translated from the Russian by Alexander Muir. Pp. xii+220. (London: Thomas Murby and Co., 1937.) 10s. 6d. net.

THE science of weathering is fundamental in any study concerned with such a question as why the mineralogical composition of the surface material of the earth is as it is. It is therefore a fundamental science in the study of how geological deposits and soils came to have their present composition. Although this science is so fundamental, it possesses very few established facts. In Nature, weathering is exceedingly slow and very complex, with the consequence that until recently very few methods have been available for examining exactly what chemical processes are taking place. The science of weathering has thus been built up rather more on plausible guess-work than on established fact.

The author of this book, who is one of the leading Russian soil geologists, has not attempted to give a critical presentation of the subject in which the various rival theories are weighed and tested against known experimental data. The book is much more a monograph in which the author sets out to give a general survey of the field of weathering as he himself sees it. He discusses the types of weathering that can take place, and follows up in some detail the cycle of compounds which the commoner chemical elements pass through while in the earth's surface.

In the last chapter the author discusses the effect of topography and of the soil hydrological conditions on the rate at which weathering proceeds. He shows how, in a region having uniform climate and parent material, soils of quite different types would be expected, ranging from the most mature and leached soils on the divides to the most immature soils in the valleys. This effect constitutes what can be called the geomorphological limitation of the theory of the existence of climatic soil groups. This chapter is one of the most suggestive in the book, and the reviewer only regrets that it was not made longer so that more detailed illustrations could be given of the effect of topography. But if it serves as a stimulus for a fuller examination of this effect the book will have been more than justified. E. W. R.

Scoliodon (the Shark of the Indian Seas)

By Dr. E. M. Thillayampalam. (Indian Zoological Memoirs on Indian Animal Types, 2.) Second edition, revised and enlarged. Pp. xiv+126. (Lucknow: Lucknow Publishing House, 1938.) 2.8 rupees.

PROF. BAHL has now presented us with seven memoirs, each dealing with an Indian animal typical of some phylum and taught as a type of the same. The taxonomic position of each is shown, its anatomy and such parts of its physiology as are concerned with its habits in life. The classificatory position in relation to the rest of the Elasmobranchii is carefully considered, aided by forty-nine line illustrations, these leading up to the history of the genus *Scoliodon* and the consideration of the species.

The anatomical account which follows is interestingly written and excellently illustrated. We are

pleased to see modern views on locomotion, and we think the student would be helped by a more 'functional' tone throughout the anatomy. In particular, we should like to see a stronger treatment of the brain and cranial nerves, the broad functions of which apply to all the higher vertebrates.

Physiology of the Central Nervous System and Special Senses

By Prof. N. J. Vasifdar. Seventh edition, revised and enlarged. Pp. x+307+vii. (Bombay: Popular Book Depot; London: H. K. Lewis and Co., Ltd., 1938.) 10s. 6d. net.

A MEDICAL work which has passed through seven editions in less than thirty years does not require any further recommendation. It is sufficient to say that the present edition has been well brought up to date and will be found a valuable handbook by the practitioner and student alike.

The text is liberally interspersed with illustrations of the different types of nerve cells, tracts of white matter, transverse sections of the spinal cord, pons and mid-brain, the results of lesions at various parts of the central nervous system, and the structure and function of the special senses.

Fish Passes in Connection with Obstructions in Salmon Rivers:

being the Buckland Lectures for 1937. By T. E. Pryce-Tannatt. Pp. 108. (London: Edward Arnold and Co., 1938.) 3s. 6d. net.

THE subject chosen for the Buckland Lectures for 1937 by Dr. T. E. Pryce-Tannatt was appropriate, for Buckland himself was an inspector of salmon fisheries and was concerned with the question of obstructions in the courses of rivers. This book outlines the laws regarding obstructions, considers the obstructions in relation to the habits of the fish, and describes the types of fish passes in existence. The problems concerned with the choice of pass best suited for the varying circumstances are discussed, and thirty-two diagrams and photographs of the different kinds of obstructions and fish passes are given. It maintains the standard of this useful series of publications.

An Inorganic Chemistry

By Dr. H. G. Denham. Third edition. Pp. viii+694. (London: Edward Arnold and Co., 1939.) 12s. 6d. net.

THE main alterations in the new edition of Prof. Denham's book are concerned with the modern view of strong electrolytes and with valency. The last chapter has been extended so as to give a broad outline of the modern theory of valency. The book is of intermediate standard, and particular attention is given to the systematization made possible by the use of the Periodic System.

The possibility of predicting many properties of the compounds of the elements from those of the oxides is also used. The continued popularity of the book may be confidently expected in its new form.

Solar Variation and the Weather

By Dr. C. G. Abbot, Smithsonian Institution

WHILE he was visiting the United States at the end of last year, Sir Richard Gregory invited me to contribute to NATURE a general review of the results of the long campaign of the Smithsonian Institution on the variation of the sun, which was instituted by the late secretary, S. P. Langley. Thus far it has accomplished about 40,000 measurements of the solar constant of radiation, involving observations filling about 10,000 days, besides numerous and interesting side researches. A more detailed account of results is expected to appear in the April issue of the *Quarterly Journal of the Royal Meteorological Society*.

In 1903, by what now seems only a coincidence, a large drop occurred in our measurements at Washington of the solar constant of radiation, and simultaneously a considerable fall from mean temperature occurred generally over the north temperate zone. To test the possibility thus advanced that solar changes occur which govern weather, we began to make day-to-day observations of the solar constant at Mount Wilson Observatory in the year 1905. These continued during the summer and autumn months until 1920. The results, which treat of solar variation, of the transparency of the atmosphere, of the quantity of its precipitable water, of the coolness of sun-spots, of the brightness of the sky by day and by night, of the distribution of solar radiation in the different wave-lengths of the spectrum, of the distribution of radiation over the sun's disk, and which involved the invention of various instruments, including the silver-disk, water-stir, and water-flow pyrheliometers for measuring solar radiation in standard units, the pyranometer for measuring the brightness of the sky, the automatic recording balloon pyrheliometer, and others, are described in volumes 2, 3 and 4 of the *Annals of the Astrophysical Observatory* of the Smithsonian Institution. During these Mount Wilson years, I made expeditions to Mount Whitney, 14,500 ft. in altitude, and to Bassour, Algeria, to test whether similar results on the solar constant of radiation are found simultaneously at stations of different altitude and far separated. Also, in 1913 and 1914, automatic recording pyrheliometers were raised by sounding balloons. The most successful flight reached 25,000 metres, and brought back records which closely agreed with solar constant

values obtained at Mount Wilson and our other stations.

Up to 1919 our observations of the solar constant had all been made by the fundamental method of Langley. Briefly, it consists in measures of the intensity of sun rays at the station, supplemented by spectrobolometric determinations of the distribution of intensity in the solar spectrum. Both types of measurement were made simultaneously, and repeated about five times daily, beginning when the sun is not more than an hour high, and continuing until it approaches maximum elevation. After correcting for instrumental losses, the area included under the bolographic curve of the spectrum is corrected to be proportional to the pyrheliometer measurement of the total solar beam intensity. Then, by computation, each part of the spectral curve is raised to the intensity it would have outside the atmosphere. Then the area included under this computed extra-atmospheric curve, divided by the area of the corrected observed curve, is the multiplier to increase the pyrheliometer reading to what it would be outside the atmosphere. After reducing this to mean solar distance, we have the solar constant of radiation.

With the long computation involved, usually but one determination could be made by this method per day. Its accuracy, apart from instrumental and computing errors, depended on perfect uniformity of the transparency of the atmosphere for several hours. If the sky was clearing up, the result was too high; if growing hazy, the result was too low.

With these drawbacks, it is not remarkable that many meteorologists were not convinced that our results indicating solar variability were sound. They were inclined to think them merely accidental consequences of imperfect observation, or imperfectly uniform sky. Mr. H. H. Clayton, however, who has deserved specially well of meteorologists as editor of "World Weather Records", was at that time chief forecaster of the Argentine. He became convinced by Mount Wilson solar constant work, not only that the sun is really variable, but also that its variations are of first-rate consequence for meteorology.

To show the reasonableness of his views, I may remind readers that the accidental error of a mean diminishes with the square root of the number of observations. Mr. Clayton made use of this

principle. He collected all the solar constant values of the years 1913, 1914, 1915, and 1918, and placed them in six groups ranging from 1.89 to 2.01 calories, of which I abstract the highest and lowest as follows :

presence of volcanic dust, or some other unusual atmospheric condition might affect it, we have frequently checked its results by employing the fundamental method of Langley.

Now I come to state the outstanding results of

DEPARTURES FROM NORMAL TEMPERATURES (F.) AT BUENOS AIRES FOLLOWING DIFFERENT INTERVALS OF SOLAR RADIATION (MAY TO NOVEMBER)

Solar Constant (Cal. per min.)	Number of Days Observed	Days after Solar Observation															
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2.00 $\pm$ 0.01	29	-2.2	-1.3	-0.9	-1.4	-1.3	-0.4	-0.4	+0.5	+2.7	+2.9	+3.6	+2.5	-0.2	+0.2	+0.4	+1.1
1.90 $\pm$ 0.01	30	+1.8	+1.8	+4.1	+2.3	-1.6	-1.8	-1.8	-2.7	-1.4	-0.9	-2.5	-0.9	+0.2	-0.5	+0.4	-0.5

The opposite trend of these values of temperature departures is obvious. Of sixteen pairs of values just given, the signs of twelve pairs are opposite. As the numbers of observations are so large, the accidental error of the mean values, approximately 2.00 and 1.90 calories, respectively, is only about one fifth as great as the average accidental error of the individual days. Hence the probability that we deal here actually with well-separated levels of solar radiation is strong. The marked opposition of the average marches of temperature departures, following the contrasted observing dates, certainly gives definite significance to these dates, and if it be not the variation of the sun, it is at least something of forecasting value.

These and other meteorological applications of Clayton's led us to wish to improve and render more continuous our solar constant programme. In 1918, therefore, we established a solar station at Calama in the nitrate desert of Chile, at a level of about 6,000 ft. From that time to the present we have endeavoured, so far as possible, to make one or more solar constant determinations on every fair day. While most of this work has been supported by the United States Government, large sums in aid have come from the income of the Hodgkins Fund of the Smithsonian Institution, from Mr. John A. Roebling, and from the National Geographic Society. At present we operate three observing stations: Monteruma, near Calama, Chile, altitude 9,000 ft.; Table Mountain, Southern California, altitude 7,500 ft.; Tyrone Station on Burro Mountain, New Mexico, altitude 8,000 ft.

In 1919 we noticed that the coefficients of atmospheric transmission for all wave-lengths of radiation could be empirically represented, to an excellent approximation, as specific functions of the brightness of the sky near the sun. This enabled us to multiply observations of the solar constant daily as the measurements were quickly made. Also, as the sky brightness could be almost instantaneously determined, the new method avoided errors due to changes in atmospheric transparency. In all recent years we have preferred this empirical 'new method', but fearing that

this long-continued daily recording of the intensity of the solar radiation. Solar variations are small but real. We may assign as the average amplitude for one combined rise and fall of the solar constant, 0.7 per cent. Such variations as this may be expected to occur about once in twenty days. That is, we may expect annually about twenty cases of rise and twenty cases of fall to give well-marked sequences of solar change averaging 0.7 per cent, and extending from three to six days during such a sequence. Rarely, however, solar changes of several times this amplitude may occur.

In order to set out the evidence quite clearly, I will refer to results published in a paper of mine three years ago. Having searched the record for the 12-year interval 1924-1935, I found 320 well-marked cases of solar change, about half of rise and half of fall. I divided these into monthly groups, so that there were about fourteen cases of each kind per month on the average. Some good months had as many as twenty, and only one test, that of falling radiation in February, was represented by less than ten dates.

For each of the 320 dates, I computed the departures from normal temperature at Washington and at three other cities for 16 days following the supposed solar change. Recalling that there were from ten to twenty cases of each kind for each month, it will be seen that by taking the mean results, I obtained fairly strong representations of the average march of departure from normal temperature which follows in each month of the year at Washington and at the other places, after a sequence of rise or of fall of solar radiation is observed to begin.

In every month these average marches of temperature departures showed opposite trends following, respectively, observed rise and observed fall of solar radiation. It would be more striking to show here a plot covering all months, but I content myself, in illustration, with giving merely the figures for October at Washington. Interested readers may plot them. The figures are adjusted to give zero average temperature departure after both rising and falling radiation, by adding

appropriate constants throughout to each of the lines of departures as originally computed. A third line gives the deviations which would be found if a curve representing 'falling' departures were folded over upon a curve representing 'rising' ones.

able conclusion than this. Solar changes exist, and are factors of prime importance governing day-to-day weather changes. Apparently if the sun's changes could be observed with accuracy from day to day, meteorologists would receive a new and important element, which might probably

THE AVERAGE TRENDS OF OCTOBER TEMPERATURE DEPARTURES (F.) FOLLOWING, FOR 16 DAYS RESPECTIVELY, RISING AND FALLING SOLAR RADIATION

Days after	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Rising	-1.0	-2.6	-3.0	-1.6	0.6	0.3	0.8	4.9	6.5	5.3	1.4	-0.7	-1.5	0.3	-1.4	-5.2	-3.7
Falling	2.2	1.9	1.2	-0.6	-0.7	1.9	-2.1	-4.6	-4.8	-3.8	-2.7	2.0	0.0	0.0	0.6	4.0	5.9
Folded discrepancy	+1.2	-0.7	-1.8	-2.2	+0.1	+2.2	-1.3	+0.3	+1.7	+1.5	-1.3	+1.3	-1.5	+0.3	-0.6	-1.2	+2.2

Number of signs of departures same for two groups 2

Range of departures following rising radiation " $6.5 - (-5.2) = +11.7$

Range of departures following falling radiation " $-4.6 - 5.9 = -10.5$

Arithmetical mean 'folded discrepancy' " ± 1.3

The range of temperature is so large that it is difficult to accept the conclusion that so great an effect is really caused by radiation changes of the order of 0.7 per cent. Hence I have tested the result in several ways. First, as shown in my paper, when comparing the earlier with the later years, the curves are very similar for the years 1924-30, as compared to the years 1931-35. Secondly, selecting 48 cases of unusually large change in the observed solar radiation, I found them followed on the average by temperature departures exhibiting features the same in phase, but of about twice the average amplitude, of those following usual observed solar changes. Thirdly, and most telling of all, I considered time next *preceding* each of the 320 selected dates. I computed for each of these cases the temperature departures of the *preceding* 16 days. Then I determined correlation coefficients between the march of temperatures for 16 days *preceding* and for 16 days *following* the cases of rising solar radiation and the cases of falling solar radiation. The result was highly significant, and is as follows:

Prior to solar change, $r = +11 \pm 6$ per cent.

After solar change, $r = -54 \pm 5$ per cent.

Thus there is no significant correlation of the trends of temperature for 16 days *preceding* rising and falling sequences of observed solar radiation, but *after* the solar change there is a negative correlation coefficient eleven times its probable error. Evidently the 320 dates were significant; but they were selected only because observation indicated that rise or fall in solar radiation began with them.

Similar results as regards opposition of trends and magnitude of their separations are found at each of the four temperature stations selected in different parts of the world. The effects are large, ranging from 10° to 20° F. I see no other reason-

enable them to predict details of weather for two weeks in advance. To attain the necessary accuracy and continuity of solar observation would require, I think, ten stations on high mountains in desert lands.

Long-range solar variations are also interesting. When we take monthly mean values, their accidental errors are reduced on the average by more than fourfold as compared with daily values, because from sixteen to twenty-five daily values enter into each monthly mean. Moreover, our three stations, separated by thousands of miles, agree fairly closely in their indications of the trend of solar variation over many years.

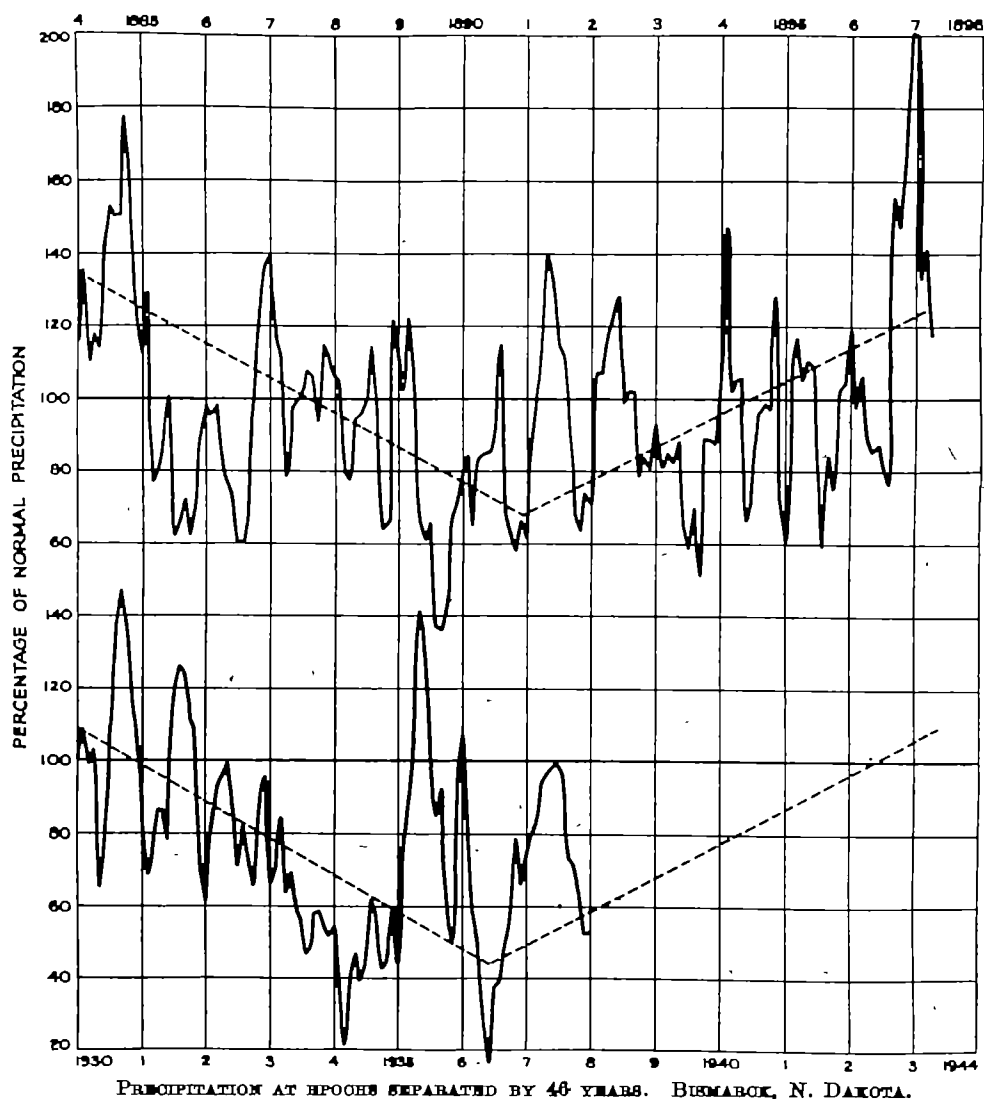
As we scan the curve of solar change since 1920, it appears to be irregular. But I have analysed it, searching for all the regular periodicities which it may contain. I have found twelve of them, ranging from 7 months to 274 months in length, and 274 months proves to be approximately the least common multiple of them all. In the case of half these periodicities, it was possible to derive them independently from two, or even three separate successive intervals, and to show satisfactorily that they persisted in approximately equal phases and amplitudes throughout the total interval of fifteen years. For the longer periods, exceeding thirty months, this check was not available. However, there was still evidence, by comparing individually several successive recurrences, that these longer supposed periodicities repeated in nearly the same phases and amplitudes.

On synthesizing these twelve periodicities, they retraced the observed trend of solar variation from 1920 to 1934 so exactly as to give an average monthly deviation from observation of only 0.2 per cent.

If, now, 274 months, or approximately 23 years, is really a master cycle in the sun, it may well be expected to reveal itself also in weather. It does

so. As noted by Wild, there is a 23-year periodicity in the temperature of that city which in his time was called St. Petersburg. Many other meteorologists have noted this cycle in other data. Hale found it in the magnetism of sunspots. The 11-year Wolf sunspot number cycles are of alternating unequal intensity. Tree-ring widths show it. It may even be discovered in the thicknesses of

92 years. These intervals correspond to double and quadruple the 23-year cycle. On this basis one may confidently predict, for example, that the great drought of the past ten years in the western United States is now broken, but will recur in considerable severity beginning 1975, and will recur with the excessive severity of the one just past beginning about 2021.



varves deposited by rivers and lakes in former geological ages.

For some stations, and notably for the precipitation, as at Nagpur in India, or at Peoria in Illinois, the principal secular features repeat themselves at intervals of 23 years so unmistakably in approximately equal phases and forms, that predictions based thereon covering years in advance are fairly well verified. More important is the recurrence of severe drought conditions at intervals of 46 years, and recurring still more severely every

In this connexion I will close by quoting from some correspondence of the past five years, illustrated by a graph showing the similarity of precipitation at Bismarck, North Dakota, in recent years, with that of 46 years before.

Under dates of January 1, 1934, January 1, 1935, March 14, 1936, February 6, 1937, and January 4, 1938, a farmer in South Dakota asked me to predict for him in each case a year in advance the trend of precipitation, and sometimes also of temperature. That area has suffered greatly from

drought in recent years. With strongly expressed cautionary statements as to the insecurity of such predictions, I have given him, year by year, the following indications.

1934: "There will be more precipitation in Minnesota and the Dakotas in 1934 than in 1933, but it will be in the latter half of 1934 that the relief will come."

1935: "One could hardly expect normal rainfall in South Dakota in 1935."

1936: "Precipitation far below normal, but with some improvement in the autumn. As regards temperature, the year 1936 followed almost exactly the pattern of temperature 46 years ago, i.e., 1890. If 1936 should follow 1890, it should show a very cold winter (as indeed has occurred), followed by normal temperature in spring and the early part of the summer."

1937: "A good precipitation in the spring or early summer of 1937, followed by a dry autumn and winter, recovery in the spring of 1938."

1938: "Normal precipitation during the first six months of 1938, with some (but not excessive) let-down for the remainder of the year, and for the first five months of 1939. Then a short dry spell in the middle of 1939, but precipitation normal or above normal after November 1939 for considerable time."

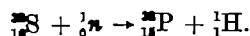
In January 1938, my correspondent said: "Because of the accuracy of your former predictions of weather conditions for the Dakotas, I am again soliciting your predictions for the coming season. I have much confidence in your ability to predict, therefore please do your best once more."

These forecasts were made by studying the departures from normal conditions at Bismarck, North Dakota, 46 years previously. How well they were fulfilled is to be estimated by examining the accompanying graph.

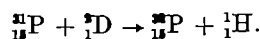
Use of Isotopes in Biology

THE discovery both of artificial radioactive elements and heavy non-radioactive isotopes, together with methods of concentration of the latter, has opened up new methods of examining the reactions and movements of substances in the body.

The isotopic indicator most frequently used in biological research is radioactive phosphorus (^{32}P) which may be prepared by the bombardment of carbon disulphide by neutrons from a radium-beryllium source. The sulphur atom takes up a neutron and gives out a proton, forming heavy, unstable, radioactive phosphorus (half-life period 14 days):



The phosphorus is then oxidized to phosphate. Stronger preparations may be obtained by bombarding red phosphorus with deuterium ions using a cyclotron:



For use, a small amount of the labelled sodium phosphate is added to ordinary sodium phosphate solution, and by this means the path of the phosphorus in the body can be traced. Estimations are carried out by observing the decay, at a given time, using a Geiger counter, and comparing directly with the decay of a similar standard at the same time, thus avoiding corrections for the rate of decay due to lapse of time. Thus if it is desired to determine the radioactive phosphorus content of the bone of an animal to which a labelled phosphate solution has been administered

(and hence determine any exchange in the phosphate of the bone), a known weight of bone ash from the animal is placed under the Geiger counter and the strength observed. This is compared directly with the same weight of calcium phosphate, precipitated together with the labelled phosphate from a known weight of solution. This method has placed an extremely delicate method of estimation in the hands of the experimenter and has the great advantage that it is not necessary to purify the substance carefully from non-radioactive elements.

Of the non-radioactive elements, deuterium (^2H) has been isolated in a state of purity; while heavy oxygen (^{18}O) and heavy nitrogen (^{15}N) have been concentrated sufficiently to make their use as indicators possible.

Heavy hydrogen and oxygen may be accurately estimated by conversion to water, and, after careful purification, determination of the density of the latter. Heavy nitrogen is determined by the mass-spectrograph. This method may also be used for the determination of heavy oxygen: it has the advantage that very careful purification is unnecessary.

It may be objected that the use of isotopes as indicators in the living body may disturb the normal conditions. Actually, the proportion of radioactive phosphorus which it is necessary to use is extremely small, and the radiation from it may be comparable with that from the potassium which is already present in the body, and on decaying it is converted to a sulphur atom. Heavy

non-radioactive isotopes are also already present in small proportions in the body, and the use of a slightly greater concentration as an indicator should not be objectionable. In the case of deuterium, it may be best to avoid the use of concentrated preparations.

A joint meeting of the Chemical Society and the Physiological Society on February 9 last took the form of a discussion on the use of isotopes in biology, which was opened by Prof. G. von Hevesy, of the Institute of Theoretical Physics, Copenhagen.

Among examples of the use of radioactive phosphorus, Prof. Hevesy described the results of experiments in which labelled sodium phosphate was injected intravenously; blood samples of known volume taken at intervals showed a very rapid decrease at first, followed by a slow decrease, in the labelled phosphate. This was found to be taken up by the bones and organs of the body, but chiefly by the former. It can be shown, by shaking up solid calcium phosphate with labelled phosphate solution, that there is a rapid exchange between the phosphate ions and the phosphate in the solid, the rate depending on the concentrations of the ions and the surface area of the solid. In the case of the body, the weight of the solid phosphate in the bones is very great compared with the inorganic phosphate in the blood, and most of the labelled phosphate will exchange with ordinary phosphate on the surface of the bones. As phosphate is lost by excretion through the kidneys and bowels, the uptake of labelled phosphate by the bones will cease, and finally, when the labelled phosphate in the blood is nearly removed, there will be a slow exchange of labelled phosphate back from the bones to the blood. Thus it may be possible to detect labelled phosphate several weeks after administration. Examination of the separate organs of the body enables the passage of the phosphate to be followed, and similarly examination of sections of bone shows that the rate of exchange of phosphate varies with different bones. In the case of growing bone such as the teeth of rats, the greater activity is found in the tooth formed after the addition of the labelled phosphate; the part formed before the addition, however, also shows some activity, indicating that exchange of phosphate takes place at the same time as new growth.

Phosphorus atoms in an organic molecule such as lecithin do not exchange with labelled sodium phosphate. Thus, if active lecithin is found, it indicates that the lecithin molecule has been synthesized after the administration of the labelled sodium phosphate (in the presence of suitable enzymes) and thus a distinction can be made between old and new molecules. This method may be used, for example, to find the place of

formation of the phosphatides in the yolk of hens' eggs. By killing a hen five hours after an injection of labelled phosphate, it was found that the liver and plasma phosphatide were very active (the former more than the latter) compared with that in the ovary and yolk; thus the phosphatide molecules formed during the last five hours do not originate in the ovary, but are taken by the ovary from the plasma and used in the building up of the yolk. It was also found that after the egg had left the ovary no labelled phosphatide was formed in it. This was shown by examination of labelled phosphate (the egg, after leaving the ovary, remains in the oviduct about 20 hours).

The use of radioactive sodium phosphate has also been of great help in a study of the formation of (goat) milk. Samples of blood and milk taken at intervals after administration of labelled phosphate were examined for the activity of the phosphate in the blood and the various phosphorus compounds in the milk. It was found that after three to four hours the milk inorganic phosphate was replaced by the active phosphate of the plasma; while if heavy water was injected at the same time as the active phosphate, after one hour water samples prepared from blood and milk had the same density, the difference in the rates being due to the fact that water molecules diffuse through the membranes at a greater rate than phosphate ions. From the rate at which the casein phosphorus becomes active, compared with the active inorganic phosphorus in the milk, it was estimated that the time of formation of casein in the gland cells was about one hour.

The fact that a few hours after addition of the labelled phosphate the milk phosphatides are only slightly active compared with the inorganic phosphate, indicates that the latter cannot be produced from the former, thus contradicting the view that the fats and inorganic phosphate are produced by the breaking up, in the milk gland, of the phosphatides of the blood. The investigation of problems of milk secretion was also referred to by Dr. S. K. Kon.

Labelled sodium phosphate has also been used in a study of the movements of phosphate in plants. Maize and sunflowers grown first in a culture solution were then transferred to a second solution containing labelled phosphate. The leaves which grew while the plant was in the second solution were examined for activity and compared with the leaves which grew in the first (inactive) solution. It was found that, after four days, the lower leaves had 80 per cent of the activity of the upper leaves, showing that a rapid replacement of phosphate took place. Similar experiments have been carried out using heavy nitrogen as indicator.

The use of deuterium as an indicator was discussed by Prof. H. S. Raper and Dr. W. E. van Heyningen. The former referred to the work of Cavanagh and Raper, in which fats labelled with deuterium were fed to animals and a study made of the rate of formation of the deuterium labelled lipins in the liver and kidney; the latter gave an account of the work of Schoenheimer and Rittenberg *et al.* on deuterium as an indicator in the study of intermediary metabolism, and referred especially to the uses and limitations of the method.

The use of heavy oxygen as an indicator was discussed by Dr. J. N. E. Day. He referred to the work of Aten and Hevesy, who examined the possibility of exchange of oxygen in sulphate, with other oxygen atoms present in the body, by injecting heavy sodium sulphate into rabbits, and concluded that there was little or no exchange. Reference was also made to the work of Day and Sheel on the use of heavy oxygen in animal

respiration, in which the heaviness of the expired carbon dioxide was determined.

Radioactive sodium was dealt with by Dr. B. G. Maegraith, who mentioned experiments in which active sodium chloride had been injected into rabbits, and the distribution of the active sodium investigated. He suggested that this might be used to estimate the extracellular fluid content of the rabbit.

Dr. W. D. Armstrong described experiments dealing with the exchange of phosphorus of the enamel of teeth and the blood using radioactive phosphorus. A very slow exchange was noticed, indicating, not the formation of new molecules, but exchange of phosphate between enamel and blood. Mr. C. H. Collie referred to work of Collie and Morgan showing that radioactive sulphur can be used as an indicator.

Dr. D. Roaf described a method of producing radioactive phosphorus by irradiation of trioresyl phosphate with slow neutrons.

Obituary Notices

Prof. Franz Werner

PROF. FRANZ WERNER'S death, which took place in Vienna on February 18 after a short illness at the age of seventy-two years, came as a shock to his numerous herpetological friends and colleagues the world over. Born in 1867, Franz obtained his doctorate at the University of Vienna in 1890 at the early age of twenty-three years, was appointed assistant in the First Zoological Institute of the University, later rising to be professor there, and had a distinguished record as a teacher until 1933, when he became emeritus professor. For more than fifty years, almost up to his death, he was zealously engaged in zoological researches, being in the foremost ranks of European herpetologists and a recipient of many honours. He was a corresponding member of the Vienna Academy of Sciences, an honorary doctor of the University of Athens, an honorary member of the American Society of Ichthyologists and Herpetologists, and a member of numerous other scientific societies.

Prof. Werner was a prolific writer, having more than a hundred papers, including some voluminous works, to his credit, the list including not only papers on Amphibia and Reptilia, in which he was principally interested, but also titles on Orthoptera and scorpions. Interested at first in morphological problems, he became more and more devoted to faunal exploration and herpetological taxonomy as the years went by. He undertook many travels for the sake of such study, and made valuable contributions to our knowledge of the fauna of Greece and the Aegean Islands (1902, 1912, 1927, 1930, 1933, 1935, 1936, 1937), Algeria and Morocco (1914, 1929, 1931), Asia Minor

(1902, 1903, 1905, 1929), Persia (1903, 1917, 1929, 1936), South and West Africa (1902, 1913, 1915), Anglo-Egyptian Sudan (1914, 1919, 1924), Guatemala (1903), the Andes (1916), China (1903, 1924), etc. His contributions on Chamaeleontidae (1911), Eublepharidae, Uroplatidae, Pygopodidae (1912) and Reptilia Loricata (1933) in "Das Tierreich"; on Amphibia and Reptilia in Brehm's "Tierleben" (1913); and on Amphibia (excluding Anura) in Kükenthal's "Handbuch der Zoologie" (1930-31) are models of deep learning and lucid expression, and will make him familiar to younger generations of herpetologists even when the charm of his personality is long forgotten.

He was a patient, enthusiastic and indefatigable worker for herpetology. B. C. MAHENDRA.

Dr. E. H. Hankin

THE death on March 29 of Ernest Hanbury Hankin at the age of seventy-four years removes one who in the early days of the development of bacteriology did much to forward its practical applications. The son of a clergyman, he was educated at Merchant Taylors' School, at University College, London, and at St. John's College, Cambridge, of which he was a scholar and later a fellow, obtaining the M.A. and Sc.D. degrees. He also studied at St. Bartholomew's Hospital for a time, but did not proceed to a medical qualification, and worked in Koch's laboratory in Berlin and in the Pasteur Institute, Paris. He then accepted an appointment as chemical examiner, analyst and bacteriologist to the North-West Provinces and Oudh, India, and spent his professional

life at Agra. Dr. Hankin's earlier researches before proceeding to India were mainly concerned with the germicidal action of proteins of blood-serum and of cells, so-called 'alexins', upon which he published several papers in the *Proceedings of the Royal Society*, *Journal of Pathology and Bacteriology* and *Centralblatt für Bakteriologie*.

In India, Hankin soon took up the study of cholera, isolated the cholera vibrio from contaminated well- and river-water, and so early as 1894 insisted that the disease was a microbial one and not a 'miasm'. He studied methods for destroying microbes, particularly the cholera vibrio, in the contaminated water of wells, first by means of excess of lime, and afterwards with permanganate of potash, and his method of "pinking" wells continued in use until the introduction of chlorination. In connexion with cholera, he noted that the waters of the Jumna and Ganges possessed a natural germicidal action upon the vibrio, which was not removed by filtration but was destroyed by boiling, but in spite of much work on the subject, he was unable to discover the nature of the germicidal agent. This was not elucidated until many years later through the work of Twort and of d'Hérelle upon the filterable lytic agent that destroys bacteria, the bacteriophage. Hankin also published several papers dealing with plague, the plague bacillus, and the relation of insects and rats to its spread.

Besides his bacteriological work, Dr. Hankin's other pursuits included observations upon the problems of flight, studied mathematically, experimentally with kites, and by observations on the flight of birds, which were embodied in a small work "Animal Flight". He also published "Methods of Design in Mahomedan Art", an analysis of geometric patterns, especially of those that adorn the Taj Mahal.

R. T. HEWLETT.

Prof. Ettore Pais

WE regret to record the death of Prof. Ettore Pais which took place recently in Rome at the age of eighty-three years. Prof. Pais was a historian of international reputation, widely known as one of the foremost authorities on the history, laws and customs of ancient Rome and the early history of the peoples of the Italian peninsula generally.

Ettore Pais was born in 1856 and educated at the University of Florence, afterwards studying under Mommsen in Berlin. His first appointment on his return to Italy was as curator of the museum at Cagliari. Afterwards he occupied the chair of ancient history in the University of Palermo. In 1906 he was appointed to the University of Rome, after holding professorial chairs at Pisa and Naples. In Rome the researches in archaeology and the early history of Roman rule, which he had initiated when in Sardinia, Sicily and southern Italy in his earlier years, came to full fruition. During his twenty-five years tenure of his chair, his lectures and writings on the epigraphy, antiquities and prehistory of Italy and on the history of Rome up to the Punic wars came to be recognized as of standard authority, more

especially for the insight displayed in his brilliant interpretations of the results of the excavations of Roman and Etruscan antiquities.

Among the honours which Pais received were honorary doctorates of the Universities of Oxford, Paris and Chicago, membership of the Institut de France, and in 1922 elevation to the rank of senator.

Miss Ella C. Sykes

WE regret to record the death of Miss Ella Constance Sykes, which took place in London on March 23. Miss Sykes, who was educated at Lady Margaret Hall, Oxford, had been secretary of the Royal Asiatic Society (1920-26), and was a member of the Royal Geographical and Central Asian Societies, at whose meetings she was well known as a traveller with first-hand and intimate knowledge of the land and peoples of Persia in the earlier years of the century. She accompanied her brother, Major (afterwards Brigadier-General Sir) Percy Molesworth Sykes, on journeys of geographical and archaeological interest, made when he was seconded from the British Army in India to the consular service and was Consul-General in Kerman. On one occasion she and her brother rode on horseback from the Caspian to India, and in 1915 they travelled together in Chinese Turkestan and the Pamirs. Her experiences in Persia were embodied in "Through Persia on a Side-saddle" and in "Persia and her People". She was also joint author with her brother of "Through Deserts and Oases of Central Asia". Miss Sykes visited Canada to investigate the question of the employment of educated women there on behalf of the Colonial Intelligence League. "A Home-Help in Canada" records her experiences.

WE regret to announce the following deaths:

Dr. J. Anderson, formerly lecturer in bee-keeping in the North of Scotland College of Agriculture, aged sixty-six years.

Prof. W. Cramp, professor of engineering in the University of Birmingham, on April 20, aged sixty-three years.

Mr. E. W. Fraser-Smith, secretary and treasurer of the North East Coast Institution of Engineers and Shipbuilders since 1911, on April 5.

Mr. H. J. George, University lecturer in chemistry in the University of Oxford, on April 19.

Prof. F. N. Guild, emeritus professor of geology and mineralogy in the University of Arizona, on March 12, aged sixty-eight years.

Captain H. M. S. Laidlaw, known for his work on hydrography and in re-surveying small islands in the South Seas, on April 16, aged fifty-two years.

The Rev. W. J. O'Leary, S.J., director of River-view Observatory since 1929, known for his work in seismology and astronomy, aged seventy years.

Sir William Ramsay, emeritus professor of humanity in the University of Aberdeen, formerly professor of classical archaeology and art in the University of Oxford, on April 20, aged eighty-eight years.

News and Views

Sale of Food and Drugs

THE annual report of the Ministry of Health for 1937-1938 contains some very interesting information relating to the results of the examination of samples of food and drugs by public analysts in England and Wales. In all, 151,370 samples of food and drugs were examined, and of these the surprisingly high number of 8,401 or 5 per cent were reported against. The distribution of the adulteration among the counties and towns is amusing, but the differences in sampling probably makes the comparison of the different areas inconclusive. Oxfordshire and West Suffolk lead the English counties with 24.2 and 25.8 per cent of adulterated samples respectively, and the city of Oxford does little to redeem this with 12.5 per cent, which is high among the boroughs. These figures may well be compared with 8.4 per cent in Cambridgeshire and 5.1 per cent in Cambridge itself. The metropolitan boroughs show a quite low rate of adulteration, the worst being Shoreditch, with 11.1 per cent.

Of the common foodstuffs, 7 per cent of the samples of milk were unsatisfactory, one even containing formaldehyde, an adulterant also found in two samples of cream. Some remarkable cheeses have been exposed for sale; one, a cooking cheese, consisted practically of crude casein and water, and others sold under fancy names were found to be made of fat not derived from milk at all! The unsatisfactory jams and marmalades showed among other things the presence of pieces of glass, and other samples were deficient in fruit or soluble solids. Many samples of canned fish were contaminated with lead or tin, and the latter metal was also found in tinned fruits, vegetables and soups. A number of samples of beer were found also to contain lead, but the most remarkable beverage was a 'non-alcoholic' raisin wine, which yielded 17 per cent of alcohol. The chief errors found in the drugs examined were of the nature of deficiencies, namely, tinctures of iodine without sufficient iodine or potassium iodide, and mercurial ointments without, in one instance, any mercury.

Exhibition of Archaeological Finds from Afghanistan

AN exhibition of antiquities of both archaeological and artistic interest from the Swat Valley and Afghanistan in the Indian Section of the Victoria and Albert Museum, South Kensington, opened on April 25. These antiquities are the material results of an archaeological expedition to the Swat Valley and Trans-Oxiana in 1938, which was supported by the Museum and the Royal Geographical Society, and was led by Mr. Evert Barger. An account of the expedition was given by Mr. Barger before the Royal Society of Arts on November 30 (see *NATURE*, 142, 1029, 1046; 1938). The object of the expedition,

as was then stated, was to study the development of the Græco-Buddhist art which flourished in these regions from the first century B.C. until the fifth century of our era. The importance of this investigation lies in the fact that it followed up the route by which Indian cultural influence penetrated to central Asia and eventually to China; but although the Swat Valley had been visited by Sir Aurel Stein in 1926 no excavations had been carried out previously. The finds now exhibited reveal a remarkable local hybrid culture, caused by the meeting of Græco-Roman and Indian influences. Especially notable are a large number of very fine carvings in grey schist, illustrating scenes in the life of Buddha. An outstanding specimen is a seated Buddha, of which the drapery and head-dress are markedly Greek. This came from Amaluk, a ruined monastery in the hills, 4,000 ft. above the valley. Another carving shows Buddha being asked to preach the law. Several small plaster heads of Buddhas and Bodhisattvas, and specimens of ironwork, including door-hinges and a monastery bell, come from Swat. In the region across the Oxus, the ancient Bactria, no excavations were made; but coins, seals and fragments of pottery, found on the sites of ancient cities, are shown. Little is known of the ceramics of this area. Three Hellenistic column bases of stone, seen and photographed at Kunduz, are the first Greek structural remains to be found in Afghanistan and constitute the expedition's most important discovery.

Cultural Contacts with India

It may be recalled that at the meeting of the Royal Society of Arts at which Mr. Barger described the results of his archaeological investigations of the evidences the spread of Indian cultural influence to the Oxus and beyond, when Lord Zetland, Secretary of State for India, was in the chair, attention was directed in the discussion which followed to the importance of the study in Britain of the culture and archaeology of India as an influence making for closer contact between Great Britain and India. Lord Zetland, when presiding at the twenty-ninth annual meeting of the India Society at Burlington House on April 24, took advantage of the occasion again to emphasize the importance of such cultural contacts. Pointing out that politics was not the only link between Great Britain and India, he referred to the invitation which he himself had tendered to Sir Leonard Woolley, when Lord Linlithgow, as Viceroy, had intimated that he would welcome the visit to India of an archaeologist of world-wide distinction. This intimation was evidence of the interest taken by the Viceroy in the archaeological problems of India. In the result Sir Leonard Woolley had produced a report of the highest interest, which contained suggestions for the future work of the Archaeological Department. Lord Zetland went on to say that

although we were living in times of financial stress, when it was impossible to devote as much money as could be wished to work of this character, he was not without hope that the outcome of Sir Leonard's visit would be greatly to the advantage of the cause of Indian archaeological exploration and research. His concluding remarks were especially noteworthy: "As a people", he said, "we should surely stand condemned if, when judgment was passed on us at the bar of history, it should be said of us that we had neglected in our long contact with India those cultural values, which alone raised man above the level of the animal world and were an index of his achievement in the domain of the spirit."

Neanderthal Man in Central Asia

AN announcement of a discovery in the Uzbek republic of the U.S.S.R. of very considerable interest is announced by the Russia To-day Press Service. The skeleton and other traces of man of palaeolithic age have been found in a cave some twelve miles north-west of the town of Baisun. Stone implements found on the site are said to fix the date of the stratum, in which the discovery was made, as late Mousterian. Prof. Gerasimov, the well-known Russian archaeologist, has succeeded in restoring the skull, and a commission has been appointed, which will make a special study of the reconstructed relic. These remains are the first indisputable signs of palaeolithic man to be found in central Asia, and previously no traces of the Mousterian culture had been known to occur there. The skull, it is stated, was found lying under a single stratum, close to the wall of the cave, while the remainder of the skeleton lay scattered beside it. The remains are those of a child of about eight years of age; and as it is in a fair state of preservation, it is possible to decide that it differs markedly in structure from the human skeleton of to-day. The contour of the skull, particularly, is said to recall that of the anthropoid ape—a statement which, at first sight, seems to conflict with the further comment that it is said to refute the racial theory that present-day man developed independently of Neanderthal man. The trend of recent discovery, it may be pointed out, would certainly not necessarily be widely at variance with modernistic tendencies in a skull of such a facies, but until further details are to hand judgment one way or the other is obviously premature.

Introduction of Screw Propulsion

At a meeting of the Newcomen Society held at the Science Museum on April 19, in a paper entitled "The First Twenty Years of Screw Propulsion 1838-58", Engineer Captain E. C. Smith gave some interesting information regarding the early inventors of screw propellers, Sir Francis Pettit Smith, John Ericsson, George Lowe, George Blaxland and Bennet Woodcroft, whose names were most closely associated in the minds of their contemporaries with the early trials of sea-going screw-driven vessels and the adoption of the screw-propeller on a wide scale. It was appropriate, Capt. Smith said, that the subject

should be dealt with at a meeting at the Science Museum, for Bennet Woodcroft was the virtual founder of that institution, while Smith was for some fourteen years the curator under Woodcroft. Both these pioneers were buried in Brompton Cemetery, and their tombstones mention their participation in the introduction of the screw. Ericsson's work began with his patent of July 1836, the building of the little *Francois B. Ogden* and then the slightly larger *Robert F. Stockton*. Soon after the trials of the latter in the Thames in 1839, she was sailed to America; Ericsson soon followed her and it was in the United States that his main work in connexion with screw propulsion was done, his most notable vessel being the U.S.S. *Princeton*, built in 1841-43. She was the first screw-driven warship ever launched. By 1850, about a hundred and fifty American vessels had been fitted with the screw. The most important work in England was done by Smith, but of this Capt. Smith is to deal with in a future paper. In an appendix to the paper prepared by Dr. H. W. Dickinson, Mr. A. A. Gomme and Mr. E. W. White, a review was given of the various law cases which arose out of the patents and over which a vast amount of time, energy and money were wasted.

Acquisitions at the British Museum (Natural History)

THE trustees of the Museum have purchased for the Department of Geology the terminal section of a tail-sheath of an extinct giant armadillo (*Hoplophorus* sp.) discovered in the Pleistocene deposits of Santa Fé, Argentine. The giant armadillos had a solid bony shell and armour of the same type on the head and tail. When danger threatened, they withdrew their limbs into the shell, closed the head end by means of the bony casque, and lashed the club-like tail from side to side so as to ward off attack from the rear. Some genera had massive horny spikes on the end of the tail, but in *Hoplophorus* the tail was covered with scales. The Department of Mineralogy has acquired a superb specimen of cheerylite from Tsumeb in South-West Africa, and an extremely beautiful specimen with bright yellow plates of wulfenite (lead molybdate) on a glistening white ground of calcite crystals from Arizona. The Department has also purchased from the widow of the late Dr. A. E. H. Tutton a collection of the salts, chiefly double sulphates and selenates of the alkalis (potassium, rubidium, caesium, etc.), utilized by Dr. Tutton in his researches on the relation between physical properties and chemical composition in isomorphous series of compounds. An important addition to the departmental library is a first edition of the "Speculum Lapidum" by Camillus Leonardus, physician to Caesar Borgia, to whom the book is dedicated. It is a fine example of the printing press of Sessa in Venice. The book was one of the most widely read 'lapidaries' of the time, and its editions ran from the first in Latin in 1502 (forty-four years before Agricola's "De Natura Fossilium") to an English edition in 1750, bridging the gap between medieval and modern mineralogy. The late Frederick Adams of Jersey has bequeathed to the Department

of Botany a collection of 23,000 microscope slides of diatoms, together with catalogues, books and pamphlets, and the microscope with which he worked. For many years past Mr. Adams acquired whatever diatom collections came on the market, and thus accumulated the largest collection in private hands.

British Museum Excavations in Northern Syria

SOME further details of finds of the British Museum archaeological expeditions to northern Syria under Sir Leonard Woolley and Mr. M. E. L. Mallowan in 1938 are given in the official summaries (*Brit. Museum Quarterly*, 13, 1; 1939). The most important objects found within the palace at Atchana, in the opinion of Sir Leonard Woolley, are the clay tablets inscribed in cuneiform in the Akkadian language, from which it has been possible to learn not only the name of the place—Alalakh—but also the names of several of its rulers. One of these was contemporary with Saushtatar, a king of Mitanni, already known as a leading potentate in western Asia in the middle of the fifteenth century B.C. Among the small objects the most interesting is a steatite roundel engraved on both surfaces with formal patterns surrounding a middle ring, which encloses characters of the Hittite hieroglyphic writing. At Tall Brak Mr. Mallowan found the great palace to be a building of Naram Sin of Agade, bricks being stamped with his name, and tablets being found of the Agade period of about 2500 B.C. The south-west corner of the palace proved to be built over the ruins of a great mud-brick tower, probably part of a temple, belonging to the Ismet Nisar period, more than five hundred years earlier. It rested on a clay platform, under which was buried a great number of votive objects. Most of them were in underground chambers, which had been visited by robbers in antiquity. Apart from a large collection of beads, there were many amulets of two principal kinds, the first being stamp seals in the form of animals, or animal heads, and secondly little stone 'idols' found in large numbers, which though classed as amulets, are of unknown significance. They vary little in style; but some show as many as three pairs of eyes side by side, while one or two seem to portray mother and child. Many sherds of prehistoric painted ware were found, especially of the Tell Halaf style.

Recent Earthquakes

AN earthquake giving rise to large amplitudes on seismograms is reported by European observatories to have taken place on April 18, the initial waves being received about 6h. 36m. G.C.T. and the tremors lasting about three hours. The shock was well recorded at Stonyhurst, near Blackburn; at Kew, where it was received at 36m. 22s.; at Uccle, where it was received at 36m. 31s.; and at Zurich, where it was received at 36m. 18s. A very prominent feature of the seismograms at the latter three observatories was the *S_pP_sS* or *SKS* wave, which is a pulse starting at the epicentre as a transverse wave, being transformed at the earth's core to a longitudinal wave, continuing thus to the other side of the core

where it is again changed back to a transverse wave. It is received as a transverse wave at the observatory. The epicentral distance of the shock from Uccle is calculated from the arrival times of the various pulses to be approximately 105°, which is consonant with an epicentre in Chile, though the azimuth has been difficult to determine, and confirmation or otherwise is awaited from the American observatories.

Two earth tremors are reported from Barbados to have been felt about 1.45 p.m. on April 20. At St. Kitts, several shocks were felt, though no damage is reported from the vicinity of either area. Tremors in the West Indies are by no means uncommon, and it will be recalled that the earthquake swarm which occurred in 1934 and 1935 in Montserrat led to the dispatch of an expedition to that island, and to consequent valuable reports by Mr. A. G. Macgregor and Dr. C. F. Powell. In September 1938 the Wiechert seismograph and eight Jagger shock recorders set up at the time of the expedition were still in operation on the island under the care of Mr. Kelsick. Then from August until November 1937 about forty shocks were reported from Dominica. The Royal Society afterwards nominated a West Indies Seismological Committee, which contemplated sending an expedition to this latter island. The shocks, however, diminished in frequency, and it is now wondered whether or not the centre of seismic activity in the islands has again changed.

Long-Distance Automatic Telephony

AS improvements were made in manually operated switchboards, the trend of telephony has always been to substitute automatic devices for human labour. So much progress was made in this direction that it soon became obvious that even in large cities it would be possible to eliminate almost all the operators by the substitution of electrically controlled machinery. In the *Revue Générale de l'Electricité* of March 11, M. R. Dreyfus discusses the prospects of long-distance automatic telephony and points out that in small countries like Switzerland and Holland automatic inter-urban working is already in process of realization. It has now been developed to the extent of eliminating the operator at the exchange of the subscriber initiating a trunk call. By simply using his dial the subscriber puts himself in touch with any other subscriber in the same country. M. Dreyfus thinks it quite likely that automatic operation will now be developed for international calls. The International Consulting Committee for Long Distance Telephone Communication (the C.C.I.T.), which was formed by international delegates at a conference in Paris in 1923, has now taken up the problem. It is stated that within a few years a subscriber in Paris will be able merely by dialling to put himself through to a subscriber in New York.

Factory Lighting

THE spinning and twisting of real silk threads for the hosiery and silk weaving trade involves the processing of threads as small as two-thousandths of an

inch in diameter. The throwsters, that is, the operators who twist silk fibres into raw silk or raw silk into thread, find that they can work much better and much more quickly when the threads are brilliantly illuminated by the light from electric discharge lamps. To avoid eye strain, the Factories Act which came into force in July 1938 has emphasized the necessity for adequate lighting in such cases. We learn from an article on factory lighting which appeared in the *Electrician* of March 24, that G. H. Heath and Co. of Macclesfield and an associated company, British Crepe, Ltd., said to be the largest firm of silk throwsters in Great Britain, after experimenting with many kinds of lighting, have recently adopted as standard throughout their factories the electric discharge lamps made by Siemens Electric Lamps and Supplies, Ltd., with very successful results. In one case a room at the factory was lighted by discharge lamps consuming a total of 4.7 kw. and giving approximately 13-15 foot candles, whereas with gas-filled electric lamps the same room would have required 14.5 kw., that is, more than three times as much, and would only have given a lighting intensity of 7-8 foot candles. The sizes of the Siemens "QH" lamps installed are 80 w. and 125 w., according to the size and height of the rooms. The economy effected in running costs is very noticeable.

Compulsory Illumination in Factories

In a special leaflet (Form 282) dated March 1939, the Factory Department of the Home Office reminds the owners of factories that the Departmental Committee appointed to deal with the subject has issued its fourth report (H.M. Stationery Office. 1s. 1d.) It recommends certain minimum standards of illumination below which work in factories should not be done regularly, and further recommends that these standards should be made legally compulsory next July. Tables of lighting practice suitable for many industrial processes can be obtained from the Illuminating Engineering Society, 32 Victoria Street, S.W.1. Another similar table is issued by the Electric Lamp Manufacturers Association, at Savoy Hill, W.C.1. The Secretary of State directs attention to a memorandum of the Air Raid Precautions Department, dealing with a general scheme of lighting restrictions to be enforced in the event of war. Occupiers of factories are recommended to obtain and study this memorandum, but naturally it deals more particularly with the screening of windows and roof lights in order to prevent the emission of light from buildings. It is in no way inconsistent with the requirement of adequate and suitable lighting within the building. Information and advice on general lines are usually obtainable from the gas or electricity undertaking supplying the factory.

Progress in Horticultural Science

VOL. 7 of *Scientific Horticulture*, the journal of the Horticultural Education Association (from the Hon. Editor, Mr. R. T. Pearl, S.E. Agric. Coll., Wye, Kent. 4s. net.; 4s. 6d. by post, February 1939)

contains a well-balanced collection of papers for gardeners, both practical and professional. There are papers upon commercial horticulture in Eire, Devon, Lancashire and Bedfordshire, and articles upon the practical control of slugs by the use of 'Meta fuel', by S. G. Jary, and the horticultural work of the Land Settlement Association, by H. Fairbank. Messrs. H. G. H. Kearns and H. Martin contribute an account of the physical properties and practical use of combined insecticidal and fungicidal washes for use upon expanded blossom and foliage. They conclude that oil emulsions afford the most promising basis for combined direct and protective sprays, and practical instructions are given for their use upon various tree fruits and soft fruits. Interesting possibilities of the controlled nutrition of horticultural crops by growth in nutrient solutions are envisaged by Messrs. S. R. Mullard and R. H. Stoughton. Though the huge increases in yield claimed for the method in California were not realized in England, growth of gladioli was superior to that from soil-grown corms. Lela V. Barton summarizes the work of the Boyce-Thompson Institute, New York, upon germination and dormancy in seeds. Effective pre-treatments for dormant seeds and for the after-ripening of certain species, are condensed into three tables of great practical utility. Epicoity dormancy, where the radicle begins growth but not the plumule, can be broken by keeping rooted seeds at a cool temperature, usually between 40° and 50° F. for a few weeks. A series of papers by members of the staff of the East Malling Research Station, or the occasion of the Association's annual conference in September 1938, is also included in the volume.

Radio Meteorology in the United States

THE growth of aviation has resulted in an urgent and intensive demand for accurate weather forecasting not only at ground-level but also at all heights now utilized by aircraft. Methods previously employed for determining aerological data in the atmosphere have utilized kites, sounding balloons or aeroplanes to carry special instruments recording the temperature, pressure and humidity at various altitudes. A mimeographed report entitled "The Radio-Telemeter and its Importance to Aviation", by R. W. Knight has recently been circulated by the U.S. Civil Aeronautics Authority. This report discusses the general problem of determining aerological data by radio sounding balloons, to which are attached transmitters emitting signals carrying the indications of the meteorological instruments. A somewhat detailed description is then given of the apparatus developed for this purpose by the Blue Hill Observatory of Harvard University. Illustrations are given of the complete radio transmitter, with the associated instruments for determining temperature, pressure and humidity. At the ground station, the signals are received on a simple pen-writing recorder, from which the aerological information can be observed while the balloon flight is in progress. A specimen record indicates that heights up to 72,000 ft. (14 miles) can be obtained by this type of apparatus. The U.S.

authorities maintain a network of teletypewriter communication facilities for disseminating the weather data to other meteorological stations, while radio broadcasting is used for the benefit of airmen. Plans are in hand for extending to other parts of the United States this application of radio methods to aerological observations.

Value of an Auxiliary Language

A PAPER by M. Talmey on the auxiliary language question, in which the value of an auxiliary language as an agency for world peace is discussed, has been reprinted from the *Modern Language Journal* of December 1938. Dr. Talmey discusses the basic requirements of an auxiliary language, particularly the importance of being more expressive than the natural languages and strictly neutral. It must also be as suitable for the expression of all ideas as the most efficient natural languages are. He discusses the development of Esperanto in the United States and the reasons for its failure, and then describes the origin and development of a new international system known as 'Arulo' or 'Gloro', which aims at removing the ambiguity which characterizes most modern languages. In this system the main parts of speech are recognisable by characteristic endings, of which there are eighteen, six occurring very rarely. He suggests that the fitness of a language for translation is the best criterion of its efficiency.

The School Health Services

A BOOKLET entitled "The School Health Services: their Initiation, Growth and Character" has been issued by the National Union of Teachers, Hamilton House, Mabledon Place, London, W.C.1. It is a review by the Union designed to show how the school health services came into being, how they have developed, and what part the National Union has taken in their initiation, conduct and progress. Provision of meals, medical and dental inspection and treatment, physical education and school camps are some of the subjects dealt with, and finally recommendations are put forward which it is considered would improve the services. The memorandum is primarily intended for the information of members of the Union, but has been issued to the public in the hope that it may prove of use to those concerned with the health and fitness of the children of the nation.

Oxford Science

THE second quarterly issue of this publication maintains the high standard and interest of the first number. There are two articles on the teaching of chemistry at Oxford, one by an undergraduate, the other by Dr. J. H. Wolfenden, the former deliberately critical and even fault-finding, the latter an admirable exposition and defence of the unique system of training that has been in force at Oxford during the past seventeen years. The possibilities of science as an education are discussed by Dr. J. Z. Young. He advocates means of making scientific courses more

valuable as a part of general education so that whoever takes them may in some sense be educated and not, as too often at present, merely filled with plain facts. There are two articles on popular lines. Dr. A. H. Cooke of the Clarendon Laboratory gives a short account of the technique used there in attaining low temperatures and discusses briefly the more important results that have been obtained; Prof. J. H. Burn discusses the phrase 'suffering from blood-pressure' in a paper which will be read with interest by all and with relief by some. In "Correspondence" the Nuffield professor of clinical medicine criticizes some of the suggestions about the medical curriculum made by one of the medical tutors in an article in the first issue. There are also reviews of scientific books and short accounts of the activities of the scientific and medical undergraduate societies.

History of Cholera in Poland

In his inaugural thesis (*Thèse de Paris*, 1938, No. 739) Dr. Kac Hirs, a native of Warsaw, gives an interesting account of the history of cholera in his country, in which there were six epidemics of the disease between 1831 and 1902, the last of which persisted until 1915. The study of cholera epidemics in Poland as in the rest of Europe shows that they start in the East and then follow as a rule one of two routes, namely, (1) by land, passing through Astrakhan and Russia, or (2) by sea, when they are conveyed by pilgrims coming from Mecca who had landed at Odessa. Since the first epidemic in 1831 all the countries in Western Europe have taken a lively interest in the behaviour of cholera in Poland and have actively collaborated with the Government of that country in a campaign against the disease.

Progress in Photochemistry

THE third report of the Committee on Photochemistry (Reprint and Circular Series of the National Research Council, No. 108, July 1938) contains eleven review articles dealing with various aspects of recent photochemical research written by seven different authors. Each is provided with a bibliography. There is a long table of quantum yields which gives a very useful review of this part of the subject. The report strikes a good balance between theory and experimental methods.

Large Sunspots

Two new large groups of sunspots have recently appeared. Particulars from the Royal Observatory, Greenwich, are as follows, the areas being measured on April 21 and expressed in millionths of the sun's visible hemisphere.

Date on Disk	Central Meridian		
	Passage U.T.	Latitude	Area
April 20-May 2	April 20.1	27° N.	1060
April 20-May 2	April 20.6	16° S.	1350

Chromospheric activity in the region of the first group was noted on April 21, an extensive bright eruption beginning at 9^h 3^m and lasting for about half an hour.

The Night Sky in May

THE duration of night (sunset to sunrise) on May 1 in the latitude of London is 9.3 hours, decreasing to 7.8 by June 1. The moon is full on May 3 at 15.3^h, and new on May 19 at 4.4^h. A total eclipse of the moon, invisible from Great Britain, occurs on May 3. On May 5, the bright star β Scorpii (mag. 2.9) is occulted by the moon, the disappearance as seen from Greenwich taking place at 3^h 34.5^m at position angle 164° from the north point. Lunar conjunctions with the planets occur as follows: on May 9^d 10^h with Mars; on May 14^d 23^h with Jupiter; on May 16^d 21^h with both Venus and Saturn; on May 17^d 14^h with Mercury. Venus, Jupiter and Saturn are morning stars. Mars rises about an hour after midnight at the beginning of the month and just before midnight at the end. Mercury is not visible either as a morning or evening star. On May 12 at about 3^h 45^m it is worth looking at Jupiter when satellites I, II and IV present a curious arrangement on the east side of the planet. A corrected ephemeris for Comet Pons Winnecke (1939 c) is given in I.A.U. Circular No. 758. On May 17, the ephemeris places the comet 6° greater in declination than the star β Boötis. No ephemeris is available here for the bright comet, Comet Haase, discovered on April 18 in the constellation of Andromeda. Solar activity is sufficiently high to warrant a look-out to be kept for auroras. (All times are given in Universal Time; add 1^h to convert to Summer Time.)

Announcements

THE first superintendent of the new Engineering Research Establishment in Australia (see p. 697) is Mr. L. P. Coombes, formerly senior scientific assistant of the Royal Aircraft Establishment, Farnborough, where he was in charge of the aeroplane experimental tank.

PROF. GUSTAVE ROUSSY, professor of pathological anatomy in the University of Paris, has been elected a free academician of the Paris Academy of Sciences in succession to the late Paul Halbrönnner.

THE Makdougall-Brisbane Prize of the Royal Society of Edinburgh for the period 1934-1938 has been awarded to Prof. D. M. S. Watson, for his paper published in the *Transactions* of the Society, within the period, entitled "On *Rhamphodopsis*, a Ptyctodont from the Middle Old Red Sandstone of Scotland", and for his many distinguished contributions to the science of vertebrate paleontology.

THE International Congress of the Latin Federation of Eugenics will be held at Bucharest next September under the presidency of Prof. C. Parhon, when the subjects for discussion, among others, will be: (1) prophylaxis of hereditary diseases, (2) heredity and liability to infections, (3) inheritance of intellectual aptitudes, and (4) heredity and endocrinology.

THE annual Congress of the Royal Institute of Public Health and Hygiene will be held at Hastings

on May 23-27 under the presidency of the Right Hon. Walter Elliot, Minister of Health. The Congress will consist of five sections, in which the following subjects will be discussed: Section I, State medicine and industrial hygiene; Section II, women and children and the public health; Section III, tuberculosis; Section IV, rheumatism and allied diseases; Section V, nutrition and physical education.

FARMERS and all interested in agriculture in its practical, technical, or educational aspects are invited to visit the Rothamsted and Woburn plots at any convenient time between the beginning of May and the end of October. Mr. H. V. Garner and Capt. E. H. Gregory will be in charge of the demonstrations. There is ample material at each farm to occupy a full day, and therefore visitors should arrange to see them on separate days. The director, Sir John Russell, will be happy to arrange full details with organizations of farmers, farm workers and others wishing to accept this invitation; small groups of farmers are specially welcomed. Further information can be obtained from the Secretary, Rothamsted Experimental Station, Harpenden.

A NATIONAL conference on Maternity and Child Welfare will be held at the British Medical Association House, Tavistock Square, W.C.1, on June 27-29 under the presidency of Mr. Walter Elliott, the Minister of Health, when the following subjects will be discussed: safety in childbirth for mother and child; encouragement of breast-feeding; the nursery school, nursery class and the day nursery; the child in relation to foster mother and the daily minder; parents with a physically defective child, and propaganda on the maternity and child welfare movement. Further information can be obtained from the Secretary, National Association of Maternity and Child Welfare Centres, Carnegie House, Piccadilly, W.1.

WE have received an annotated catalogue of works on chemistry, pure and applied, No. 857, from Messrs. Henry Sotherton, Ltd., 2-5 Sackville Street, London, W.1. This contains a large number of interesting items, and in most cases each work has a note of bibliographical, biographical or scientific interest. The catalogue is one of considerable interest and is valuable for the large amount of accurate information it contains.

RECENT statistics show that infantile mortality in Germany, though continually falling, is greater than that in some other countries including the United States.

WE regret that in the issue of NATURE of February 25, p. 329, it was stated incorrectly that Prof. Helmuth Scheel had been appointed president and Prof. Theodor Vahlen vice-president of the Prussian Academy of Sciences; Prof. Vahlen has been appointed president and Prof. Heymann vice-president, with Prof. Scheel as director of the Academy.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 727.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Surface Transport in Liquid Helium II

IN our previous communications¹ on the 'transfer' of liquid helium II by a surface film above the liquid level, we stressed the similarity of this 'transfer' with the so-called transport phenomena in the free liquid, and suggested that the latter might be due to a process similar to the transfer above the liquid level. Later experiments on the formation of this film² seemed further to strengthen the conception that there existed a similar surface transport below the liquid level, and we have recently made two observations which seem to corroborate this hypothesis:

(a) A small Dewar vessel (see Fig. 1) containing a heating coil was suspended by a thread in a bath of liquid helium II. When no heat was supplied, the levels of the liquid both inside and outside the vessel adjusted themselves to the same height L_1 , owing to the 'transfer' through the film on the interconnecting glass surface. When, however, a current was passed through the heating coil, the level of the liquid inside the vessel rose above the outside level and took up an equilibrium position L_2 . By increasing the connecting surface between the vessel and bath by a number of wires, differences between inside and outside levels up to 5 mm. could be obtained. This clearly shows that there exists a 'transfer' of helium from a colder to a hotter place when a temperature

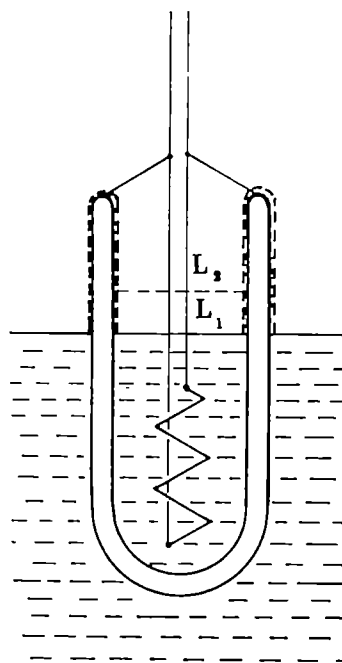


Fig. 1.

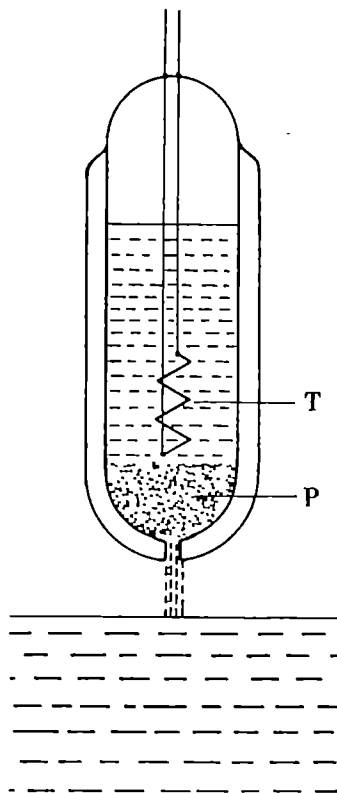


Fig. 2.

gradient is imposed. On further increasing the heat supplied, however, the evaporation from the vessel became the predominant factor and the inside level fell below that of the bath.

This effect is quite analogous to the 'fountain phenomenon' in the bulk liquid, discovered by Allen and Jones³. However, in the present case the transfer of liquid must be carried out through the surface film above the liquid level, which shows that there exists a flow of helium against a temperature gradient, even if the two containers are not connected by free liquid. One may conclude therefore that the 'fountain phenomenon' in the bulk liquid is probably also due to a surface transfer, though in this case along the surface below the liquid level. This hypothesis is further strengthened by the fact that the 'fountain phenomenon' is more pronounced when tubes containing fine powder are used to connect the two volumes of liquid rather than a straight capillary, for which the available surface is comparatively small⁴.

(b) A Dewar vessel (see Fig. 2) was closed at the top and had a hole at the lower end which was constricted by a plug, *P*, of fine emery powder. It contained a phosphor-bronze thermometer, *T*, and was suspended in a bath of liquid helium II. When the Dewar vessel was lifted out of the bath, the liquid ran rapidly out of the vessel through *P* and fell into the bath, and at the same time the temperature of the inside liquid was noticed to rise by about 0.01° . On lowering the vessel so that now liquid ran from the bath into the vessel, the liquid inside was cooled by a similar amount.

This mechano-caloric effect is evidently the reverse of the 'fountain phenomenon', for whereas the latter means that the setting up of a temperature difference results in a flow of liquid helium II, the mechano-caloric effect shows that a flow of liquid helium II is accompanied by a development of heat (or cold). Such a caloric effect has actually been postulated by Tissa⁵ for a flow of liquid helium II through capillaries. It seems to us, however, that the anomalous phenomena of liquid helium II are not so much caused by capillary flow as by a transport along solid surfaces; and these results seem to indicate that the heat content of those atoms transported by surface flow must be lower than average. The hypothesis that the transport phenomena in the bulk liquid are due (at least primarily) to a surface transport similar to the 'transfer' above the liquid level seems also to agree with observations by Allen and Misener⁶ and H. London⁷, as well as with theoretical considerations of F. London⁸.

A more detailed discussion of this tentative explanation with regard to these and other results will be given elsewhere.

J. G. DAUNT.

K. MENDELSSOHN.

Clarendon Laboratory,
Oxford.
March 21.

¹ Daunt and Mendelssohn, *NATURE*, 141, 911; and 142, 475 (1938) and *Proc. Roy. Soc.*, in the Press.

² To be published shortly.

³ Allen and Jones, *NATURE*, 141, 243 (1938).

⁴ Allen and Roekle, *Proc. Camb. Phil. Soc.*, 35, 114 (1939).

⁵ Tissa, *NATURE*, 141, 913 (1938); *C.R.*, 207, 1180 (1938).

⁶ Allen and Misener, *NATURE*, 142, 643 (1938); see also Allen and Jones, *NATURE*, 143, 227 (1939).

⁷ London, H., *NATURE*, 142, 612 (1938).

⁸ London, F., *Phys. Rev.*, 54, 947 (1938).

A New Refraction Method for Obtaining Photographic Records of Concentration Gradients

WHEN a concentration gradient in a vertical column of solution, for example, an ultracentrifuge cell, is investigated by a refraction method, it is desirable to obtain a diagram relating the refractive index gradient with height in the column of solution. The two data, the height and the corresponding gradient, are in the different methods registered along the same vertical axis or along one vertical and one horizontal axis.

Using the scale method described by Lamm¹, which at the present time is far the most accurate procedure, we get the two data registered along the same vertical axis. This makes it necessary to compute the scale photographs before the shape of the curve and the exact positions of the maxima can be obtained. In the Toepler *Schlieren* method², where the two data are still registered along the same vertical axis, we can measure the positions of

the maxima directly on the plate, but only a rough estimation of the shape of the curve is possible. The method worked out by Philpot³ gives the height along a vertical axis and the gradient along a horizontal axis. The curve is in this case obtained as the boundary between dark and white on the plate. The shape of the curve may be seen directly on the plate, and the position of the maxima can be measured in a comparator. The method to be described in this communication gives the height along the horizontal axis and the gradient along the vertical axis. On the plate the curve appears as a rather narrow dark line (Fig. 1).

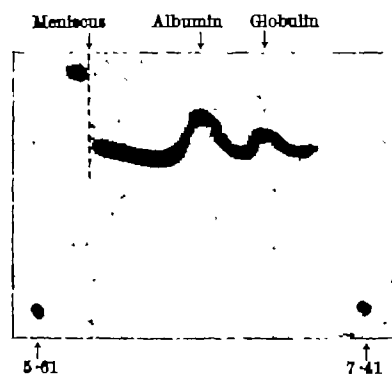


Fig. 1.

PHOTOGRAPHIC RECORD OF SEDIMENTATION IN DILUTE HORSE SERUM SHOWING THE ALBUMIN AND THE MAIN GLOBULIN COMPONENT.

Centrifugal force, 350,000 times gravity; time after reaching full speed, 50 min. Reference points and their distance (cm.) from axis of rotation are at foot of record.

Optical arrangements (Fig. 2). The light from a automobile head-lamp bulb with horizontal filament *A*, passes through a spherical lens, *B*, placed at its focal distance from the lamp, and a cylindrical lens *C*, with vertical axis, which concentrates the light on the centrifuge cell, *F*. *E* is a slit inclined at an angle to the vertical axis. The projection of the different points of the slit on a horizontal axis is focused on the photographic plate, *I*, by means of the cylindrical lens with vertical axis, *G*, and the spherical lens, *H*. Vertically the lens *H* still focuses the lamp *A* on to *I*. Conjugate foci are marked *a*, *a'* or *b*, *b'*.

If there is no deviation of light in the centrifuge cell, a horizontal straight line, *OX*, is obtained on the plate. The length, *X*, of this line corresponds to the cell-height, *h*, and the angle, θ , in the following manner:

$$X = h.m.\tan \theta, \quad (1)$$

where *m* is an enlarging factor equal to the ratio between the focal distances of the lenses *H* and *G*.

If light is deviated by an angle δ (Fig. 2) at certain height in the cell, the corresponding point of the line *OX* is displaced a distance *Z*, proportional to δ and the focal distance *f* of the lens *H*. We thus obtain the equation:

$$Z = f.\delta \quad (2)$$

The angle δ depends upon several conditions; for example, cell deformation, compression of the liquid sedimentation of low-molecular and high-molecular substances. In order to obtain the effect caused by the sedimentation of the high-molecular substance under investigation, two similar runs are made: the reference run, with pure solvent in the cell, as well

as the normal run. A diagram with the differences, Z_2 , between every two corresponding Z_1 -values as ordinate and the position in the cell as abscissa gives the desired curve. Z_2 , according to Lamm¹, is related to the cell thickness, a , and the refractive index gradient, dn/dx , as follows:

$$Z_2 = a \cdot f \cdot dn/dx \quad (3)$$

As the slit angle θ does not enter into equation 3, it is possible to alter the sensitivity by changing θ . When there is a small gradient, θ is also reduced and the ratio between ordinate and abscissa scales becomes larger. For a large gradient the image is made as broad as possible by making θ large.

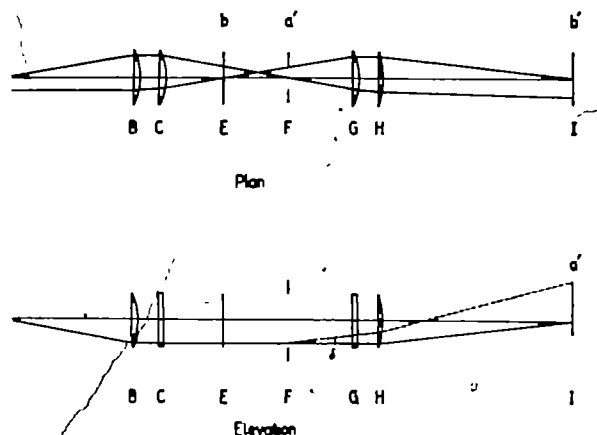


Fig. 2.

DIAGRAM OF OPTICAL ARRANGEMENT.

To obtain absolute Z_1 values, the position of the undeviated straight line OX must be recorded. In the ultracentrifuge practice this is easily arranged. The balancing cell in the rotor is provided with two index holes at distances from the axis of rotation that are smaller and greater respectively than that of the solution cell. The light passing the index holes is recorded on the plate as two points, called reference points (Fig. 1). For the calculations an enlarged image of the photograph is projected on to millimetre paper and a line is drawn in the middle of the curve. The position of the plate is adjusted to give the reference points at the same place on the millimetre paper in both the reference run and the normal run.

The optical arrangements are made in such a way that both the new method and the scale method can be used on the same run. The first use of the method has therefore been to get immediate information on the general shape of the sedimentation curve and for choosing scale distances in the scale exposures. In preliminary experiments the sedimentation constants and the concentrations of the sedimenting substances calculated according to the new method and the scale method have been found to agree satisfactorily.

In comparing this new procedure with Philpot's method there are two points worth considering. The fact that a line and not a boundary between dark and white is obtained on the photographic plate permits more exact recording of the sedimentation curve than is possible with Philpot's method. Quite recently this disadvantage in Philpot's method has been overcome by Svensson⁴. With his arrangement a line is obtained, but it is still an open question whether a modification gives enough light intensity for use in the ultracentrifuge.

Furthermore, the use of the reference points makes it possible to obtain with the aid of a reference run a well-defined base-line. On the other hand, the possibility of changing the sensitivity is more adequate in Philpot's method than in the new one.

A more detailed description of the method and its accuracy will in the near future be given elsewhere.

KJELL J. I. ANDERSSON.

Institute of Physical Chemistry,
University,
Uppsala.
March 13.

¹ Lamm, O., *S. phys. Chem.*, A, 126, 313 (1928); A, 143, 177 (1929).
Norsk Acta Regiae Societatis Scientiarum Upsalienis, Ser. IV, 10, No. 6 (1937).

² Thelander, A., Pedersen, K. O., and Eriksson-Quensel, I.-B., *NATURE*, 136, 546 (1937).

³ Philpot, J. St. L., *NATURE*, 141, 233 (1938).

⁴ Svensson, H., *Kolloid-S.*, in the Press.

Deposition of Protein Multilayers

SEVERAL workers^{1,2} have built up multilayers from proteins spread at the water-air interface, using some modification of Blodgett's technique³, and drying the wet slide between each dip. It has sometimes been assumed that this procedure deposits a monolayer of protein on the slide at each movement of the piston and that the thickness of the resultant multilayer is a simple multiple of the thickness of the surface film of the protein on water, also that this thickness is a measure of the lengths of the side chains in the protein.

The area and presumably also the mean thickness of a protein film are dependent upon the piston pressure employed. At 30 dynes the area is about half the area at 10 dynes, and multilayers which we have deposited at high pressure have shown interference colours when only 40 layers thick, indicating that an average thickness of about 20 Å. per layer can be obtained (see ref. 2) instead of the 10 Å. that has been obtained by some other workers¹.

Mitchell⁴ found that surface films of proteins go into solution readily and come out on clean portions of the surface if the pressure is near the collapse point. In his experiments, using the spreading technique of Gorter and Grendel⁵, he found collapse points between 7.5 and 15 dynes for various proteins. The same effect has been found with egg albumin spread from the dry powder on distilled water with piston pressures as low as 10 dynes, the lowest at which we have been able to build up multilayers.

The wet slide on withdrawal after dipping contains water between the two upper layers of protein, as can be demonstrated by measuring the potential. Deposition of stable multilayers can readily be achieved on gauzes both of stretched silk and of metals. Using a 'slide' of stretched silk in electrolytic contact with the trough at its lower edge, the potential was measured with an ionized air electrode at the exposed surface of the partly withdrawn slide, at the air-liquid surface in direct proximity to the slide, and at a remote part of the trough. In one experiment, at 17 dynes, the undisturbed egg albumin had a potential of 310 mv.; near the slide, where the albumin had presumably been stretched, the potential was 270 mv.; and on the upper edge of the wet slide, 210 mv. The low value indicates that the protein had been considerably stretched as it went on to the 'slide', but that it had approximately the same orientation as on the water surface. There is no reason to assume that the hydrophilic

groups have turned over and that the water adheres on top of the film; in fact a small bubble of water can often be moved about within its protein sack by tilting the slide. If protein has dissolved in the substrate, some will be in solution in the water on the slide and will remain after drying, contributing to the mean thickness of the protein in the multilayer. This factor will contribute a large error if the dissolved protein is adsorbed beneath the surface layer.

The deposition ratio (the decrease in water surface covered by the protein divided by the area of the slide covered) was measured with egg albumin spread from a powder at piston pressures of 10 and 17 dynes. With new substrates of distilled water deposition ratios of 1.0 were sometimes obtained; but after a few minutes, especially if the surface was disturbed by dipping, the deposition ratio fell and values as low as 0.6 were sometimes obtained. At the same time, the protein commenced to go into solution and came out in the piston oil and on the clean surfaces of the trough. Low deposition ratios and solution of the film were always obtained at higher piston pressures.

It would seem advisable to have some slow mechanical dipping device and to empty and clean the trough between each dip while the film is drying in order to get deposition ratios of 1.0 and no contamination from dissolved proteins. If these precautions are not observed, no valid estimate of the thickness of a surface layer of protein at a given pressure can be obtained from measurements on multilayers.

R. B. DEAN.
O. GATTY.
E. STENHAGEN.

Department of Colloid Science,
University,
Cambridge.

¹ Astbury, W. T., Bell, F. O., Gorter, H., and Van Ormandt, J. *NATURE*, **148**, 83 (1938).

² Langmuir, I., Scheffer, V. J., and Wrinch, D. M., *Science*, **86**, 76 (1937).

³ Blodgett, K. M., *J. Amer. Chem. Soc.*, **57**, 1009 (1935).

⁴ Mitchell, J. S., *Trans. Farad. Soc.*, **33**, 1129 (1937).

⁵ Gorter and Grendel, *Trans. Farad. Soc.*, **33**, 477 (1936).

Viscosity of Liquids

As a result of a detailed consideration of the mechanism of viscosity of liquids, Fig. 1 was obtained. It is a graph of the logarithm of viscosity of the *n*-paraffin hydrocarbons from *n*-butane to *n*-octadecane (represented by the figures opposite the respective points), against the function T_B/T , or the absolute boiling temperature/absolute temperature of measurement.

It may be seen from the graph that:

(1) A 'specific viscosity curve' is obtained for a family of compounds irrespective of the position of the compound in the family, provided it is not among the first few members.

(2) The function T_B/T thus becomes a fundamental basis for comparing a dynamic property such as viscosity when the effects of constitution are to be studied. It has been pointed out¹ that the reduced

temperature T/T_c and the function $\frac{T - T_f}{T_c - T_f}$, in

which T_c is the critical temperature and T_f is the freezing temperature², failed to yield results of any value when dealing with viscosity.

(3) It is generally accepted that in $\eta = Ae^{B/T}$,

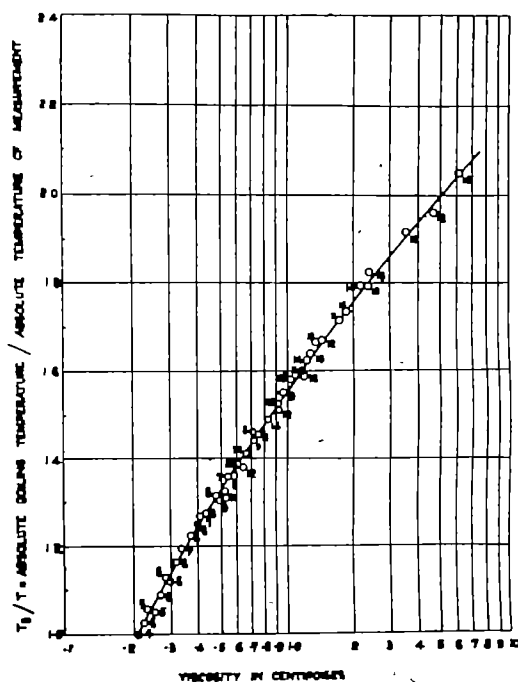


Fig. 1.

B is invariant with temperature for such liquids. This statement cannot be proved rigorously unless a liquid is examined over the entire range of temperature in which it exists as such.

In this graph, none of the liquids has been examined since the literature generally reports the results at temperatures between 0° and 100° C. Since *n*-butane boils around 0° C. and *n*-octadecane is solid at that temperature, it may be seen that this graph actually represents the viscosity of any one of the *n*-paraffins over the entire range in which it exists as a liquid. The line is not straight and, therefore

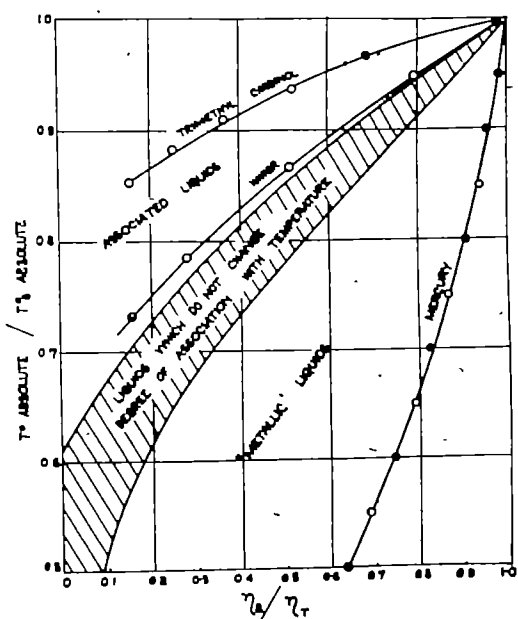


Fig. 2.

or all these members B is variable with temperature. It probably follows that for all liquids B is a function of temperature, and that the difference between associated and non-associated liquids with regard to γ is entirely a matter of degree.

For other families of compounds similar lines exist, but a better rendering of these curves is obtained by plotting the function η_B/η_T against T/T_B , as shown in Fig. 2.

The results of 137 liquids have been plotted representing *n*-paraffins (12), *iso*-paraffins (15), acyclic aldehydes (7), *cyclo*-hexene, alkyl halides (25), alcohols (11), acetaldehyde, ketones (4), anhydrides (2), diethyl-ether, carboxylic acids (5), water, cyclic compounds (30), elements (12) and inorganic compounds (10), resulting in the following conclusions:

(1) All the normal or unassociated liquids fall in a fan-shaped manner in the shaded portion of the graph. In this area, also, fall such compounds as the carboxylic acids which are known not to change appreciably the degree of association on rise of temperature and in fact evaporate to a great extent in the dimer form. Thus the shaded portion contains all compounds which are either unassociated, or if associated, have a small coefficient for the increase of association with a fall in temperature.

(2) The upper portion of the graph contains associated liquids. It is remarkable that water changes its degree of association very slowly, as the evidence of the plot tends to show, when compared with tri-nethyl carbinol.

(3) The lower portion of the graph is characteristic of liquid metals. Mercury shows the regularity of the points on the curve.

A full description of the work and the results obtained has been prepared for publication and will appear in the literature later in this year.

A. H. NISSAN.
L. V. W. CLARK.

Department of Oil Engineering
and Refining,
University,
Birmingham.

Thorpe and Rodger, *Phil. Trans.*, A, 185, 397 (1894).

¹ Bauer, Magat and Burdin, *Trans. Faraday Soc.*, 33, 81 (1937).

Surface Tension and Lindemann Frequency

ANDRADE¹ has derived the expression $\eta = \frac{4}{3} \frac{m}{\sigma}$

for the viscosity (η) of a liquid at its melting point in terms of the molecular mass (m), the Lindemann frequency (ν) and the mean molecular distance (σ). This simple relation has been amply substantiated by experimental results and has given us an insight into the mechanism of viscosity in liquids. But so far as we are aware, no equally elegant explanation of the phenomenon of surface tension in liquids has been put forward.

Let us assume that at the melting point the energy per unit area of the surface is given by the total energy of the molecules in a surface layer of unit area, each molecule vibrating with a frequency equal to the Lindemann frequency. Considering that the oscillation is simple harmonic with an amplitude a , it follows on the basis of the assumptions that the surface tension

$$\gamma = \Sigma \frac{1}{2} m a^2 (2\pi\nu)^2 = \frac{2\pi^2 a^2}{\sigma^3} m \nu^2.$$

Assuming, after Lindemann and others, that at the melting point a/σ is constant, we obtain

$$\nu = k \sqrt{\frac{\gamma}{m}},$$

a relation dimensionally correct. Calculating the Lindemann frequency both for elements and compounds from the relation $\nu = 2.80 \times 10^{12} \sqrt{T_m/MV^{2/3}}$ where T_m is the melting point, and M and V refer to the atomic weight and the atomic volume respectively in the case of elements, and to the molecular weight and the molecular volume respectively in the case of compounds², and dividing the frequency so obtained by $\sqrt{\gamma/m}$, we find that the value of k in the case of forty-six substances examined, of which twenty-four are elements, ranges between 1 and 3.5, with a mean value of 2.34. The variation of surface tension with temperature can thus be explained on the same lines as that of viscosity.

Details will be published elsewhere.

L. SIBAIYA.
M. RAMA RAO.

University of Mysore,
Central College,
Bangalore.
Feb. 22.

¹ Andrade, *Phil. Mag.*, 17, 497-511 (1934).

² Sibaiya and Rama Rao, *Cur. Sci.*, 8, 12 (1939).

Influence of Electrical Conductivity of Surroundings on the Natural Wave-length of an Antenna

THE free end of an antenna fed by an oscillator is connected to a metal plate under which is placed a basin of water. The conductivity of the water is changed by adding known weights of various salts. The solution is earthed and the distance between the plate and the solution is kept constant.

It has been found that the natural wave-length of the antenna increases with this conductivity up to a definite limit and then becomes constant for greater concentrations. This definite concentration marks the limit between the dielectric and the conductive state of the solution. The increase of the natural wave-length for small concentrations can be attributed to the fact that the dielectric constant of the solution increases with concentration.

Experiments are now being carried out for different wave-lengths and different electrolytes. The effect of this conductivity on the resistance of the antenna is also being investigated.

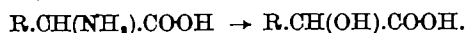
R. NAKHLA.

Physics Department,
Egyptian University,
Cairo.

Hydrolytic De-amination of Amino-Acids

Virtanen and Erkama¹ discovered recently in *B. fluorescens liquefaciens* an enzyme which causes hydrolysis of aspartic acid into malic acid and ammonia. This, however, is not the first example of hydrolytic de-amination of amino-acids. In a series of papers², we have been able to show that in aqueous solution, amino-acids are hydrolysed under the

influence of ultra-violet light to give the corresponding hydroxy-acids:



Here again, a certain resemblance exists between enzymatic and photochemical processes.

This photolysis of amino-acids is a general reaction. It is the primary process in absence of oxygen and precedes, therefore, the well-known photo-oxidation of amino-acids² into the corresponding aldehydes:



Histidin, for example, is reported by Szendrő³ to give imidazol-acetaldehyde, on irradiation. We have been able to show that here, too, ammonia and a hydroxy-acid are formed primarily; the presence of the latter one is easily demonstrated by the colour reaction with 2,7 dihydroxy-naphthalene⁴. The reaction velocity is high: 115 c.c. of a 1 per cent aqueous solution of (-)-histidin, irradiated for two hours in the apparatus, described previously, gave 18.4 c.c. of N/10 ammonia, corresponding to a 25 per cent decomposition of histidin in the above sense. In presence of oxygen only, the hydroxy-acid is degraded into imidazol-acetaldehyde.

The histamin-like biological effects of an irradiated histidin solution⁵ are due to imidazol-acetaldehyde according to Szendrő³, and there is no need to assume a photolytic degradation of histidin into histamin proper. As imidazol-acetaldehyde resembles histamin physiologically, the possibility has to be kept in mind that the 'histamin-precursor' identified by Barsoum and Smirk⁶ with histamin on the basis of their biological resemblance is also imidazol-acetaldehyde.

It would be worth while to test the biological effects of imidazol-hydroxy-propionic acid.

CH. WEIDMANN.

E. BERGMANN.

Y. HIRSBERG.

Daniel Sieff Research Institute,
Rehovoth, Palestine.
March 23.

¹ NATURE, 146, 954 (1938).

² C.R. Acad. Sci., 198, 168 (1934); J. Amer. Chem. Soc., 56, 1075 (1934); J. Amer. Chem. Soc., 50, 1799 (1928).

³ Plotnikow, "Lehrbuch der Allgemeinen Photochemie", pp. 530, 575 (Berlin and Leipzig, 1920).

⁴ Chem. Centralblatt, 1, 3126 (1927).

⁵ Hegriwe, Z. anal. Chem., 80, 121 (1932).

⁶ Ellinger, Biochem. Z., 215, 279 (1929).

⁷ Ohs. Sci., 2, 357 (1936).

Sulphonamide Drugs and Pneumococcus Capsular Polysaccharides

THE remarkable curative effects on certain types of bacterial infection of drugs of the sulphonamide group¹ immediately opens up a new field of research into the mode of action of these drugs. In a bacteriological examination of organisms isolated from the peritoneal cavity during a course of treatment of an experimental pneumococcal infection in mice by 'M and B 693' (2-[p-aminobenzenesulphonamido]-pyridine), Whitby² reported that the "capsules became swollen and crenated and eventually disappeared". Hence it might seem that the drug has a direct destructive action on the pneumococcus polysaccharide-capsular material. It is well known that the capsule is a defence mechanism of virulent bacteria and, for example, in pneumococcal infections, is probably the decisive factor in determining

the fate of the bacteria in the host. Any destructive action on capsular material by sulphonamide drugs would be comparable to the effects of the polysaccharide-splitting enzymes studied by Avery, Dubos and others³. In this work it has been clearly demonstrated that denudation of the organism of its capsule leaves the cell exposed to the phagocytic action of the body and usually the attack of pneumonia is repelled.

We have thought it of interest to ascertain whether solutions of sulphonamide drugs have any destructive action *in vitro* on purified capsular polysaccharides from Type I and Type II pneumococcus. Accordingly dilute solutions of the polysaccharides were separately incubated in physiological saline during several days at body temperature, with saturated solutions of sulphonamide, sulphonilamide (supplied by the Glaxo Laboratories, Ltd.) and 'M and B 693' (supplied by Messrs. May and Baker, Ltd.). The solutions were systematically examined for changes in specific rotation, increase in reducing power, change in viscosity and for loss in precipitin reactivity with homologous immune antisera.

We could clearly demonstrate that under the above conditions the drugs have no chemical action on the specific polysaccharides. It is likely, therefore, that the action of the drugs *in vivo* is not one of capsule destruction but one of capsule inhibition. Whilst this work was in progress, a recent investigation by McIntosh and Whitby⁴ has thrown considerable light on the problem. These authors favour the idea that the mode of action of the drugs is in some measure bound up with the inactivation of the bacterial enzymes responsible for the food requirements of the organisms. In support and extension of these findings it is of interest to recall the work carried out in this department and elsewhere⁵ on polysaccharide synthesis by bacteria. In the cases studied here it has been found that polysaccharide production is extremely capricious, for not only must the organisms have their appropriate food supply but a highly specific 'accessory growth factor', albeit in minute quantity, must also be available. It is possible that *in vivo* sulphonamide drugs can render unavailable to the organism the necessary 'accessory growth factor' and thus inhibit capsule formation; the body would then be able to rid itself of the invading bacteria by phagocytic action.

This tentative explanation would account for differences observed in the mode of action of various drugs on different groups of organisms, since 'accessory growth factors' are sharply specific for each group. A search in peptone broth or in blood for such growth-substances responsible for capsule production in the pneumococcus group, for example, might well prove a profitable study.

M. STACEY.

E. SCHLÜCHTERER.

A. E. Hills Laboratories,
University,
Birmingham.
March 23.

¹ Whitby, L. B. H., *Lancet*, 235, 6011 (1938).

² Whitby, L. B. H., *Lancet*, 235, 1210 (1938).

³ White, B., "The Biology of Pneumococcus", chap. ix.

⁴ McIntosh, J., and Whitby, L. B. H., *Lancet*, 235, 431 (1939).

⁵ Hucker and Pederson, *Cent. Bact.* II, 85, 65 (1931). Allison Hoover, *J. Bact.* 37, 561 (1934). Thorne and Walker, *Proc. Roy. Soc. B*, 41, 68 (1934). Carruthers and Cooper, *Biochem. J.*, 30, 1001 (1936). Stacey and Yood, *Biochem. J.*, 32, 1 (1938).

Sulphanilamide Therapy in Pneumonia

NICOTINIC acid has been found to be especially important as a supplement to sulphanilamide therapy of pneumonia. In a series of cases, it has been noted that there frequently occurs in victims of pneumonia treated with sulphanilamide, a black-dotted, heavy furring of the tongue akin to black-tongue. At the same time, consolidation of the lung fails to resolve though the temperature be normal and toxic effects cleared.

Administration of nicotinic acid in doses of 10-100 mgm. results in rapid clearing of the tongue, generally from behind forward. At the same time, the consolidation of the lung resolves.

Though no pathological studies have been made, it appears probable that the failure of resolution in these cases is due to changes in the mucous membrane of the bronchial tree of the same character as affects the tongue.

An interesting light is thrown on the mechanism of action of sulphanilamide by the change of typing of the pneumococci in cases treated with the drug. Following therapy, it will frequently be found that the pneumococci lose their typing reactions and cannot be typed. Characteristic typing reactions are usually restored to the organisms after animal passage.

EMANUEL M. JOSEPHSON.

GUTEL KLEWAN.

108 East Eighty-first Street,
New York.
March 6.

"Animal Language"

THERE is a point in the review of "Animal Language" in NATURE of February 25 on which I should like to comment. The reviewer writes: "At times, Dr. Huxley expresses his views with considerable confidence. 'What is the point of a rattlesnake's rattling? The answer is really very simple. The snake doesn't want to strike unless it has to. It might very easily get trodden on . . . The rattle is a warning to the intruder to keep away. . . . In the same sort of way those who install burglar alarms in their houses put up a notice to that effect outside.' This may be so, but whether it is an established truth or simply an *ad hoc* hypothesis we are given no real evidence to decide."

In the first place, "Animal Language" was not designed as a scientific monograph, but as a popular book addressed to the general public, so that citations of evidence would have been out of place. In passing, in compiling it I was astonished at the lack of any coherent body of scientific information on the comparative aspect either of sound-production or of hearing: here is a fruitful field for anybody with time and knowledge.

As regards the point concerning the rattlesnake, Jadow, in the "Cambridge Natural History", writes: "The rattle is decidedly useful to the snake as an instrument of warning off any approaching possible enemy, since no snake likes to bite unless in self-defence or in order to kill its prey." The "Encyclopædia Britannica" (eleventh edition) expresses a similar idea. So does that eminent authority, Dr. Thomas Barbour, in his book "Reptiles and Amphibians" (1926), but in considerably greater detail, and with the specific suggestion that the bison is the enemy to be warned off.

Ditmars, in his "Reptiles of the World" (1910), is one of the few authorities to express scepticism as to

the rattle's warning function—though he goes on to make the far more speculative statement that it may serve as a mating call, an assertion which, as Barbour points out, must be erroneous as snakes cannot hear.

The whole question of what constitutes "evidence" for the presumed function of an allæsthetic character, whether concerned with warning, threat, or display, is a very interesting one. I have recently¹ briefly discussed this question. It seems clear that there are different degrees of probability, culminating in proof only when the experimental method has been applied, but that the 'old-fashioned' Darwinian view of presuming an adaptive function from general study of the structure and habits of the animal in question gives a reasonable probability and puts the onus of disproof on opponents.

Ditmars indulges in one fallacy that is so common that I cannot refrain from commenting upon it. He wishes to deny the warning function of the rattle because "many species of harmless and poisonous snakes without a rattle, vibrate their tail when angered". It should surely be obvious by this time that the lack of a character or organ in one type does not preclude its being adaptively functional in another. Numerous examples of this point in regard to threat and warning characters in birds have recently been given by me². Not only this, but in this particular case the evidence adduced by Ditmars strengthens the case for the warning function of the rattle, by making it clear that tail-vibration *per se* is a warning device, presumably rendering the snakes more conspicuous without impairing their capacity to strike. In some cases it may produce auditory as well as visual effects, by rustling dry leaves on the ground. The rattle is a further auditory specialization of this widespread generalized activity.

JULIAN S. HUXLEY.

Zoological Society of London,
Regent's Park, N.W.3.
March 21.

¹ "Evolution" (Oxford, 1938); and *Amer. Nat.*, 72, 416.

² *Proc. Eighth Internat. Ornith. Congr.*, p. 430.

Production of Intercellular Hormones

IN the investigation of metabolic controlling factors (intercellular hormones) appearing in the suspending fluid when cell aggregates are subjected to lethal ultra-violet¹, X-rays², and other external agents, it seems to us of particular interest to determine whether such substances are released by living cells into the intercellular fluids or are simply dead-cell disintegration products. To study this question, suspensions of yeast in isotonic salt solution were irradiated with lethal ultra-violet for periods from 9 to 24 hours under such conditions that the full irradiation period was required to kill 90 per cent of the cells. Samples taken out at regular intervals were filtered through Berkefeld filters, and the growth potencies of the filtrates compared with those of filtrates from control suspensions allowed to stand for equal periods without irradiation. The extent of killing was determined by methylene blue staining and by plating. Maximum production of growth factors (intercellular wound hormones) preceded maximum rate of killing and occurred while most of the cells were still living.

As an alternative method, carbon dioxide and oxygen were bubbled through yeast suspensions for 24- and 48-hour periods, and the growth potencies

of the filtrates from these suspensions compared with those from controls allowed to stand for equivalent periods. Less than one per cent of the cells stained in any of these suspensions. Nevertheless, the filtrates from the suspensions exposed to carbon dioxide averaged one and one-half times as potent as the control filtrates, and four to seven times as potent as the filtrates from suspensions exposed to oxygen.

Full details will be published elsewhere.

JOHN R. LOOFBOUROW.

SISTER CECILIA MARIE DWYER.

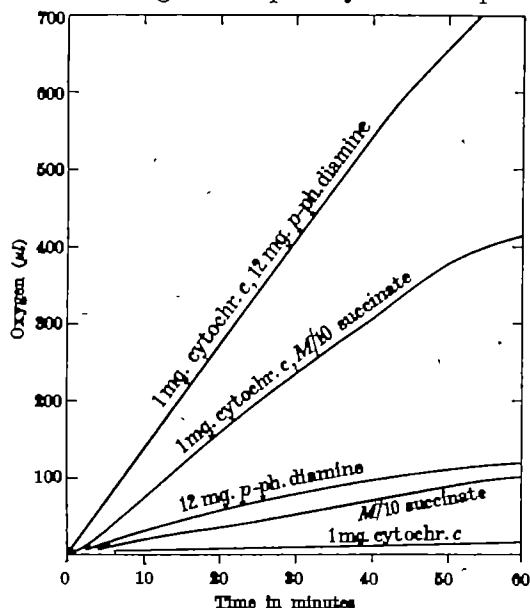
Institutum Divi Thomae,
Cincinnati, Ohio. March 7.

¹ Fardon, Norris, Loofbourow and Ruddy, *NATURE*, 129, 580 (1937); Sperry, Loofbourow and Dwyer, *NATURE*, 140, 643 (1937); *Studies Inst. Divi Thomae*, 1, 163 (1937); Loofbourow, Dwyer and Morgan, *Studies Inst. Divi Thomae*, 2, 137 (1938).

² Fardon, Carroll and Ruddy, *Studies Inst. Divi Thomae*, 1, 17 (1937).

Cytochrome Oxidase in Flowering Plants

In 1925, Keilin¹ described for the first time the absorption spectrum of cytochrome visible in the living tissues of flowering plants. We have been able to prepare from germinating seeds and other tissues of monocotyledons and dicotyledons an insoluble residue showing the complete cytochrome spectrum.



This residue behaves in the same way as the cytochrome oxidase preparations from animal tissues. Shaking the suspension in air causes the bands of cytochrome to disappear, succinate will cause the bands to appear; re-oxidation is prevented by cyanide and azide. If cytochrome c (from ox heart) is added to the preparation it is rapidly reduced in presence of succinate and immediately oxidized by shaking in air. In the accompanying graph are shown manometric measurements of the oxygen uptake of the preparation in presence of cytochrome c, succinate and p-phenylenediamine. The enzyme suspension was prepared by grinding cotyledons from germinating *Phaseolus* seeds in twice their weight of water; the greater part of the solid material was removed by a low-speed centrifuge and the opalescent fluid was spun down on a high-speed centrifuge. The slightly brownish residue was suspended in about three

volumes of water. This preparation showed a cytochrome spectrum one twentieth the intensity of that in bakers' yeast. In each experiment shown 37.5 mgm. dry weight were used in 2.2 c.c. of fluid at pH 7.4. The Q_{10} with p-phenylenediamine as cytochrome c was 20; with succinate and cytochrome c, 10.8. Tests for catechol oxidase were negative.

These results show that the cytochrome spectrum seen in plant tissues is associated with the insoluble enzyme systems which characterize yeast and animal tissues. This now proves the presence of a true cytochrome oxidase in the higher plants and a respiratory mechanism identical with that found in yeast and animals. It is not possible to state exactly how much of the oxygen taken up in the respiration of plants is by means of the cytochrome system, but in some tissues the intensity of the spectrum when compared with that of yeast is parallel with the rate of respiration. These observations are a confirmation of the general presence of the cytochrome system in aerobic organisms as originally discovered by Keilin.

R. HILL.
K. BHAGVAT.

School of Biochemistry,
Cambridge. March 24.

¹ Keilin, D., *Proc. Roy. Soc., B*, 98, 812 (1925).

Spectroscopic Power of a Human Eye due to Injury

THE case reported here of a structure resulting from an injury to an eye, conferring on the owner the power of spectroscopically analysing light, is possibly unique.

Mr. J. M. Rowe, of Adelaide, suffered, at eighteen years of age (he is now fifty-two years old), an injury to his right eye due to the impact of a stone-chip which cut through the cornea and iris, but did not apparently, penetrate further. Natural healing took place with development of a scar on the cornea the protuberant part of which was afterwards removed with a pair of surgical scissors. The pupil of the eye was left, however, displaced from its central position downwards and inwards; also it is no longer round but distinctly elliptical in shape with its long axis in the direction of the displacement. Eyesight with this eye is quite normal—Mr. Rowe has been an excellent rifle-shot—except for the fact that bright sources of light show spectral colours. Mr. Rowe has been aware of this for some years, but only recently informed me of this peculiarity of vision.

Tests made showed that the effect is due to the existence of a periodic structure in the eye of the nature of a diffraction grating. It is definitely not a prism effect since: (1) the spectrum is seen on either side of the bright source; (2) the blue is on the inside the red on the outside of these images; (3) the angle made by the direction of the blue light with that of the source is approximately half that made by the red part of the coloured image. Rough measurements of these angles was made by asking Mr. Rowe to indicate the positions of the several images on a metre rule held at a measured distance from the eye. The blue—or violet—inner edge of the coloured images was approximately four and a half centimetres distant from the central source, a single filament galvanometer lamp; the red outer edge about 7 centimetres, when the metre rule was held at a distance of one metre from the eye. This makes the first-order diffraction angle about $2\frac{1}{2}^\circ$ for the blue and about 4° for the red light, corresponding to spacing in the elements which constitute the grating.

f 1,000–1,300 'lines' per centimetre. The direction in which the rule had to be placed in order that all three images fell upon it was about 15° from the vertical and, roughly at least, perpendicular to the direction in which lay the major axis of the displacedupil.

A sodium lamp gave first-order (uncoloured) images in positions agreeing well with the above. Second-order images were seen only when a 'Pointote' arc-lamp was substituted for the filament lamp, the brightness of the spectrum causing Mr. Rowe to exclaim: "Oh! It's beautiful."

Dr. Tostevin, an eye-specialist, kindly made an examination of Mr. Rowe's eye with the aid of a slit-lamp. He states that the injury has resulted in thickening of the cornea to the iris, and that the cells of the cornea where the scar exists have lost their nuclei and are elongated in a definite direction. There is no injury to the lens.

Should any reader of NATURE suggest a reason for more accurate or other observations, Mr. Rowe has estimated his willingness to submit to them.

KERR GRANT.

University of Adelaide.
Feb. 27.

Commemoration of the Cell Theory

THE hundredth anniversary of the discovery of the cell by Th. Schwann is being commemorated this year in many countries. There seems, however, to be a mistake about the date of this great discovery. Schwann's "Mikroskopische Untersuchungen" bears the date 1839; but the first two—and I think the most important—parts of the book had already appeared in 1838. The edition must have been very small, for I have seen only one copy of them during the last twenty years. Schwann placed the 1838 edition before the Paris Academy of Sciences. At all events we are, I think, late in our commemoration.

A few years ago, by the way, I made a similar blunder. I published in my "Facsimile Edition" a reprint of the first edition of Galvani's famous work which had appeared in 1792. But I discovered too late that this work had already been published as a paper a year earlier in the 'Commentari' of the Academy of Bologna. My reprint was in reality only that of the first edition of the *separate* work.

W. JUNK.

The Hague,
March 4.

Points from Foregoing Letters

J. G. Daunt and K. Mendelssohn find that a 'transfer' of liquid helium II takes place along a solid surface when a temperature gradient is kept up. They also observe that a flow of liquid helium II through a powder plug is accompanied by a caloric effect. These results seem to support the idea that the transport phenomena in liquid helium II are mainly due to surface flow.

A new method for obtaining photographic records of refractive index gradients in a column of solution is described by Kjell J. I. Andersson. The refraction methods now used in ultracentrifugal practice are briefly discussed and the new procedure compared with an analogous method described by Philpot.

Several factors are presented by R. B. Dean, O. Maty and E. Stenhagen which may invalidate the assumption that the thickness of multilayers of protein is a measure of the thickness of a surface layer of the protein on water. Conditions for avoiding these errors are set forth and the orientation of the layers of protein on the slide is also considered.

A. H. Nissan and L. V. W. Clark state that a reasonable basis of comparison for studying the viscosity of liquids has been found so that an homologous series, for example, the *n*-paraffins, yields a solitary curve for all its members, with the exception of the first few, independent of molecular weight. It is generally accepted that in $\eta = Ae^{B/T}$, *B* is invariant with temperature for unassociated liquids. Evidence is given that *B* is a function of temperature even in the case of *n*-paraffins. From an examination of a large number of liquids it is possible to classify them into three groups with regard to viscosity: normal, associated and metallic.

Assuming that, at the melting point the energy per unit area of a liquid surface is given by the total energy of the molecules in a surface layer of unit area, each molecule vibrating with a frequency equal to the Lindemann frequency, L. Sibaiya and S. Rama Rao arrive at a simple formula connecting

the surface tension of a liquid with the molecular mass and the Lindemann frequency. The values obtained in the case of forty-five substances investigated were found to be of the right order of magnitude.

The natural radio wave-length of an antenna is found by R. Nakhla to increase with the electrical conductivity of the surroundings up to a definite limit and then to become constant.

Ch. Weizmann, E. Bergmann and Y. Hirschberg point out that the enzymatic hydrolytic de-amination of amino-acids, recently discovered by Virtanen and Erkama, parallels the analogous photochemical process, which is more general. The behaviour of histidin is quoted as an example.

M. Stacey and Miss E. Schluchterer find that certain drugs of the sulphonamide group have no chemical action *in vitro* on specific capsular polysaccharides from Types I and II pneumococcus. The tentative theory is advanced that sulphonamide drugs are active *in vitro* since they can render unavailable to the invading bacteria highly essential 'accessory growth factors' which are responsible for capsule formation; deprived of their protective mechanism, the organisms fall prey to the phagocytic action of the body and the infection is aborted.

John R. Loofbourow and Sister Ceelia Marie Dwyer have found evidence that living cells produce growth factors ('intercellular wound hormones') as a physiological response to injury in the fact that the production of such factors precedes the killing of yeast by lethal ultra-violet and occurs in suspensions of living cells aerated with carbon dioxide.

A preparation from various tissues of flowering plants showing the complete cytochrome spectrum has been obtained by R. Hill and Miss K. Bhagvat. The cytochrome is associated with cytochrome oxidase and succinic dehydrogenase showing the presence of a respiratory mechanism in the plant identical with that characteristic of animals.

Research Items

Socio-political Grouping in the Great Basin, U.S.A.

IN 1935 the University of California, and in 1936 the Bureau of American Ethnology, instituted an ethnographic reconnaissance of the Western Shoshoni and their Paiute and Ute neighbours of the Great Basin area, under Julian H. Steward. In a study of their socio-political groups (*Bull.* 20, Bur. Amer. Ethnol., 1939), it is shown what are the sociological patterns among these simple hunters and collectors, and the factors which produce them are analysed. Most of the Basin Plateau peoples live at bare subsistence level, and their culture is meagre in content and simple in structure. Problems of daily existence dominate their activities and limit and condition their institutions. Population density depended directly upon the quantity of plant and animal food which the hunting or gathering devices known in the area allowed to be procured. This, therefore, determined in each region the size, nature and permanency of the population aggregate, which in turn determined the social structure and political controls. Generally exigencies of existence allowed little latitude for variation; but where ecology permitted such latitude; warfare, festivals, ceremonies, etc., became determinants of sociological patterns. Hence among the Western Shoshoni and Paiute it was physically impossible for families to remain long in one place or in permanent association. The outstanding sociological unit, therefore, was the biological family and the small winter village.

Carbohydrate Metabolism and Muscular Work

F. C. Courtice, C. G. Douglas and J. G. Priestley (*Proc. Roy. Soc., B*, 127, 41; 1939) have studied in detail the respiratory exchange and quotient and the sugar, lactic acid and carbon dioxide combining power of the blood in two subjects during the period after prolonged moderate muscular work (a ten-mile walk at a speed of 4½ miles per hour). During rest after work there is a reduction in the glucose tolerance, which is very like that following a low-carbohydrate, high-fat diet, and is also associated with a low respiratory quotient and ketonuria. It appears, therefore, that the low R.Q. after exercise is to be attributed to a diminution in the ratio of carbohydrate to fat oxidized. There was no evidence that the reduced tolerance to glucose was accompanied by a change in the sensitivity of the tissues to insulin, since the response of the blood sugar to intravenous insulin was the same whether after exercise or after a low-carbohydrate, high-fat diet. The administration of insulin is followed by a prolonged but slight increase of the respiratory quotient, suggesting an increased oxidation of carbohydrate, and it is tempting to assign the similar rise in quotient which occurs during exercise to the same cause. The injection of insulin is, however, accompanied by a large fall of blood sugar, and such falls do not occur during exercise. It is probable that other endocrine secretions, for example, adrenaline, play a considerable part in the control of carbohydrate metabolism during exercise. Administration of adrenaline causes an increase in the oxygen consumption, hypergly-

cæmia and certain characteristic changes in the lactic acid of the blood. If insulin and adrenaline are injected together, they neutralize one another in as far as their effects on the blood sugar are concerned but the changes in the blood lactic acid are the same as if adrenaline alone were injected.

Habits, Distribution and Anatomy of *Ophelia clathensis*

IN 1935, I. P. McGuire described a new polychaet worm from the sands near Millport under the name of *Ophelia clathensis* which had escaped recognition until that time, sometimes possibly because it had been taken for the young of another species. R. S. Brown (*Proc. Roy. Soc. Edinburgh*; 1938) has given a full account of the habits, distribution and anatomy of this form, thus establishing completely its identity and specific distinctness. The adult reaches a length of 15 mm. in the male and 18 mm. in the female or rarely slightly larger than this, so it is not a large worm. It has twenty-five segments, all save the last being setigerous, and 8-10 pairs of gills. The body wall is semi-transparent so that the animal is a pinkish colour due to the colour of the haemoglobin-containing blood showing through. It is found just below high water neap tides, and in spite of its recent discovery may be present up to 273 per square metre.

Effect of Apple Diet on Intestinal Flora

G. M. Daak, R. Johnson and L. R. Dragstedt (*J. Inf. Dis.*, 64, 52; 1939) have made a comparative study of the bacterial flora of the duodenum, ileum and caecum of three *Macaca mulata* when these monkeys were on a control and a raw apple diet. Surgical fistulae were made in the three levels of bowel to simplify the removal of specimens under physiological conditions. The bacteriological examination included the determination of the relative number of *Bact. coli*, the predominant organism, and the numbers of *L. acidophilus* in the caecum. Dysentery bacilli were looked for as the monkey is a susceptible host to bacillary dysentery. A search was also made for *Bact. necrophilum*, which has been associated with ulcerative processes in the bowel of man and animals, but with negative results in both cases. No essential differences were found in the flora of monkeys on a control diet as compared with the apple diet. The authors conclude that any therapeutic effect that raw apple diet may have is not by virtue of any change which occurs in the bacterial flora of the bowel. Hydrogen ion determinations were made and there was no radical shift in the pH of the caecum which would account for inhibitory effects or bacterial growth.

Phenology of 1938

THE Phenological Report, 1938, by Major H. C. Gunton (*Quar. J. Meteor. Soc.*, 65, No. 279; 1939) is the forty-eighth annual report of this kind. For meteorological reasons the period with which it is concerned, namely, December 1937-November 1938, is one of exceptional suitability for the study of the

sections of wild life to abnormal conditions. The change from winter to summer in the British Isles, instead of taking place in its usual rhythmical manner, spring being made up of short bursts of warmth, sometimes equal to that of summer, followed by abrupt wintry retrogressions due to sudden incursions of cold air from the Arctic, seemed on this occasion likely to be a sudden one, winter holding sway in February and summer from the beginning of March onwards. In actual fact, however, the exceptional warmth of March did not persist beyond that month, and there were long cold and dry periods in April and May, with frequent night frosts. These conditions caused much damage to blossom and foliage, and the report instances cases where song thrushes and blackbirds deserted the young birds in their nests in the drought, when insects must have been unusually scarce. The weather continued very abnormal even after May, for there were notably severe midsummer gales, and very stormy weather again in October, which resulted in an early fall of the leaves, which had already suffered damage. In November came the second spell of unseasonable summer warmth, which was as remarkable as that of March except in its duration. It is not surprising that butterflies and moths were on the whole scarce throughout the year, but there were some exceptions, among them the silver ground carpet moth and the chalk hill blue butterfly. Red admirals, moreover, were observed in large numbers in September and October, and even as late as November. The early fall of the leaves made the autumn a poor one for grouse, but the November warmth caused numerous abnormal second flowerings of shrubs and trees.

The Weddell and Ross Seas

THE Weddell Sea and the Ross Sea, the two great bights on the opposite sides of the Antarctic continent, have different relations with the Southern Ocean. These contrasts are indicated by G. E. R. Deacon in a paper on the "Antarctic Voyages of R.R.S. *Discovery II* and R.R.S. *William Scoresby* 1935-37" in the *Geographical Journal* of March. In the south-west of the Weddell Sea freezing is intense in winter; this raises the salinity of the surface layers by the salts left when the ice is formed. Thus the surface waters sink rapidly and, as a bottom current, spread over the whole Southern Ocean and northwards into the Atlantic, Indian and Pacific Oceans. Bottom temperatures and salinities at great depths show a continuous increase towards the east and the oxygen content a continuous decrease. The increase in temperature is due to mixing with the deep Southern Ocean water subsequent to sinking from the cold surface, and the decreased oxygen content is due also to distance from surface origin. It is thus clear that the Weddell Sea is the chief supplier of the cold bottom water. The Ross Sea has comparable surface conditions but a submarine ridge between Cape Adare and King Edward Land cuts off the bottom waters from the Southern Ocean. This basin, south of the ridge, is filled with very cold saline water that cannot escape. Thus the Ross Sea has little influence on oceanic circulation in general.

Analysis of Ethylene Oxide - Carbon Dioxide Mixtures

A MIXTURE of carbon dioxide (90 per cent) and ethylene oxide is now largely used as a fumigant. The analysis of this mixture has caused some

difficulties and J. R. Branham and M. Shepherd (*J. Res. Nat. Bur. Stand.*, 22; February 1939) have now described a simple and accurate method with a reproducibility of 0.05 per cent. Ethylene oxide is rapidly and quantitatively absorbed by a small volume of sulphuric acid, which takes up more than 5,000 times its volume of the oxide but no significant amount of carbon dioxide, which is then absorbed in concentrated potash solution. A type of apparatus in which the gases are measured dry is described.

Reduction of Silver Ions by Hydroquinone

ALTHOUGH the reduction of silver ions by hydroquinone is of considerable interest in connexion with photographic development and fogging action, no detailed investigation of its mechanism has been made until recently. T. H. James (*J. Amer. Chem. Soc.*, 61, 648; 1939) has now studied the reaction in gelatin and gum arabic solutions. The reaction in slightly acid solution is strongly catalysed by colloidal silver, gold, palladium and silver sulphide. The rate of reaction catalysed by silver varies as the first power of the hydroquinone concentration and as the two thirds power of the silver ion concentration. The dependence of the rate upon the hydroxyl ion concentration shows that both unionized hydroquinone and the univalent ion participate in the reaction in the pH range 5.15-6.27. The rate of the catalysed reaction varies proportionately with the surface of the catalyst and inversely with the concentration of gum arabic. The mechanism suggested by the results involves a primary adsorption of silver ions on the surface of the catalyst, as is indicated by the fractional power of the concentration. No adsorption of hydroquinone is disclosed by the experiments. The difference between the mechanism and that found for the reduction of silver ion by ferrous ion, which indicates that the homogeneous reaction between the ions is very rapid in comparison with the rate of deposition of silver on condensation nuclei, is pointed out.

Solid Adsorption

THE great influence which the addition of a very small proportion of a second metal may have on the resistance of a metal to corrosion has been known for some time; for example, small quantities of aluminium added to copper or brass retard oxidation. In two recent papers (*Bull. Polish Acad.*, March-May and October-December, 1938), the first by Dr. S. Dobinski, the second by Drs. Dobinski and Jagielski of Cracow, it is shown that these effects are due to adsorption of one of the constituents of the solid solution at the surface, in accordance with the Gibbs rule of the 'Equilibrium' paper of 1878, that if diffusion of the constituents can take place the one with the smallest surface tension will concentrate in the surface. Unfortunately the surface tensions of solids have not yet been measured, but Desch and others conjecture that they are proportional to those of the liquids. By surface electron diffraction photographs the authors show that for alloys of lead and antimony, zinc and tin, copper and calcium, silver and cadmium, copper, aluminium and nickel, and copper, aluminium, nickel and magnesium, the constituent which concentrates in the surface when polished or when the alloy is heated to about 200 °C. is in each case that the surface tension of which in the liquid state is the least.

The University Observatory, Glasgow

By Prof. W. M. Smart

THE new observatory buildings of the University of Glasgow were formally opened on April 17 by Sir Arthur Eddington in the presence of a representative assembly presided over by the Chancellor of the University, Sir Daniel Stevenson, who was supported by the Principal, Sir Hector Hetherington, and Prof. John Walton, dean of the Faculty of Science. During the proceedings, Sir Arthur Eddington gave an address on "The Expansion of the Universe", in which he described his recent work, involving relativity and quantum theory, of predicting the actual rate of expansion.



UNIVERSITY OBSERVATORY, GLASGOW. TOPS OF THE TRANSIT HOUSE AND THE 7-INCH DOME ARE SEEN ON THE RIGHT. [Glasgow Herald.]

Owing to the exacting demands of modern observational astronomy as regards instrumental equipment and favourable atmospheric conditions, the new observatory (which is within a stone's throw of the main University departments) has been designed mainly for instructional purposes. The principal room of the main building is a library which can also be used for lantern lectures: a fine collection of fifty astronomical transparencies is mounted in this room. The other accommodation consists of a large instrument room and rooms for the director and his assistant. A 7-inch refractor carrying a small spectroscopic equipment is mounted on the high ground behind, and close by is a transit house. The observatory is also well equipped with subsidiary instruments. For two centuries and perhaps more, particularly during the last thirty or forty years, comprising the directorship of Prof. Becker, astronomy has proved, academically, to be of interest to a fair number of students, and it is hoped that the new facilities will further encourage astronomical study and research in the University.

The present observatory is the third astronomical institution established by the University. The Old College of Glasgow was in possession of a telescope so far back as 1603, and although astronomy was one

of the subjects taught in these early days by the occupant of the chair of physics (or, from 1727, of natural philosophy), no proper accommodation for observational work was provided until 1756, when the University received the valuable bequest of the instruments belonging to Alex. Macfarlane, a wealthy Jamaican merchant and a graduate of the University. The erection of an observatory—known as the Macfarlane Observatory—was immediately undertaken and the regius chair of practical astronomy was established in 1760 under a warrant of King George III. It is noteworthy that it was the establishment of the

Macfarlane Observatory that led directly to James Watt's appointment as instrument maker to the University, and it was in this capacity that he effected the improvements in the steam engine that made his name world famous.

At the beginning of the nineteenth century the rapid extension of the city and the increasing industrialization of the neighbourhood made astronomical observations almost impossible, and matters were not improved when some fifteen or twenty degrees of the meridian were securely blocked by the high steeple of a new parish church. It would appear that by 1820 the Macfarlane Observatory was reduced to little more than a centre of instruction, and it was there that Kelvin was taught the use of astronomical instruments.

In 1836 Prof. John P. Nichol was appointed to the chair—one of the applicants, it is of interest to note, was Thomas Carlyle. Nichol's success as a lecturer led to the formation of the Astronomical Institution of Glasgow, and a new observatory, with Nichol as director, was established as a private concern in 1841 at Dowanhill. The enthusiasm of the Glasgow citizens, however, waned with almost as great a rapidity as it had been stimulated and in 1843 the University acquired the Observatory together with the liabilities of the dead society. Nichol's successor was Prof. Robert Grant, whose two great publications—"The Glasgow Catalogue of 641 stars" and the "Second Glasgow Catalogue of 215 stars"—form a remarkable output for an observatory with such limited resources. The last effective directorship at Dowanhill was that of Prof. Becker, from 1891 until 1935. On his retirement, the University was confronted with the same problem which the academic authorities had to face, a century or more before, in connexion with the Macfarlane Observatory. The new observatory at Gilmorehill represents the solution. If auguries have any significance, the brilliant address of Sir Arthur Eddington and the benediction of an unclouded sun on the opening day should speak the beginning of a career of usefulness to the new institution in a University and City where astronomy and science as a whole have such long traditions.

The Early Sealers in West Antarctica*

PROF. W. M. HOBBS has written a long and elaborately illustrated monograph on the history of the Graham Land area of Antarctica from Smith's discovery of the South Shetlands in 1819 to Ellsworth's flight in 1938. The earlier years of this history have been much discussed by Mill, Balch, Nordenakjöld, Bruce and others, but assiduous search from time to time reveals new material, chiefly in the form of forgotten log books. Prof. Hobbs's reproductions of early maps alone give his monograph great interest. Some of his conclusions, however, do not appear to be justified from the available facts. Thus he goes to great pains to prove that the Antarctic continent was first sighted in November 1820, when the American sealer, N. B. Palmer, saw land to the south and south-east of Deception Island of the South Shetlands. This land soon after appeared on maps as Palmer Land and is now regarded as a part of the Trinity Peninsula of Graham Land. Prof. Hobbs, however, is entirely unconvincing in his refutation of the accounts and charts which are available establishing Bransfield's sighting of Trinity Land in January and February 1820. W. S. Bruce, and later R. T. Gould, have shown convincingly that Trinity Land was the original discovery of Antarctic and antedated Palmer's discovery by at least ten months. The attempt to establish an American discovery of Antarctica fails.

The chief interest, however, in Prof. Hobbs's monograph lies in his strictures on Weddell. These strictures have a weak foundation, but since they impugn the veracity and reputation of a notable explorer, cannot be overlooked. Between 1819 and 1824, Weddell made three southern voyages in the course of which he surveyed in part the South Shetlands and the South Orkneys and gained a high southern latitude in lat. $74^{\circ} 15' S.$, long. $34^{\circ} 16' 45'' W.$ in the Sea of George the Fourth, which is now called the Weddell Sea. He published his account of these voyages, his discoveries and his route chart in his well-known volume "A Voyage Towards the South Pole", etc. (London, 1825). He sailed southwards into the Weddell Sea about long. $30^{\circ} W.$ and came

north again between long. 30° and $40^{\circ} W.$ from his southern record where he saw a sea free from field ice with only four icebergs in sight. He had, however, seen "many ice islands" in places on the way south. Ross, twenty years later, failed on account of ice to follow Weddell's route, and the *Scotia* in 1903 had to keep farther eastward to gain a high latitude, but in 1904 crossed the middle of an almost ice-free Weddell Sea and reached lat. $72^{\circ} S.$ before difficulty began. The *Deutschland* and the *Endurance* in later years were caught and drifted in Weddell's longitudes. But from these scanty records we are not entitled to assert, as Hobbs does, that the Weddell Sea is unnavigable. The pack of the Weddell Sea is partly due to local formation in that sea and partly due to the sweep of pack from the east which is caught in this great bight. The pack is carried towards the south-west coast which may be always blocked, and then flows north before wind and current until, in the latitudes of 65° to $60^{\circ} S.$, it is swept eastward again by the set of winds and the eastward drift of the waters. With the amount and distribution of the pack in the Weddell Sea dependent on many factors, local and general, it would be surprising if the distribution of ice remained constant, as indeed a limited knowledge of that sea shows not to be the case.

Wordie has commented on the low average wind velocity in the Weddell Sea as promoting ice congestion in the western side. A year of unusually strong southerly winds in this area might easily clear away the ice for several weeks or even for a whole season. Years or periods of open water are likely to occur, and Weddell was fortunate enough to sail in such a season. Hobbs's deductions on the state of ice, based on the scanty data available, are not a foundation for the destruction of Weddell's reputation and the slandering of his name. Similarly, Hobbs's charge that Weddell did not make surveys in the South Shetlands but merely copied Powell's earlier map (published in 1922) would seem to ignore Weddell's practice of surveying from boats and not direct from his ship, for which reason Weddell did not mark his route among island groups. It is a pity that such charges should disfigure a work that comprises much research, even if some of it lacks scholarship.

R. N. R. B.

* The Discoveries of Antarctica within the American Sector, as revealed by Maps and Documents. By W. M. Hobbs. *Trans. Amer. Phil. Soc.*, Philadelphia. New Series, 31, Pt. 1, pp. 1-71; 1939.

Absorption Spectra of Single Crystals of Hæmoglobin in Polarized Light

By M. F. Perutz, Cavendish Laboratory and Molteno Institute, Cambridge

SINGLE crystals of hæmoglobin generally show strong pleochroism¹. They are dark red and almost opaque in two extinction directions and become light red and transparent in the third. An investigation of the absorption spectra corresponding to the principal vibration directions was undertaken with the view of obtaining information on the molecular structure of hæmoglobin.

Horse methæmoglobin crystallizes in the monoclinic system, as described in a previous paper², and is usually obtained in the prismatic form terminated by domatic faces (Fig. 1). The orientation of the optic axes may be seen from the figure; the sign of the double refraction is probably negative. The crystals show strong absorption in vibration directions parallel to β and γ , and weak absorption parallel to α .

The absorption spectra of the crystals were studied while they were mounted on microscope slides and immersed in their mother liquor (3 parts sat. $(\text{NH}_4)_2\text{SO}_4$ + 1 part molar $(\text{NH}_4)_2\text{HPO}_4$; pH = 6.3) to which gum tragacanth had been added in order to keep the crystals stationary. Preparations were made with crystals lying on their a , b and c faces respectively, the last two having been cut with a razor blade. The absorption spectra were observed through a microspectroscope replacing the eyepiece of a polarizing microscope.

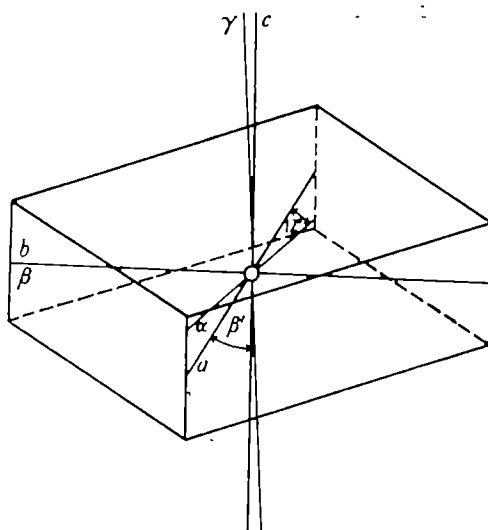


Fig. 1.

CRYSTAL OF HORSE METHAEMOGLOBIN.

The axial ratios are $a:b:c = 1.72:1:0.86$; $\beta' = 68^\circ$. α makes an angle of 12° with a ; β is parallel to b ; and γ makes an angle of 10° with c . The domatic faces are 210 faces.

In unpolarized light, the spectra of the crystals conformed with the spectrum of acid methemoglobin in solution, showing a strong absorption band at $637 \text{ m}\mu$, faint bands at $582 \text{ m}\mu$ and $548 \text{ m}\mu$ and a general absorption increasing from the green towards the violet end of the spectrum. (The band at $504 \text{ m}\mu$ was not visible owing to the low resolving power of the spectroscope.)

The results of the spectroscopic examination in polarized light are recorded in the accompanying table.

Vibration direction parallel to	Absorption band at $637 \text{ m}\mu$	Absorption bands at 582 and $548 \text{ m}\mu$	General absorption in the green and blue
α	weak and smeared	faintly visible	weak
β or γ	strong, broad and sharply defined at the boundaries	not visible, probably overshadowed by general absorption	very strong

As the α , β and γ directions are parallel or nearly parallel to the a , b and c axes, the crystals show strong pleochroism when the light is travelling perpendicular to the b or c planes, whereas pleochroism is completely absent when the light is travelling at right angles to the a plane.

Crystals of methemoglobin can be treated with acid without being immediately dissolved. If a drop of $n/10 \text{ HCl}$ was added to the mother liquor, the

acid could be seen to penetrate the crystal by the change in colour which travelled from the edge towards the centre. Simultaneously, the spectrum changed gradually from that of methemoglobin to that of ferrihematin chloride, the edge of the absorption band in the red ($637 \text{ m}\mu$) shifting from $640 \text{ m}\mu$ to about $675 \text{ m}\mu$, until finally a very broad band stretched from about $640 \text{ m}\mu$ to $680 \text{ m}\mu$. At the same time, an increase in the general absorption in the green and blue could be noticed. Strong pleochroism was visible for several minutes after the acid had penetrated the crystal, which was lying on its c face. When the vibration direction was parallel to β , the bands of the spectrum of acid hematin, especially the band in the red, were strong and sharp. If the nicol was turned, the band contracted from the red end until it was narrow and smeared, when the vibration direction was parallel to α . After five minutes the pleochroism disappeared and the crystal dissolved.

Crystals of *sheep methemoglobin* were obtained in large thin pseudohexagonal plates which X-ray analysis had shown to be triclinic. Their spectrum

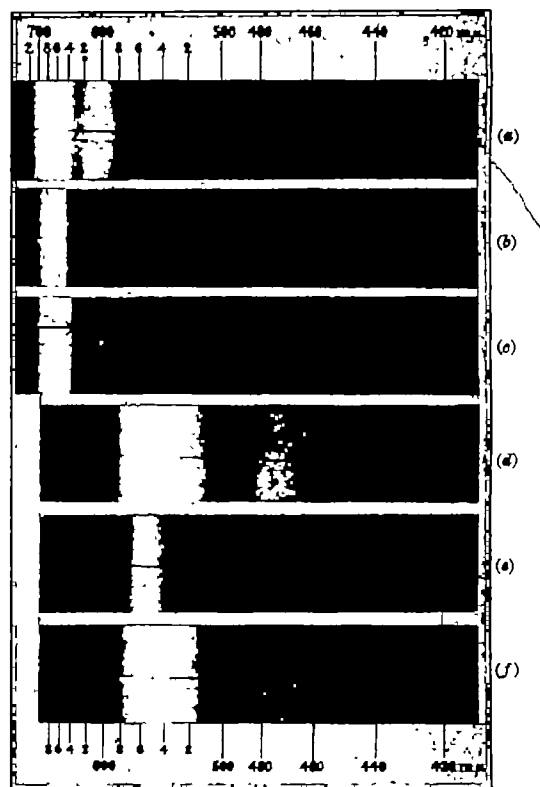


Fig. 2.

ABSORPTION SPECTRA OF A SINGLE CRYSTAL OF SHEEP METHAEMOGLOBIN.

(a) taken in polarized light with the vibration direction parallel to α ; (b) it is parallel to β ; and (c) shows the spectrum in unpolarized light. The exposure times of (a) and (b) are equal; in (c) the time is reduced to one third to counterbalance the absence of the nicol. (a), (b) and (c) are taken on a panchromatic plate, (d), (e) and (f) are the same photographs taken on an isochromatic plate. The reproductions are positives. The arrow in (c) indicates the absorption band in the red.

was similar to that of horse methaemoglobin, except that the absorption in the green was more pronounced. The small thickness of the crystals rendered examination in any other than the *c* plane impracticable, but made it possible, on the other hand, to get spectra which were bright enough to photograph (Fig. 2). The photographs taken on the panchromatic plate show the change in width and strength of the band in the red, while those on the isochromatic plate illustrate the variation of the general absorption in the green and blue.

In needles of horse oxyhaemoglobin, both the characteristic absorption bands in the green and in the yellow were strong and sharp when the vibration direction was perpendicular to the needle axis, and faded out when the vibration direction was parallel to it.

In horse methaemoglobin the absence of pleochroism in the *a* plane and the sharpness of the band in the red in combination with the high general absorption in the green and blue in vibration directions parallel to β and γ , indicate that the four haeme groups contained in one molecule are approximately parallel to each other and lie in the *a* plane. This orientation also agrees with the positions of the high refractive indices. It was shown by the effect of acid on the crystals that the absorption must be due to dipoles induced in the haeme groups themselves, since the relation of the absorption bands to the vibration directions in the crystal remained unchanged even after the haeme groups had become detached from the globin component and the position of the absorption band had shifted to that corresponding to free haematin chloride.

In drawing these conclusions it has been assumed that the coefficient of absorption is high when the electrical vibration of the polarized light is parallel to the haeme groups and low in any other direction. This assumption appears justified, since the strong colouring power of the haematin complex is understood to be due to its large planar system of conjugated double bonds, and dipoles induced in this system

must reach their maximum value when the electrical vibration of the light is parallel to the plane containing the double bonds. This relation between pleochroism and molecular orientation has been established by Bernal and others, who applied it to the structure analysis of crystals possessing layers of flat molecules or chains*.

X-ray data showed that the four haeme groups in methaemoglobin must be arranged in pairs related by twofold axis¹. Their parallelism now indicates that they may lie at the corners of a square as suggested by Pauling². In horse oxyhaemoglobin their arrangement appears to be the same as in methaemoglobin, since its crystals belong to the same system, have similar axial ratios and exhibit the same type of pleochroism³. According to Haurowitz⁴, reduced horse haemoglobin crystallizes in the form of hexagonal plates, which on contact with oxygen change spontaneously into the monoclinic needles of oxyhaemoglobin. This change of symmetry indicates that a rearrangement of the haeme groups may take place on reduction.

I have to thank Dr. G. S. Adair for his collaboration in preparing the crystals, Prof. J. D. Bernal for suggesting this research, and Prof. D. Keilin and Dr. E. F. Hartree for much practical help and advice.

Summary. The absorption spectra of single crystals of haemoglobin in polarized light have been examined. In met- and oxyhaemoglobin of horse and in methaemoglobin of sheep, the width and strength of the absorption bands was dependent on the vibration direction of the polarized light. The results indicate an approximate parallelism of the four haeme groups in the met- and oxyhaemoglobin molecule.

¹ Redbert and Brown, "The Crystallography of the Hemoglobins" (Carnegie Inst., Washington, 1909).

² Bernal, Fankuchen and Perutz, *NATURE*, 141, 523 (1938).

³ Bernal and Crowfoot, *Trans. Farad. Soc.*, 29, 1033 (1933). Taylor, *S. Kristall.*, A, 93, 151 (1933). Wells, *Proc. Roy. Soc., A*, 167, 172 (1938).

⁴ *Proc. Nat. Acad. Sci.*, 21, 186 (1935).

^{*} *S. physiol. Chem.*, 254, 256 (1933).

Chemistry and its Applications in Modern Life

Meeting of the American Chemical Society

A MEETING of the American Chemical Society was held early in April at Baltimore, when many papers of topical interest were presented. Grouping the papers by subjects, it is possible to indicate some of the more striking advances which were recorded.

One group of papers dealt with vitamins and hormones. The close relation between vitamin A and vitamin A₂ (occurring in visual purple and in the livers of freshwater fish) has been established by distillation under very low pressure. Papers on the content of vitamin C in various vegetables and its changes on boiling and storage showed, among other things, that loss on boiling is reduced by putting a cover on the vessel so as to exclude air. A covered aluminium vessel was better than covered glass or enamel vessels unless sodium carbonate was added to the green vegetable, in which case the loss was greater with the aluminium vessel. Contrary to the general belief that citrus fruits and tomatoes are the

richest sources of the antiscorbutic vitamin C, it has been found that freshly picked parsley, broccoli, kale and cauliflower contain two to three times as much vitamin C as citrus fruits. Vitamin A concentrates were found not to lower the fat content of milk produced by cows fed on them, whilst fish oils tended to lower the fat content.

Whey has been shown to be a valuable source of vitamins and vitamin products, including all the known water-soluble vitamins, the fat-soluble provitamin D, vitamin K (pro-thrombin), vitamin E, oestrin and vitamin B₂ or G. The importance of whey as an adjunct to feeding animals was shown experimentally. The use of whey products in human foods, especially in bakery goods and confectionery, has also been the object of research.

Zinc insulin crystals have been widely used in the treatment of diabetes in the United States and Canada. The chemistry of the visual systems and of the adrenal cortical hormones has been actively

worked upon. Adrenal gland extract has been shown to contain at least twenty-four different substances allied to cholesterol, bile acids and the sex hormones, one of them being progesterone, the hormone produced by the corpus luteum of the ovary. The biological functions of the pituitary gland have been more closely investigated and the results correct many views formerly held in this field. For example, it is now known that certain physiological effects claimed to be due to different separate anterior pituitary principles can be attributed to one principle, exerting these effects in ways depending on its mode of administration. Doubt has been cast on the assumption that the thyroid stimulating effect of the pituitary is produced by a separate principle acting on the thyroid gland only.

Another group of papers dealt with cellulose and cellulose products. The purification and utilization of wood cellulose have been investigated, and the suitability of various kinds of woods studied. The main object in view was the production of a cellulose suitable for the production of viscose, since this accounts for 80 per cent of the wood-pulp cellulose used for chemical purposes. An interesting paper dealt with the use of the whole cotton plant with ripe bolls for the production of cellulose; the oil is first extracted from the seeds of the whole ground plant and the cellulose isolated from the residue.

Petroleum and its products received attention from several points of view. The dehydrogenation of petroleum by cracking has led to an increased supply of reactive olefines used in the synthesis of iso-octane, ketones, organic derivatives and plastics. The production of aviation fuels by high-pressure hydrogenation is increasing, one of the principal blending agents being iso-octane. New catalysts have been developed. The superior fuels now available have enabled engine manufacturers to build engines capable of greater power output per unit weight. The stabilization of petrols by small quantities of organic compounds known as deactivators, which prevent oxidation, is an important advance.

Casein products and the utilization of lactic acid provided topics of interest from the point of view of plastics, including polymethylacrylate from lactic acid. A wool-like fibre is made from casein by dissolving in alkali solution and forcing under pressure into a solution containing acid, formaldehyde and either salts or sugars. The fibre is then treated with oils and other substances to increase its flexibility and strength and to bleach it, and is cut into staple lengths, carded and spun into yarn. It may be dyed and laundered in the same way as wool. It shrinks less than wool but has poor tensile strength, especially when wet.

Resins, shellac varnishes, house paints, organic sulphur compounds, and other topics of technical interest also featured in the papers. Of more academic interest were papers on exchange reactions of heavy isotopes of oxygen and nitrogen. The use of aspartic acid as an anticoagulant for blood is of medical interest, as it prevents clotting in the circulation. Aspartic acid is a natural component of plant and animal tissues; it is used as the sodium salt injected intramuscularly, but further studies are to be made of the possible injurious effects on the kidney such as are noted with other anticoagulants. It is stated that, of the long list of amino-acids formed from proteins in digestion, only two have any appreciable effect in preventing clotting, namely, cysteine and aspartic acid, and aspartic acid is much more potent.

Science News a Century Ago

The Zoological Society

THE anniversary meeting of the Zoological Society was held on April 29, 1839, Lord Braybrooke being in the chair, when the reports for the year were submitted. That by the auditors stated that the receipts had been £14,094 2s. 9d. and the expenditure £12,588 12s. 1d. Among the assets of the Society was the farm at Kingston valued at £11,000. In the report of the Council it was stated that steps were being taken to reduce greatly the permanent expenditure. In 1837 salaries were £3,548, but for the coming year that would be reduced to £2,916. An increase had taken place in the cost of provisions due to an increase in the number of animals, "and amongst other circumstances to the growth of the larger elephant". There were 3,010 members of the Society, 38 candidates for election and 126 corresponding members. The Museum contained 760 mammalia, 5,230 birds, 1,000 reptiles, 1,170 fishes and 83 mounted skeletons.

Jupiter's Satellites

UNDER the above title, the *Athenaeum* of May 4, 1839, said, "An irregularity in the first satellite of Jupiter has for some time attracted the attention of M. Boguslawski, the director of the observatory at Breslau. He observed it on the 14th of April 1838, and on the 1st of May he made further observations, when he found that its lustre, which, generally speaking, is greater than that of the second, appears to be much weaker when it quits the disc of the planet after its passage across, especially when its shadow is seen upon Jupiter. By means of the heliometer he kept the second satellite always by the side of the first, and at the same distance from the disc, in order to ascertain if the light of the planet were the cause of the diminution. For several hours after leaving the disc at 12 h. 54' 26.2" sidereal time, the first satellite was evidently paler than the second; it then slowly began to resume its light, but which at 15 h. 18' had not yet attained that of the second. The next day it had quite resumed its lustre, and again surpassed that of the second".

Palon Heinrich Ludwig von Boguslawski was born at Magdeburg in 1789 and died in 1851. He was well known for his observations of comets and published an astronomical year-book, entitled "Uranos".

Further Discoveries by M. Lartet

IN its column of Miscellaneous, the *Athenaeum* of May 4, 1839, said: "The indefatigable M. Lartet, of whose labours we have so often spoken, announced the discovery of two fossil Carnivora, one of which appears to constitute a sub-genus, intermediate between the badger and the otter, and the second approaching to the dog, differing but little from that gigantic fossil which he has described under the name of *Amphicyon*. He is of the opinion that the latter is the same animal as that of which some remains were found at Epelsheim, and which constitute the *Agnotherium* of M. Kaup. There are a considerable number of fossil mammifera found on the border of the Rhine, which appear to be identical with those which are daily brought to light at the foot of the Pyrenees. These affinities are the more interesting, because the intermediate countries, Auvergne, for instance, possessed very different races of animals."

Societies and Academies

Paris*

Academy of Sciences (C.R., 208, 853-952,
March 20, 1939).

A. ROSE: Thermal dissociation of zinc carbonate.
A. DOGNON and C. PIFFAUT: Action of various radiations on superficial films of proteins.

MME. M.-E. RUMPF-NORDMANN: Contribution to the study of some permolybdates.

E. GRILLOT: Lead halogen-ethanoates.

H. SCAFFTA: A phenomenon of *expirgation altitque* of tropical soil in West Africa.

N. MENCHIKOFF: Carboniferous of Issaouane (Central Sahara).

C. FRANCOIS-BOTUF: Remarks on some measurements of salinity of the waters of the Orne, between Jaen and the mouth (Franceville).

L. CAGNIARD: Propagation of a signal in a rarefied ionized atmosphere. The speed is that of the group.

G. BOUVRAIN: Presence of woody bundles in the upper part of the root of *Helianthus annuus* (var. *viriflorus*).

J. MAGROU: New attempts at the cultivation of mycorrhizal fungi.

MME. L. LEVINA: Contribution to the study of the movement of water and of dissolved substances across plant tissues.

L. PLANTEFOL and R. GAUTHIER: Glucose and the respiration of plant tissue cultures.

A. DE PUYMAY: Modifications undergone by an alga taking part in the constitution of a lichen *Placynthium nigrum* S. Gray).

MME. L. PITTIER: Differentiation of reproductive organs in abnormal buds of *Solanum tuberosum* L. var *Estorlingen*.

MME. S. VILLENEUVE-BRACHON: Superficial structures of heterotrich ciliates and the genetic continuity of their *cinétozo*.

P. LEBES: Polymorphism of certain Bostrychid Coleoptera.

M. ROSE: Physiology of the parabasal of *Trypanophis Grobneri* Poche.

MME. L. RANDOIN and C.-P. LEBLOND: New biochemical method of estimating vitamin C.

MME. P. BERTHELE: Coefficient of specific magnetization of oxyhaemoglobin.

A. LEBES: Examination of some substances as precursors of ascorbic acid.

J.-H. VIVIEN: Role of the hypophysis in the determinism of the female genital cycle of a teleostean, *Gobius paganelus* L.

J.-O. VILIS: Physico-chemical properties of desoxycholic acid.

(*Continued from p. 695.)

Cracow

Polish Academy of Sciences and Letters (Feb 6, 1939).

S. BANACH: The 'supreme law' of Hoene-Wronski.

MME. L. STANKIEWICZ: Some formulae of the calculus of inverses.

M. WOJCIK: The degenerate states of helium. If the two states I and II are due to degeneration, they ought to exist also in solid and gaseous helium.

M. KAMINSKI: Origin of Wolf's comet (1).

S. PIOTROWSKI: Graphical method for finding pairs of stars of which the geographic latitude is determined by the method of corresponding heights.

J. CHOJNACKI: Modifications of biacene ($C_{24}H_{18}$). Two forms, α and β , are obtained by crystallization of solutions in benzene below and above $100^\circ C$. respectively. Crystallographic data are given.

M. CHENTERSZWER and A. WOLDENBERG: Presumed disaggregation of metals in liquids under the influence of ultra-violet light. Colloidal solutions in water of iron, lead, silver and mercury are formed, due to the production of ozone which acts as an oxidizing agent.

MME. R. LUDWICZAK and J. SUZKO: (1) Dibrom derivatives of quinidines and their transformation into natural bases. (2) Vinyl-phenol bases of quinidine: cupreine and cupreidine.

K. KONIOR: Geological structure of the neighbourhood of Strzyków.

A. BURSA, MME. H. WOJTUSIAK and R. J. WOJTUSIAK: Researches on the submarine fauna and flora of the Bay of Gdańsk, Baltic Sea, carried out with the aid of a diving apparatus.

J. BOBYNOWICZ: Comparative researches on the cyto-architecture of the corpus geniculatum externum.

Moscow

Academy of Sciences (C.R., 20, No. 9, 1938).

V. S. FEDOROFF: Polynomes of a complex variable.

A. G. DANOW: Splitting of nuclei by cosmic rays at high altitudes, according to observations made with the help of photoplates with a thick layer.

L. I. ROUSSINOW and A. A. YUSEPHOVICH: Soft radiation from bromine.

R. V. TELEBIN: Rate of variation of iron magnetization at different sections of the hysteresis loop.

P. A. CHEREMENKOV: Spectrum of visible radiation produced by fast electrons.

S. S. SHALYT: Anomalous magnetic properties of anhydrous $FeCl_3$.

L. KHVOSTIKOV and N. ERSHOVA: Instability of the ozone layer at sunrise and sunset and the problem of determination of the height of the ozone layer.

N. A. TOROPOV and P. F. KONOVALOV: Solid solutions of the orthosilicates of barium and calcium.

L. I. KORNILOV and V. S. MIKHAIJEV: Alumino-metric method of producing chrome-aluminium alloys.

W. A. ISMAILSKI and E. A. SMIRNOV: (1) Coloration of the arylamides of the *p*-nitro-phenylacetic acid. (2) The coloration of the arylamides of the *p*-nitro-hydrocinnamic acid.

M. K. DJAKOVA, A. V. LEZOVJOV, T. G. STEPANZ-EVA and S. A. SENJAVIN: Solution of coals.

B. V. IVANOV, A. I. ZVETKOV and I. M. SHUMILO: Egyptian blue and refractories for copper smelting furnaces.

A. F. KALINKOVICH: Effect of nitrogen-potassium periodic supply upon yield of root and store of rubber in 'kok-saghyz'.

G. M. LITVIN: (1) Susceptibility of the sporogony process in oocysts of Coccidia to ultra-violet rays as dependent upon temperature conditions and the separative power of oocysts. (2) The significance of aerobic and anaerobic conditions for the affect of ultra-violet rays on processes of sporogony of Coccidia from rabbit.

M. SAVCHUK: The gradient-field (in regeneration).

N. I. SHAPIRO: Time and spontaneous mutation in *Drosophila melanogaster*.

V. P. ZOSENKOVICH: Interspecific hybridization in *Beta*. (1) Experimental synthesis and the origin of *Beta trigyna* W. and K. (2n = 54).

N. E. ZAIKOVSKAJA: Reduction division in inter-specific hybrids in the genus *Beta*.

P. V. MIKHAILOVA: Inheritance of yellow leaf colour in *Nicotiana tabacum* L.

N. D. TABNAVEKY: Role of nucleic acid in chromosome conjugation.

N. A. KARPOV: Nitrogen supply to sunflower according to development periods.

G. M. PSAREV: Effect of day length upon growth of stem parenchyma cells in soya.

M. I. GOLDIN: (1) Tobacco mosaic virus as influenced by micro-organisms. (2) Adsorption of tobacco mosaic virus by micro-organisms.

P. A. NESTERENKO and S. N. ZARITSKY: 'Hollow-ness' in Clary sage (*Salvia sclarea* L.).

K. S. SOUKHOV and A. M. VOVK: Mosaic of cultivated cereals and its transmission in Nature.

S. A. IVANOVA: Influence of excessive parathyroid hormone on the development of bones.

A. W. RUMJANTSEV and L. F. BEREZINA: Inductive action of cartilage *in vitro*.

Rome

National Academy of the Lincei (*Atti*, 28, 217-272, 1938).

Q. MAJORANA: Comparison between thermal theory and experiments in metallic photo-resistance.

G. CHECCHIA-RISPOLI: Observations on the structure of the shell of Clypeasters.

E. BORTO LOTTI: Differential projective geometry of dualistic transformations.

R. CALAPSO: Deformation of the Voce lattices of a Euclidean S_4 .

C. MIRANDA: A problem of differential geometry set by Minkowski.

U. SALINI: Applications of Minding's method for the deformation of ruled surfaces.

A. TONOLO: Extension of a trigonometrical theorem of Legendre.

M. VILLA: Quasi-asymptotic curves (1).

G. COLONNETTI: Investigation of the experimental foundations of the theory of elasto-plastic equilibrium.

G. B. BONINO and R. MANZONI-ANSIDINI: Raman spectrum of ortho-deuteroxybenzaldehyde.

G. GOMDANICH: Influence of the stock on the receptivity of the graft towards parasitic infections.

V. ZAGAMI: Researches on the seminal fluid (8). pH value of the seminal fluid of the rabbit.

Forthcoming Events

[Meeting marked with an asterisk is open to the public.]

Monday, May 1

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—A. M. Champion: "By Motor Van from Cape Verde to Nairobi" (Film).

Tuesday, May 2

UNIVERSITY COLLEGE, LONDON, at 5.—Prof. E. J. Bigwood: "Chemical Reactions between Proteins and Electrolytes".*

ST. MARY'S HOSPITAL, LONDON, W.2, at 5.—Dr. Wilson Smith: "The Prevention and Control of Virus Diseases".

INSTITUTION OF CIVIL ENGINEERS.—Prof. Karl von Terzaghi: "Soil Mechanics: A New Chapter in Engineering Science" (James Forrest Lecture).

Thursday, May 4

UNIVERSITY OF CAMBRIDGE (CAYNENDISH LABORATORY at 4.30.—Prof. P. M. S. Blackett, F.R.S.: "Cosmic Rays: New Results and Further Problems" (Soc. Lectures. Succeeding lectures on May 5 and 8).

PHYSICAL, CHEMICAL AND ROYAL METEOROLOGICAL SOCIETIES (at the Royal Institution), at 5.30.—Discussion on "Chemical and Physical Investigations of the Upper Atmosphere" to be opened by Prof. F. A. Paneth.

Friday, May 5

ROYAL INSTITUTION, at 9.—Prof. W. L. Bragg, F.R.S. "Magnets".

IRON AND STEEL INSTITUTE, May 3-5. Annual meeting to be held at the Institution of Civil Engineers.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

SCIENTIFIC OFFICERS, JUNIOR SCIENTIFIC OFFICERS AND ASSISTANTS (grade II) in the Chemical Defence Research Establishment, Sutto Oak, or the Chemical Defence Experimental Station, Porton—Chief Superintendent, O.D.R.D., 14 Grosvenor Gardens, London, S.W. (May 5).

ASSISTANT CHEMIST for the London Shellac Research Bureau—The High Commissioner for India, General Department, India House Aldwych, W.O.2 (May 6).

SENIOR RESEARCH OFFICER (grade II) to take charge of the Poultry Disease Laboratory, Edinburgh and RESEARCH OFFICERS for work in parasitology in the Veterinary Laboratory, Weybridge—The Secretary Ministry of Agriculture and Fisheries, 10 Whitehall Place, London S.W.1 (May 8).

PROFESSOR OF GEOGRAPHY in an Art College for Girls to be opened in Calcutta—The High Commissioner for India, General Department India House, Aldwych, London, W.O.2 (May 13. Quote 3/64A).

JUNIOR SCIENTIFIC OFFICERS in the Chemical Research Laboratory Teddington, Middlesex—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster S.W.1 (ref. J 89/6, May 16).

SENIOR LECTURER in the ZOOLOGY OF VERTEBRATES and JUNIOR LECTURER in the ZOOLOGY OF INVERTEBRATES in the University of Edinburgh—The Secretary (May 23).

NIGHT CHEMISTS in Admiralty Cordite Factories—Secretary of the Admiralty (O.E. Branch II), London, S.W.1.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Transactions of the Royal Society of Edinburgh, Vol. 59. Part 3, No. 25: Differential Fertility in Scotland, Part 2. By Dr. Huid Charles. Pp. 675-686. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 1s. 6d. [293]
Rhodesia—Nyasaland Royal Commission. Report. (Omd. 5949.) Pp. x+233. (London: H.M. Stationery Office.) 7s. 6d. net. [303]
This Cruelty called Sport! By Air Commodore L. H. O. Charlton. Second edition. Pp. 45. (London: League for Prohibition of Cruel Sports.) 6d. [313]

Other Countries

Indian Association for the Cultivation of Science. Special Publication No. 6: Gems and their Role in Nature. Based on Lectures delivered by Sir Lewis Leigh Fernor. Pp. v+106. (Calcutta: Indian Association for the Cultivation of Science.) 2.8 rupees; 4s. net. [273]

Ministério de Educação e Saúde. Anuário publicado pelo Observatório Nacional do Rio de Janeiro para o ano de 1938. (Ano 55.) Pp. xiii+492. (Rio de Janeiro: Observatório Nacional.) [283]

Le fonds national de la recherche scientifique et l'industrie. Par P. Beghin. Pp. ix+408. (Bruxelles: Fonds National de la Recherche scientifique.) [293]

Outline of the History of Mathematics. By Raymond Clare Archibald. Fourth edition, revised and enlarged. Pp. ii+66. (Oberlin, Ohio: Mathematical Association of America, Inc.) 50 cents. [303]

New Zealand: Department of Scientific and Industrial Research. Bulletin No. 69: Scientific and Industrial Research, 1937-1938. Pp. vii+113. 2s. 6d. Meteorological Office Note No. 23: The Cyclonic Storms in Northern New Zealand on the 2nd February and the 20th March 1938. By Dr. M. A. F. Barnett. Pp. 34. Meteorological Observations for 1937. Pp. 33. (Wellington: Government Printer.) [313]

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Industrial Development and Social Welfare

FEW major questions have emerged so rapidly from the theoretical to the practical stage in recent years as that of the location of industry. When the problems of the location of industry in Great Britain were first discussed by Political and Economic Planning (P.E.P.) in 1931, the idea of aiding the location of industry was generally dismissed as impracticable, and little improvement in public opinion was discernible when P.E.P. in 1935 first began the preparation of its report on this question, a summary of which appears elsewhere in this issue (p. 770). Since then, however, many authorities and considerations have stressed the importance and urgency of attention to the complex problems which this question presents.

This was one of the main points made by Lord Stamp in urging the establishment of a Royal Commission upon population changes and the agencies required to deal with questions arising from these problems as they develop. A programme of research proposed by a group of experts in the universities, quoted by Lord Stamp in his "The Science of Social Adjustment", includes a quantitative investigation of regional distribution of population with reference, among other matters, to the location of industry. The report of the Town Planning Institute last year, recommending the National Advisory Board, directed attention to the importance of recognizing trends in population changes due to the location of industry as well as to changes in age distribution and the declining birth-rate.

Already in 1934, in endowing the Commissioners for the Special Areas with financial and other powers to induce industries to locate themselves in areas of unemployment, Parliament has given limited shape to the public concern that industrial enterprise should be so prompted and directed

that it would meet effectually the requirements of the community, not only in the supply of goods and services at the point where they are wanted, but also in the supply of employment where it is wanted. The reality of that public concern finds further expression in the view asserted in Parliament and elsewhere that the Special Areas Act itself is an experiment to determine the value to these areas of providing special treatment, and to learn whether the results obtained warrant a wider application. The pressure of opinion which compelled the Government early in 1937 to over-rule a departmental decision to build an aircraft factory in the Maidenhead district sprang as much from growing awareness of the necessity of long-range statesmanship and resolute scientific investigation in the interlocked problems of town planning, location of industry, national health and defence and the provision of amenities, as from the threat to amenities and the vulnerability of a factory contiguous with the Greater London area.

The dangers of the excessive concentration in the Greater London area were emphasized in many ways at the time of the September crisis last year, and planned control of the growth of London has been advocated by Sir Raymond Unwin before the Garden Cities and Town Planning Associations. Since then, the question of planning the location of industry in regard to defence has assumed increasing importance as a factor in defence against air attack, and defence considerations have to be taken into account in any system of State guidance or location of industry.

The P.E.P. report leaves no room for doubt as to the complexity of the problem and its dynamic rather than static character. Essentially the location of industry involves the problem of the

use of the land. This is the affair of town and country planning and of land management. With this particular aspect, local authority planning committees, the Ministry of Health, individual landowners and agents in charge of public or semi-public estates are already dealing. The chief need here is to secure a better informed and more co-ordinated type of development, through a central planning body able to collect the necessary information and use it in guiding the local authorities concerned. Some pooling of ownership and management, in the public interest, of land in and around growing towns may also be required.

Secondly, there is involved the maintenance of a balance between different regions of Great Britain which will prevent some from exploiting and sapping the vitality of others, and in particular prevent London from dominating further and enfeebling the life of the rest of the country. The third problem is regional development and the guidance of the location of industry. This problem affects the industrialist, the utility services, the Board of Trade and the Ministries of Labour and Transport, just as the second concerns public administration, aided by the universities, the British Broadcasting Corporation and other cultural agencies.

The report frankly recognizes that a long-term policy is involved, and that many years may pass before the full effect of that policy is felt, even if a number of immediate steps could be taken to improve the present situation or minimize its dangers. The first need is, however, the elaboration of a definite and constructive national policy, and in this a clear statement of objectives is required. The State, it is true, cannot be expected to avert the consequences to industries of natural phenomena, technical progress or international forces. At the best it can only mitigate them. When, however, the odds are lengthening against the selection, by the most far-sighted industrialist, of a location which will remain economic for him for a long period, owing to the increasing rate of technological change and the multiplication of extraneous and unpredictable factors, it is essential that the State be prepared to establish services which will enable the industrialist to perform his function more efficiently.

To promote the efficient functioning of industry without detriment to existing standards of living or disruption of society is one of the first objects of national industrial policy. A second objective must be the co-ordination of the many State

activities which affect industry and economics, and as to eliminate overlapping and waste and to co-ordinate the provision of State services generally with industrial requirements over a long period. Powers will also be required to curb the activities of the minority of economic pirates whose influence may be out of proportion to their numbers, and it is now necessary for the State to possess power to direct the nature of industrial development with reference to the requirements of national security.

The primary need, accordingly, is a well-formulated but flexible policy which will guide the use of all national resources. In several spheres start has already been made in this direction: the unification of coal royalties in the hands of the Coal Commission, the establishment of the Electricity Commission and of the Central Electricity Board, as well as the unification of numerous local bodies into catchment boards, being examples. As yet, however, the control of the use of the land under the Town and Country Planning Act which must form the starting-point of any form of actual control over national resources, is scarcely effective, and it is evident that local authorities should be given more explicit guidance in the principles they should observe.

Industrial location is, of course, a wider problem involving a balance between the varied economic requirements of the community and the requirements of the manufacturer, and a fundamental conclusion of the report is that it requires treatment as a whole on a national as well as on a regional or local scale. Reconditioning of the present Special Areas and the prevention of the recurrence of the same troubles elsewhere can only be a gradual process. Permanent machinery is required for guiding and adjusting industrial growth.

Extension of national action in this respect would require a reassessment of priorities, and this in turn involves the collection of information and the evolution of a satisfactory method of measurement. Existing methods of measurement have scarcely been adequate for the complex problem of measuring the current prosperity and future prospects of localities, and accordingly one of the major tasks of the Industrial Development Commission proposed in the report would be the provision of a centralized information service to assist industrialists in the choice of sites and locations of new plant and in problems of industrial development generally.

This proposed Commission would accordingly be charged with the responsibility of keeping und

review factors affecting the efficient operation of industry, with particular reference to those factors arising from the choice of location. It should be empowered to publish information concerning the facilities available for the establishment of factories in all suitable areas. It should be provided that the services of the officers of the Commission would be available for prior consultation by persons desiring to apply for licences in respect of new factories or extensions.

This is regarded as one of the most important sections of the work of the proposed Commission, and the smooth working of the machinery as a whole would probably depend largely upon the success achieved by the Commission in collecting and disseminating information and advice calculated to assist manufacturers in this matter. An efficient central advisory service, in practice, might obviate all question of compulsion in the majority of individual cases, since the choice of a suitable site would be determined in amicable agreement, and confirmation of that choice through the licensing machinery would then be a formality. Moreover, such a service, on the basis of continued research, should relieve industrialists of the laborious and wasteful task of conducting their own preliminary investigations, and present the relevant facts for consideration much more rapidly and lucidly. It might also put before the industrialist factors he might otherwise overlook, such as the interest of the industrialist as well as of the community in creating and maintaining a reasonable balance of industries within broad economic regions.

The organization of an efficient information service is largely a matter of intensive economic research into the growth of industry and the factors affecting it, and of ensuring that the service is recognized by industry and used in practice as a matter of course. The task of undertaking the necessary research and keeping the information up to date should not, however, be underestimated. It involves, for example, the determination of the economic regions into which Great Britain would be divided by the Commission, and the needs of those regions in relation to industrial balance. A comprehensive knowledge of sites available and suitable for further industrial development is essential as well as a full knowledge of the existing distribution of industry and of national resources generally. It also involves the determination of a line of policy with regard to social and strategic considerations

in relation to the distribution of unemployment, vulnerability to attack and other factors.

We have here, in fact, a scientific approach and a programme of research which have long been advocated by those, within the ranks of scientific workers or without, who have sought to approach these complex problems in the spirit of science. This alone should commend the report and its recommendations to the interest and support of scientific workers, while the value and magnitude of this preparatory work are indicated in the opinion expressed in the report that a considerable interval would be justified between the establishment of the Commission and the coming into force of certain of its executive powers, such as the licensing provisions.

The second main purpose of the Industrial Development Commission recommended by the report is the co-ordination of policies and actions of central and local government authorities, public utilities and other institutions, and it is in pursuance of the task of guiding the future location of industry, to avoid the repetition and multiplication of mistakes of the past, that the report suggests that the Commission should be charged with the responsibility of licensing new factories or extensions to existing factories. Such powers of restraint are regarded as essential, although it is believed that only rarely would it be necessary for the Commission to exercise its veto. Not the least service of the report is the way in which, fairly but undisguisedly, it puts the case for such compulsion.

These proposals of the report in regard to the licensing of new factories and evacuation and resettlement schemes for derelict areas, radical as they seem, are only the logical extension of principles which have already been tentatively adopted. Moreover, the clear but far-sighted statement of the principles of evacuation or re-settlement which the report contains should dissipate controversy on general ideas and facilitate the elaboration and execution of detailed plans, even if the financial estimates of the report prove to be somewhat optimistic. The conception of spending to create a model town, instead of prolonging the life of one that is moribund, is essentially in keeping with a scientific policy, and the bold constructive proposals of this report have strong claims on the attention of all scientific workers who are in sympathy with its underlying conception of a new co-operation both in form and in purpose for the integration of industrial expansion and social welfare and stability.

Science and Trusteeship in Africa

Science in Africa

A Review of Scientific Research relating to Tropical and Southern Africa. By Dr. E. B. Worthington. (Issued by the Committee of the African Research Survey under the auspices of the Royal Institute of International Affairs.) Pp. xiv+746. (London, New York and Toronto: Oxford University Press, 1938.) 10s. 6d. net.

IN his Rhodes Memorial lecture in 1929, General Smuts directed attention to the paucity of information available regarding the policies, activities and plans of the different European colonial powers in Africa, and made the valuable suggestion that a comprehensive survey should be undertaken to collect such material. A committee was appointed to give practical effect to his proposal; funds were made available by the Carnegie Corporation of New York; Sir Malcolm (now Lord) Hailey was invited to direct the survey, and a number of preparatory studies of different aspects of the survey were commissioned. Among other studies, Dr. E. B. Worthington, whose biological studies of East African lakes are well known, was asked to prepare a report on the progress of scientific research and technical services having a bearing on African development. Dr. Worthington began this work in the autumn of 1933, and in the course of his studies accompanied Lord Hailey during 1935 and 1936 in his visits to Nigeria, Dahomey, Togoland, the Gold Coast, Sierra Leone, Gambia, Senegal and the French Sudan.

When Dr. Worthington's draft report was completed, the committee in charge of the Survey came to the conclusion that the material it contained should be published as a separate volume: for while much of it could be summarized and incorporated in Lord Hailey's comprehensive survey, to do full justice to Dr. Worthington's studies and to provide scientific workers and scientific and technical institutions, both in Africa and Europe, as well as the many interests associated with African finance and administration, with a detailed record of scientific endeavour and its bearing upon African development, demanded space which would have added too greatly to the bulk of the major volume and upset its balance. The committee is to be congratulated on its decision and Dr. Worthington on the result of his labours. With the assistance of specialists in many fields of research, he has presented us with a clear account of the nature and extent of the

problems confronting African administrations, the contributions which scientific workers have already made towards their solutions, an indication of the paths in which their future activities should be directed and the organization necessary in order that the results of research may be more effectively applied.

From one point of view this is an encouraging volume: from another, exasperating. It is encouraging because much has been done during the past fourteen years to improve and extend the scientific and technical services in British Colonial Africa, where any existed, and to provide them where there were none. At least some of the prejudice against central research stations has been broken down with recognition of their obvious utility. Also there is a growing tendency to utilize the services provided by the Imperial Research Bureaux. Other European Colonial powers are paying much more attention to the function of utilitarian scientific research in the development of Africa's resources. The Belgians—to a lesser extent the French—have developed a system of co-ordination between scientific workers in Africa and those in the universities and research institutions in Europe which presents features that might with advantage be incorporated in our own. Another important point is the realization by the several European Colonial powers that certain problems are common to all African territories, for the solution of which international co-operation and pooling of funds and effort is essential. Some of this co-operation is effected through the Health Section of the League of Nations, some by the interchange of information and literature between the different centres in Europe, and at least one major menace, the locust, has led to the formation of an International Locust Control Committee.

It is expecting too much, however, for international co-operation to advance rapidly while the co-ordination of research and technical services of British territories is still meeting with opposition. Many local executive and legislative councils still lack the vision to realize that well-staffed and well-equipped laboratories serving groups of territories and drawing financial support from each member territory of the group would result in economies as well as more effective work, at the same time giving urgently needed assistance to those territories which at present lack the money to provide any research services of their own. Again, even in some British territories there is

such avoidable waste of effort due to the non-existence of any machinery for the systematic collection and dissemination of data from the notebooks of field-workers: neither is there any effective agency for the interchange of results and information between the different scientific and technical departments. Further, there is still far too little co-operation between the universities of the British Empire and other centres of research, and those agencies directly responsible for the investigation of African problems.

There is yet another aspect of co-operation to which Dr. Worthington directs attention. It must be obvious that the fight against human, animal and plant diseases, the war against pests like the mosquito, tsetse-fly and locust, effective measures against erosion, soil desiccation and the destruction of forests, and the general improvement in methods of cultivation, stock-raising and the health of the people, depend upon the effective co-operation of Africans with the European personnel. In their present stage of development, the tropical and sub-tropical African territories cannot be expected to shoulder much more in the shape of additional financial burdens involved in the essential expansion of the specialist services, unless the expansion either takes the form of the employment of African personnel or the European powers are prepared to advance the necessary funds for considerably more European specialists. But even if money is forthcoming from outside Africa, it would better be spent on the training and recruitment of Africans than on the provision of many more

Europeans. Already the time of many highly trained Europeans is too much occupied in performing routine field duties which experience has shown could be quite efficiently done by Africans were they given the necessary preliminary education and training. This much is certain—not until there are thousands of trained Africans co-operating with Europeans will the results of the researches of the latter into African problems bear the fruit they deserve. Africa has an abundance of generals, but it lacks the disciplined forces to fight this epic battle with Nature. Mass education for Africans alone can provide the material from which these forces can be raised.

It is impossible to give, even in outline, an account of the work on African problems which Dr. Worthington surveys in seventeen chapters on the different specialist services, or even to summarize the gaps and deficiencies which must be made good. It must suffice to commend the volume to the attention of all scientific workers interested in tropical and sub-tropical research: to all individuals and companies interested in the economic development of the territories: to all missionaries and education officers: and to all members of African administrative services. It will be of the greatest service to them. Together with Lord Hailey's survey and Prof. Frankel's masterly account of "Capital Investment in Africa", it should help them to appreciate the magnitude and complexities of the tasks before them and, above all, the implications of European trusteeship.

A. G. CHURCH.

Precautions against Air Raids

Commonsense and A.R.P.

A Practical Guide for Householders and Business Managers. By Major-General C. H. Foulkes. Pp. 92. (London: C. Arthur Pearson, Ltd., 1939.) 1s. net.

THERE has been so much nonsense talked and written about A.R.P. that it is refreshing to read this little book, even if one does not entirely agree with all it contains. It will not be popular to suggest that the reason for the better balance with which the subject is here presented is that the book is written by a soldier; but much misunderstanding would be avoided if the public could be made to realize that A.R.P. is a war problem. It is true that General Foulkes is an exceptional soldier, because besides being an engineer officer of great experience he was Director

of Gas Services during the war of 1914-18; so that anything he has to say, either on the subject of cover from high explosive or on defence against gas, is worthy of the closest attention. He has also been consulted by many important works and offices about their A.R.P. schemes, so that he has a wide knowledge of the problems that actually arise. The book lives up to its title, and is a simple and practical guide to those who wish to take reasonable precautions.

I must join issue with General Foulkes on one point. On p. 27 he says:

"Expert opinion is now almost unanimous in believing that gas is very unlikely to be used, not because of its supposed inhumanity, but because it would not be as effective, weight for weight, as high explosives when employed against an organised community sheltered in buildings. The

conditions were very different in the chaotic state of the battlefield: men had necessarily to occupy gas-contaminated ground for days at a time; and guns had to be served and ration and working parties were compelled to expose themselves in the open. Decontamination of scores of square miles of scarred surface was an obvious impossibility, and the air in a bombarded area remained dangerous for days, while contaminated mud was often carried unwittingly into sleeping quarters, with disastrous results."

Now consider an area containing important munition works surrounded, as many are, by workers' dwellings; after a bombardment with high explosive many of the houses would be blown down, and the area covered with dust and debris. If such an area were bombarded with mustard gas it would be extremely difficult to decontaminate—in fact, the present method of decontamination would not succeed in removing mustard gas from a pile of broken brick and plaster—so that, to quote General Foulkes, the air in the bombarded area would remain dangerous for days. The workers would therefore either have to evacuate the area, remain in their houses, or stay in the factories. Unless they stayed in the factories, work would be stopped, and even if they did stay, transport to and from the factories would have to pass through the area to bring food and materials and to remove manufactured articles. In any event, I think that there would be a large

number of slight casualties from carelessness, and a hundred thousand sick, on account of the care they would require, may be a great disadvantage in war.

I do not wish to exaggerate the power of gas, but it is dangerous to belittle it, and we should not forget that during the Great War mustard gas was distributed in shells and only came in pints, whereas in aeroplane bombs it would come in gallons.

The book makes no mention of the magnesium incendiary bomb, which in my opinion is likely to prove more effective than the thermit bomb. I am also sorry to find that there is no reference to the possible use of bacteria. But perhaps these matters are left out for the sake of simplicity which is the keynote of the whole book.

The author has a keen sense of humour but he has carefully suppressed it, so that it only breaks out, generally in the form of a footnote, when some irresistible absurdity has to be exposed. The book is cheap, clear, and concise, and should be read by everyone in a position of responsibility. Its value is largely due to the acceptance of three fundamental facts, namely: (1) that if we fight at all the paramount policy is to win the war; (2) that our resources, though large, are not unlimited, and must be disposed of in accordance with this policy; and (3) that in war time some casualties are inevitable.

H. A. Sisson.

To-day and To-morrow in Inorganic Chemistry

Modern Aspects of Inorganic Chemistry

By Dr. H. J. Emeléus and Dr. J. S. Anderson. (Twentieth-Century Chemistry.) Pp. xi+536. (London: George Routledge and Sons, Ltd., 1938.) 25s. net.

THE science of inorganic chemistry to-day is very different from what it was fifty years ago; it has been invaded, even pervaded, by physics to an extent that it is the physical and physico-chemical aspects which are taught to-day and are destined to provide the developments of to-morrow.

The modern student of honours standard has no difficulty in approaching the subject from this angle; the older generation find it less easy, especially as the rate of progress is so fast that what is regarded as fact to-day may be cast aside to-morrow. Perhaps only believers should study modern physics; critics as a class may have to

wait a decade before they are tolerated as of service.

The personal reputation of the authors of the work under notice ensures their competency to undertake the task, which they avow in the preface, of reviewing the developments of the last two decades and relating them to the science as a whole: the book is intended for teachers, honours students and research workers and has the further laudable object of helping to overcome the comparative neglect of inorganic chemistry in Great Britain as compared with its popularity in Germany. The authors believe that it should rank as an absorbing experimental science which offers unlimited opportunities for the development of new experimental methods.

The reviewer endorses this view the more because he clearly remembers practically the same thing being said by the greatest of organic

hemists, Emil Fischer, about 1900 to his two young assistants, O. Ruff and A. Stock, when first causing them to work on the subject of inorganic chemistry. The literature shows how much these two men and their students have now contributed to the subject, and one can admire the prescience of Fischer at a time when organic chemistry was so vigorous. It is to be hoped both that the British authors will imitate the men mentioned and that their book will inspire others to do likewise.

The time-worn method of discussing the elements in groups has been abandoned. First comes atomic, then molecular structure, followed by

chapters on co-ordination compounds and inorganic stereochemistry, which leads up to polyacids and silicates. Hydrogen and the hydrides receive a chapter, as do the peroxides and peracids, the carbonyls, etc. Another section deals with reactions in liquid ammonia and liquid sulphur dioxide, and a final one with radioactivity and atomic disintegration.

At bottom the book is essentially chemical, and though stiff reading to many of us, it is as clearly written as is possible in these days when scientific language contains so many coined words that it requires the aid of a glossary to interpret it.

E. F. A.

Rock Carvings in the Far North

Monumental Art of Northern Europe from the Stone Age

by Gustaf Hallström. 1: The Norwegian Localities. Pp. 544 + 64 + 48 plates. (Stockholm: Bokförlags Aktiebolaget Thule, 1938.) n.p.

THE occurrence of rock carvings in Norway and Sweden has long been known. They are found on hard rock surfaces on the west coasts of Scandinavia from the county of Tromsø right up to the north to the extreme south of Sweden. They also occur inland in Jemtland and elsewhere. More than one technique can be observed and alimpeests also have been found. Clearly this art includes figures of very different ages. Actually two distinct groups can be distinguished. One is centred in Bohuslän, north of Göteborg, and is well known, being characterized by the large number of ships depicted; it dates for the main part to the Bronze Age and has been well studied and published; figures belonging to it are found so far north as the Trondhjem district.

The second group, with which the present work is concerned, is the older. This can be demonstrated at Bardal where a superposition occurs, figures belonging to the Bronze Age group being uppermost. For the most part these older rock carvings are of animals executed in a naturalistic or semi-naturalistic way, but signs and other figures do also occur. Very occasionally paintings both of human beings and of animals are found, but these are invariably extremely conventionalized. This earlier art group can be subdivided, a three-fold chronological sub-division having been determined by considering (a) palimpeests, (b) style, (c) position. As many of the decorated rocks occur on raised beaches which were once under

the sea, it is sometimes possible to be certain of a date *post quem*, at any rate. This art is usually connected with the Arctic Culture, the roots of which lie far back in mesolithic times. The motives underlying its production are completely unknown.

The present work is in the nature of a catalogue of this early art group in Norway. The second volume, dealing with the sites in Sweden, Finland and Russia, will be published in about a year's time. Actually, of course, the title is misleading. These glacier-worn surfaces of rock covered with engravings or peckings should not be described as monuments, but this does not detract from the very great importance of the work as a whole, and archaeologists will be particularly grateful to Dr. G. Hallström for having at last put on record a corpus of the finds. The system he has adopted is geographical, and a numbered sketch map gives the position of the various sites, which are then described in order. There is a number of illustrations at the end of the volume and a separate portfolio of reproductions of the drawings.

In no sense is the work meant for armchair reading. It is a catalogue, but none the less important for that. The English, though sometimes a trifle quaint, is not obscure. May I recommend that anyone wishing to spend an interesting vacation abroad should acquire this book and visit some of the sites therein described. Doubtless the explorer will find it wise to bind up the work in three or four smaller fascicules for convenience of handling, but I know I can promise him a very interesting expedition, made possible for the first time by the publication of this work. We all eagerly await the second volume.

M. C. BURKITT.

The Ojibwa Woman

By Ruth Landes. Pp. viii+247. (New York: Columbia University Press; London: Oxford University Press, 1938.) 15s. net.

THE psychological study, of which Miss Landes gives the results in "The Ojibwa Woman", was undertaken with the express purpose of pursuing the inquiry in conditions other than those, that is, of Western civilization, in which similar psychological investigations have usually been carried out. Her choice of the Ojibwa of western Ontario, among whom she spent seven months collecting material, was well judged. The conditions, which here form the background, were certainly both unusual and peculiar. In the Ojibwa society, which came under Miss Landes's observation, it is only the male half of the population and its activities which fall under traditional regulation. The female half is left to a spontaneous and confused behaviour. In consequence there is a wide range of development in the personalities and careers of the women. As the author says, "Some rival the most successful men in ambitions and honours received, but do not pursue them in systematic male fashion; others engage in both male and female pursuits; still others are reduced to an incompetence that continues until death". This dictum is demonstrated in detail, and the resulting conduct and mentality of men and women are contrasted in youth, in marriage, in occupations and in abnormal manifestation. The force of the study is much enhanced by a free use of the actual words of the subjects under observation, and further illuminated by a number of life-histories.

Étude pratique des rayonnements

Solaire, atmosphérique et terrestre (méthodes et résultats). Par Ch. Maurain. Pp. iv+189. (Paris: Gauthier-Villars, 1937.) 80 francs.

IN this monograph, Dr. Ch. Maurain, the director of l'Institut de Physique du Globe, covers chiefly from an observational point of view the important study of radiation, solar, atmospheric and terrestrial. Certain phenomena associated with the ionosphere indicate that the sun's ultra-violet radiation varies in sympathy with the eleven-year sunspot cycle; yet the reality of a related periodic variation of the integrated radiation (the 'solar constant') as received at the earth's surface is extremely difficult to demonstrate in spite of years of observation linked with the name of O. G. Abbot (see NATURE of April 29, p. 705). Passing from the determination of the solar constant, there is the allied study of the incoming solar radiation as it passes earthwards through the atmosphere; the long-wave radiation from atmosphere and earth, and the distribution of these various factors in the energy balance sheet, which Dines first showed meteorologists how to prepare.

The present work usefully brings together the methods of measuring the various quantities involved, the instruments used, their principles and the practical difficulties encountered. A number of numerical examples and other tabular matter include observations made at the Observatory of Saint-Maur near Paris.

La Vie morale et l'au delà

Par Jacques Chevalier. (Bibliothèque de Philosophie scientifique.) Pp. 211. (Paris: Ernest Flammarion 1938.) 17 francs.

THIS timely work gives an analysis of the ultimate causes of the darkened intellectual outlook of our time, and proposes the necessary remedies. The excess of liberty and the restriction of liberty which characterize our age are to be accounted for by the absence of strict moral discipline. But an ethical doctrine is not to be constituted at random to suit some particular ends: it must be founded upon a rigorous metaphysics embodying a clear vision of reality and the spiritual values attached to it. This reality does not stop short at the world of appearance; but it goes beyond it and causes our belief in another life the nature of which is the real foundation of our moral discipline in this world.

Written in beautiful language and displaying with restraint a valuable metaphysical experience, this recent work of the learned dean of the Faculty of Letters of the University of Grenoble is well worth of an English translation. T. G.

An Introduction to Chemistry

By Prof. John Arrend Timm. (International Chemistry Series.) Third edition. Pp. xx+568. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 21s.

IT is not surprising that Prof. Timm's book has reached a third edition since its first publication in 1930, for it has many features which will recommend it to students and teachers. It is not so much a regular text-book of physical or inorganic chemistry as a general survey of many parts of chemistry which are of particular interest. It does not deal systematically with the elements, and in fact it requires much supplementing by other books; but it takes up such topics as the atomic and molecular theories, atomic structure, valency, combustion, radioactivity, solutions and electrochemistry, colloids, and some part of organic chemistry, and develops these subjects in a very interesting manner. There are many historical allusions.

Les Méthodes actuelles de la chimie

Par Prof. Pierre Jolibois. (Collection Armand Colin. Section de Chimie, No. 37.) Troisième édition entièrement refondue. Pp. 224. (Paris: Armand Colin, 1938.) 15 francs.

THIS unpretentious little book gives a very accurate and readable survey of the fundamentals of physical chemistry and their application which all students could digest with profit. The mathematical equations are not deduced; but they are clearly stated and their applications are illustrated by well-chosen examples. Recent advances, such as Raman spectra, strong electrolytes and the structure of crystals, are included, and the sections on the phase rule are particularly good. Students who wish to improve their knowledge of scientific French and at the same time to clarify their ideas on many branches of physical chemistry will find this an excellent book for their needs.

The National Nutrition Conference

THE modern State accepts without serious question the duty of applying, without stint, all the resources of science and finance to the effective defence of its citizens from enemy attack. It would appear at least equally important that the democratic State should utilize all the help of modern science to make its citizens worth protecting.

The cost in money of providing proper and adequate food for every citizen in Great Britain who at present is unable to provide it for himself is at the worst only a fraction of the cost of defensive armaments, whilst the cost in disease, in social and industrial, or even military inefficiency and in sheer human distress of allowing malnourishment to continue is one that no civilized people can afford.

An adequate scientific basis has existed for several years for a positive national nutrition policy linking health and agriculture; there has been wide discussion of the bases of such a policy, and an increasing demand from several quarters that it be put into practice. This policy would on the one hand provide the benefits of a sufficient supply of total nutrients, and in particular of protective foods—milk and dairy produce, fresh fruit and vegetables, eggs, fish, and, to a lesser extent, fresh meat, most of which are produced at home or in the Dominions—to citizens of all ages; and on the other hand it would assist the home farmer by giving him a much larger and guaranteed market for that type of human food which the climate and soil of Great Britain are particularly fitted to provide.

All interested in the development of a healthy, physically fit citizen must therefore have welcomed the decision of the British Medical Association to call a national conference to deal with the wider aspects of nutrition.

The conference was duly held during April 27–29 at British Medical Association House. In view of the quality of the discussions and the character of the participants—there were many senior representatives of medicine, physiology and nutritional science, agriculture at home and abroad, industry, social services, and education present—their pronouncements can only be ignored by a Whitehall completely insensitive to informed public opinion. With our present Government, these discussions can scarcely fail to encourage those who frame our policy to act, and to act quickly. The gap between the extent of our nutritional knowledge and the social utilization

of such knowledge on a national scale has been widening steadily, and further delay can only mean, in terms of readily understood coinage, inferior recruits, persistent industrial inefficiency, continued high expenditure on hospitals and sanatoria, and more subsidies of the wrong kind to farmers, and, in terms of a different coinage, an unconscionable waste of human life, happiness and potentialities.

The conference covered a wide field. The inaugural address was delivered by Sir Arthur Salter, M.P., who summarized the general findings of recent nutritional surveys in Great Britain and recalled the inevitable conclusions drawn as to the inverse relationship, on the whole, between income on one hand, and disease and death-rates on the other. He pointed out the great part played by milk in the prevention of malnutrition, the severe economic penalty now attached to large, or even moderate families, and the necessity that the cost of the major items in the cost of living figure should be kept to an absolute minimum. One of the policies he advised is a standard guaranteed price to home producers of the more important foodstuffs. He criticized severely some of the recent measures adopted by the State to help farmers as ill-conceived and wasteful, and in particular the weaknesses inherent in the Agricultural Marketing Acts. By this legislation, for example, the consumer price of milk is controlled by the statutory power of the Milk Marketing Board, a body composed solely of producers, which must inevitably consider milk primarily as the channel of an important part of the farmer's income, and only secondarily as the most essential of foods. The whole system of control should be reformed so as to make the public interest prevail.

Sir Arthur gave an account of the present position of Great Britain as regards food storage requirements, and urged the need for provision of food reserves on a much more adequate scale than anything that has yet been done. One per cent of our annual defence expenditure would provide the total sum required to handle the necessary quantities.

Following the inaugural address came a discussion on the physiological aspects (misnamed in the programme the 'medical' aspects) of nutrition. Prof. E. P. Cathcart pointed out that proper nutrition depends not only on an adequate and balanced food intake, but also on exercise, sleep, housing and working conditions, and adequate relaxation of body and mind. He made a cautious

survey of some of the requirements of an adequate diet, emphasized the need for education on how best to spend a relatively low income and how to make the best use of available foodstuffs. Dietary habits, despite man's natural conservatism as regards food, are changing for the better. It is most desirable to study the means by which this slow change in dietary habits could be accelerated. Dr. G. P. Crowden mentioned, *inter alia*, one of the ways in which this is being done, namely, by wide circulation of small, inexpensive household guides on sound dietetic lines, containing shopping lists, menus and recipes.

Major-General Sir Robert McCarrison, in a cogent contribution, emphasized that there is now no controversy about the main principles of nutrition. Food, as fresh and natural as possible, produced from unimpovertished soil, is the main factor for health. He regards malnutrition as essentially a functional disturbance, and only in its later stages does malnutrition lead to gross bodily changes. His plea for more precise methods of assessing malnutrition, especially in the young, was repeated time and again throughout the conference. Another factor requiring further research and elucidation is 'freshness' in food. What exactly does freshness mean, and how important is it, nutritionally? This was mentioned by several speakers. Later speakers also stressed the real need for keeping clearly distinct the *minimal* diet, on which health might be barely maintained, and the *optimal* diet which, without excess, provides a factor of safety.

The second session, on the "Means of Stimulating Production (a) Home Agriculture" was under the chairmanship of Sir John Russell. The thesis of Lord Astor's paper, which immediately followed the chairman's pertinent remarks as to possible ways of reorganizing agriculture, was that the abolition of malnutrition should be the next major social reform. He, in common with other speakers, expressed deep dissatisfaction with recent agricultural-cum-nutritional policy. It is high time that a home agriculture should be developed which is more suited to our times and needs—among which adequate nutrition of the whole population is the foremost—and which avails itself more freely of recent scientific and mechanical progress. Although home agriculture is still very much alive, the gross output of British farming being greater than it has ever been, he considers that, with the further spread of progressive methods of production, the protective foods could be provided for all consumers at cheaper rates than those now in force. Properly planned distribution, from which redundant services have been eliminated, can still further cheapen the consumer cost of milk, for example. These benefits should not be withheld

any longer by marketing boards, whose presence freedom from Parliamentary control should be withdrawn. He enlarged on the changes which might easily be brought about in milk production and would benefit producers and consumers alike and regretted the hasty withdrawal last December of the Milk Industry Bill before it received proper consideration by Parliament. Public money being spent on agriculture now in a wasteful way which helps only a few farmers. This money should be available to finance a properly conceived national nutritional-cum-agricultural policy, which would bring health and welfare to millions, not least to the farmers themselves. Dr. Keit Murray, in a thoughtful paper, also gave reasons for believing that some form of subsidy from the Exchequer would be required, at least until such time as increased productive efficiency, a factor normally of slow operation, should have caught up.

Mr. Anthony Hurd agreed that farmers could make a much bigger contribution than they are making at present towards the better feeding of the human community, and also stressed the need for wider education in food values. Both he and Mr. Cleveland Fyfe regard it as essential to consider also the balance of farming and the need for the preservation of the fertility of the soil so that the generations of farmers who come after can continue to play their part without hindrance in the future feeding of the nation. Prof. W. C. Miller emphasized that the health and adequate nutrition of farm stock are prerequisites to the production of satisfactory dairy produce, poultry and eggs, and that any increasing demand for home-produced protective foods could not be met without a sound foundation, on the farm, of knowledge and practice of disease prevention. Proper housing, satisfactory methods of rearing, adequate exercise, as well as feeding, are as necessary to the farm animal as to the citizen if health is to be maintained.

The direct interest of the Dominions and the role of the Dominion producer in Great Britain's nutritional policy were ably dealt with by Mr. F. I. McDougall (Australia) and by other Dominion representatives. A nutrition policy for the whole Empire is needed. Malnutrition exists in acute forms in various parts of the Empire, and, in fact, in the world at large. An effective endeavour to meet it would solve not only many of the problems of Dominion food producers, but probably also some of the international problems which underlie the present tension. Recent international agreements, far from remedying the acknowledged under-nourishment of half the world, have been agreements to restrict food production, to which Dominion Governments have been hesitant and unwilling partners.

Mr. G. V. Jacks regards the high food output of some of the Dominions as the result of ruthless over-exploitation of stored soil fertility which will have to be paid for in the near future by diminished productivity due to soil exhaustion and soil erosion. In Great Britain and some of the older countries soil conservation, including manuring, draining, proper crop rotation, etc., has been carried out for centuries as a matter of course. The costs of this good farming represent the major part of the difference in costs of production between home produce and similar produce from the Dominions. Prof. S. M. Wadham would not accept this view as applying to Australia, where farmers over the really productive areas are fully alive to the danger of soil exhaustion and have already dealt with it.

There was nearly complete unanimity that lack of purchasing power among the lower income classes of the population is at present the main factor in faulty nutrition. Mr. L. S. Amery, M.P., in introducing the discussion on family allowances, pointed out that a wage system which takes no account of family needs and responsibilities is to-day inflicting grave hardships on millions of malnourished children. He made a convincing case, both on the grounds of simple social desirability and of the future industrial and defence needs of the country, for additional purchasing power for families in which there are growing children. Parents are now finding their own solution to the problem by refusing to have children, and as a consequence we are heading for national catastrophe at a speed measurable by the decline in the birth-rate. Family allowances should effect an appreciable saving on the £300 millions annually which the nation pays for ill-health, not to speak of the new wealth they would add through the positive increase of national efficiency. Mr. Amery's views were supported by Mr. Laurence Cadbury and Sir Kenneth Lee, who emphasized that no time should be lost in getting a national scheme into working order. Where private industrial schemes of family allowances are already in being, increased expenditure on food, that is, improved nutrition of the family, has been shown to be the major result. Extensions of the facilities for provision of free milk and meals direct to school children and to expectant and nursing mothers were advocated by Dr. Stella Churchill, not as a substitute for family allowances but as an efficient supplement to them. She emphasized that money spent on school meals and milk meant less spent on hospital beds, sanatoria, and unemployment in later life due to ill-health resulting from early malnutrition.

The final session of the conference, presided over by Sir Cyril Norwood, linked up the scheme

for improved nutrition with education both in the schools and amongst adults. Mr. Lester Smith stated that the colleges at which housecraft teachers are trained are very much alive to their opportunity of improving national nutrition by training their students in what to eat, as well as how to cook it. He made the useful suggestion that school journeys ought to embrace visits to farms, market gardens and orchards, as well as to industrial and manufacturing concerns. The greater use of the radio for the education of the public in matters of health and nutrition was recommended by Prof. V. H. Mottram, and the part played by the women's institutes, whose membership is largely made up of those actually responsible for the purchase and cooking of the family food, was emphasized by Mrs. Henry Haldane. This discussion made it clear that one of the main requirements in our educational system, having in view the objective of an improved national nutritional status, is a greatly increased emphasis on the elements of science and their bearing on health, throughout school life. Through this educational channel every future consumer, housewife, farmer, administrator and statesman has to pass.

The text of the resolution passed at the end of the Conference may be given in full, as it marks a clear but conservative appeal which ought soon to be reflected in Government policy.

"This conference called by the British Medical Association and composed of representatives of Medicine, Agriculture at home and overseas, Industry and Education, is deeply impressed with the importance of nutrition to the national welfare. It urges upon the Government the formulation of a long-term food policy in which the requirements of Health, Agriculture and Industry shall be considered in mutual relation. It is convinced that measures to secure the more ready availability to all sections of the community of food-stuffs which are held to be desirable on nutritional grounds should be accompanied by an educational campaign to encourage their increased consumption."

It is reasonable to expect, in a democracy, that Government policy, particularly when dealing with home needs, will be largely under informed democratic control. If, with proper knowledge of the circumstances, public opinion asks for, and is ready to pay for, improved social conditions, then if democracy means anything at all an honest and pertinacious attempt must be made by executive authority to plan and provide the necessary services. The present international tension, far from excusing any delay in making such provision for an adequate long-term food policy, sharpens the need for it.

The Living Coelacanthid Fish from South Africa

By Dr. J. L. B. Smith, Rhodes University College, Grahamstown

THE recent discovery of the Coelacanthid fish (*Latimeria chalumnae* J. L. B. Smith) near East London, as described in NATURE of March 18, p. 455, has aroused great interest. This has partly found expression in numerous requests from all parts of the world for the earliest possible publication of a detailed description. I am able to pursue my investigations only in very limited spare time. The preparation of an adequately illustrated detailed description, under present conditions, will occupy several months. I have therefore decided upon the somewhat unusual procedure of issuing a synopsis of the more important results of my investigations to date. This is in the form of brief outlines without discussion.

Few scientific workers are as fortunate as those who have concentrated upon Coelacanthid remains. The present specimen is a living tribute to the accuracy of their interpretations and reconstructions.

The specimen was somewhat damaged in the trawl, the skin having been broken in several places. Repairs were skilfully executed by the taxidermist.

Skull and head. The skull is unfortunately not quite intact. The basisphenoid and part of the structures around the foramen magnum were removed (and discarded) in mounting. The soft parts of the head appear to have been removed rather roughly. The remaining tissues are in poor condition. Only the structures left intact will be described as fact.

Air-bladder. According to the fairly definite evidence of the taxidermist, this organ was at the very most but feebly ossified.

The scales are cycloid and but little ossified. The proportion of residue after ignition of the unornamented portion of a mid-body scale is very much less than, but qualitatively identical with, that obtained by similar treatment of a teleostean scale. The exposed surface of a scale varies from one fourth to one sixth of the total area. The ornamentation on the caudal scales is in the form of spines, on the rest of the body as tubercles. The tubercles are superficial only; each is set in a thin oval basal plate with corrugated surface. The plates are attached to the scales by tissue which is softened by alkali. The tubercles are of simple structure with a central cavity (see Fig. 1). The lateral line tubes are posteriorly widely bifurcate.

Fins. All the rays of the first dorsal, of the principal and of the supplementary caudal are spinate. A few of the rays of the second dorsal and of the anal are basally feebly spinate. The outer face of the pectoral is spinate. The pelvic only are quite smooth. The bony rays of the dorsal and caudal are articulated. The soft ray are finely articulated to their bases. All rays are composed of two fused lateral segments.

Dermal bones. The cheek-bones are a post orbital, a squamosal, a preopercular and a sub orbital (lacrimojugal). On the middle of the lower surface of each cheek is a small bony stud which may be an obsolescent quadratojugal. The opercular is moderate in size. There are two dermal structures in a stage of arrested metamorphosis from scale to dermal bone, which are regarded as subopercular and interopercular respectively.

The intertemporals and the supratemporal appear to be fused. The exposed portion of each frontal is small, oval and flat. These bones are at feebly ornamented. The splenial and angular alone show externally on the lower jaw. The gular are large and heavy.

Fronto-rostrals. Just beneath the skin there are nineteen bones in this series on each side. On large frontal and a smaller 'pre-frontal'; nine 'rostronasals', including a canal-bearing bone (No. 18) often named 'premaxilla' in fossils.

There are eight bones in the 'parafrontal' series the anterior expanded bones having been named 'antorbital' in fossils. Besides these nineteen there are the small dentigerous rostral plates. Most of these bones are small and laminate.

Sensory canals. The main canals run much as have been shown in reconstructions. From the lateral line the canal passes through the supratemporal and intertemporal, thence 'parafrontal' to the snout. There it has a small superior median branch. Just below that it gives off an inferior branch which is the infraorbital canal (running through the lateral limb of bone No. 18, which anastomoses with the suborbital). Below this junction is a commissure across the snout. The canal then runs downwards and curves outwards to end on the outer edge of the rostrum around the inner face of bone No. 18. Just behind the frontal is the junction of the infraorbital canal running downwards through the postorbital, which continues through the suborbital to the snout. The anterior limb of the squamosal anastomoses with the

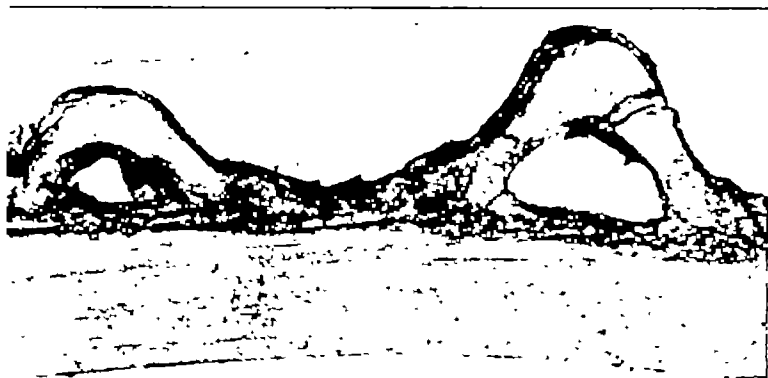


Fig. 1.

SECTION OF A SCALE ($\times 50$) OF *Latimeria chalumnae* J. L. B. SMITH.

postorbital-suborbital anastomosis and carries the uveal canal which continues through the preopercular, thence as a tube in the skin obliquely over the lower outer face of the quadrate. It enters the angular very obliquely and thence runs forward on the lower margin just below the surface of the symphysis. There is a posterior branch on the lower surface of the angular.

Olfactory organs. There are on each side three 'narial' apertures, two conventionally on the side of the snout before the eye, the third on the front of the rostrum. Each opening is the end of a simple tube which leads from a median capsule situated beneath a thin layer of mesethmoidal cartilage. The tubes and the capsule were apparently lined with fine rugose tissue. The capsule is depressed conical in shape. There is also on each side of the rostrum an infero-lateral nasal tentacle, apparently imperforate. On each side of the snout, anterior and anterior to the median nasal cavity, lies a sac, typically covered below, laterally, and partly behind, by the prevomer, in front by bone No. 18. That bone lies against the outer surface of the hind column of the prevomer. These sacs correspond with the usual 'olfactory capsules', but do not appear to have any external narial opening. The nerve supply to these paired capsules appears to be from the olfactory lobe, and to enter at the upper inner portion of the surface. The nerve supply of the mesethmoidal (pineal?) cavity appears to come from farther back.

Respiratory organs. The branchial arches and appendages were lost. The arches are stated to have been strongly spinate. Remaining is a spinate epihyal and ceratohyal. Also a superficially ossified tuberculate copula ('tongue'), to which appear to have been attached four branchial arches. There is apparently a hyoidean gill-slit behind the free margin of the 'preoperculum'. The spiracles are small and probably functionless.

The palato-pterygo-quadrate apparatus is massive

and typically oelacanthid. There is no hyomandibular. The prevomer is an unexpectedly solid structure, with the anterior edge of the autopalatine bearing against the hind surface of its outer columnar vertical process. The ectopterygoid overlaps the autopalatine and the pterygoid above.

Upper jaw. Maxillæ are absent, probably also premaxillæ. The upper jaw bears paired dermal plates attached to rostrals, prevomers, palatines and ectopterygoids. These plates are of fused

small teeth, and each bears one or two large conical tusks. On the pterygoids and parasphenoid are conical granular teeth. There are two feeble granulate 'epi'-pterygoid areas.

Lower jaw. There is a series of small 'labial' dentate plates on the outer surface of the dentary. Superiorly are four dentate plates on each dentary. The anterior coronoid is small and bears granular teeth as well as several large tusks. The posterior coronoid is large and feebly granulate at the base. The articular-prearticular plate is very long and is granulate anteriorly only.

Several letters from overseas have contained very harsh criticism about the loss of the carcass of this fish. Few persons outside South Africa have any knowledge of our conditions. In the coastal belt only the South African Museum at Cape Town has a staff of scientific workers among whom is an ichthyologist. The other six small

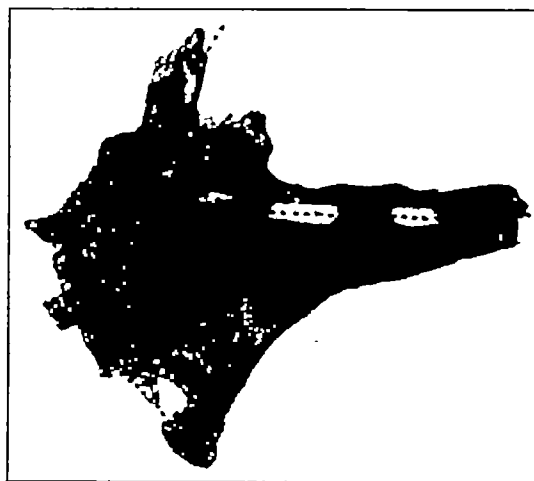


Fig. 2.

ROSTRO-NASAL, No. 18. NAT. SIZE. INNER MARGIN TO THE LEFT. A PIECE OF WHITE PAPER HAS BEEN INSERTED INTO THE CANAL. THE DOTTED LINES SHOW THE COURSE OF SENSORY CANALS. THE RIGHT-HAND LIMB ANASTOMOSES WITH THE SUBORBITAL.

museums serving the coastal area are in extremely poor circumstances, and generally have only a director or curator, who cannot possibly be an expert in all branches of natural history. There are not uncommon fishes in the sea which to any of the

latter would appear as strange as, if not stranger than, a coelacanthid. It was the energy and determination of Miss Latimer which saved so much, and scientific workers have good cause to be grateful. The genus *Latimeria* stands as my tribute.

Science at the Royal Academy, 1939

THE one hundred and seventy-first exhibition of the Royal Academy of Arts, which opened on May 1, may be described as conservative artistically, although many will regard it as dull. Whatever trends in art it may reveal, it is remarkable in that it reflects nothing of the alarms and excursions, of political events almost unparalleled, of the clash of arms and the clatter of armoured vehicles that dominated the period in which the painting was done. In the exhibition there are more Elizabethan men-at-arms on one picture than there are modern soldiers in the thousand other works. There is one interior that contains a gas-mask, and, surprisingly, only two or three pictures of refugees.

Few will grieve at this eclipse of war even if only on canvas; but the neglect of belligerent science extends also to the other branches almost as much, and, of the thirteen hundred pictures on show, only about one hundred can be said to include any features of scientific interest and that even in the widest possible sense. Of the nine or ten branches of science which one may allege to be represented, botany and geology appear to be the most favoured.

Agriculture is fortunate in being depicted in two of the finest works in the Academy. "Harvest", by Dame Laura Knight, R.A., with its sun-chequered scene, and James Bateman's "Haytime in the Cotswolds", one of the pleasantest landscapes of the year.

Antiquaries have not far to seek for interest, because the second picture in the first room is "Antiquity", by Alan Beeton, A.R.A. This shows a human skull surrounded by palaeoliths and resting upon a copy of *Antiquity*. The work is rather small, but this is compensated by the very large panel, destined for Brighton Grammar School, entitled "Hollingbury Camp, 1929", by Louis Ginnett, in which a party of archaeologists is seen at work in the field. The anthropologists are better served, numerically, with a dozen pictures of much interest and considerable artistic distinction. Dame Laura Knight again heads the list with "Gipsy Family", a typically brilliant study

which is certain to be acclaimed as one of the pictures of the year. Negro studies are unusually prominent, of which "The Dance, Zululand" (218), "Zulu Woman" (271) and "Zulu Exodus" (278), should be mentioned. A. R. Thomson's "Prince Kessie of Ashanti" and Neville Lewis's "Pond Youth" are interesting portraits. A more comprehensive work is "The Village in the Jungle", by David Paynter, with a man, a woman and a child in the foreground. In addition there are a study of a Jamaican, Japanese and Chinese portraits and the delightful Burmese "Ma Seyn Nu", by Gerald Kelly, R.A.

For the botanists, there are a profusion of titles and a riot of colour. Apple blossom, carnations, celery, cinerarias, chrysanthemums, gladioli, lilies, marguerites, roses, tulips and even tobacco flower (these last by Dod Procter) are only a selection of the delights available. There are also surprises such as the unexpected "Flex Tree", a Montallegre landscape by Gerald Kelly. Gilbert Spencer's "Cherry Tree in Winter" and Sallis Benney's "Beech Trees" are other arboreal attractions. There are flowers under their own names, flower as "Still Life", "Rainbow Colours", "Purity", or just "Flowers". Mr. C. R. W. Nevinson's "Autumn bouquet", and Sir George Clausen's "Roses" are noteworthy, while Miss Grace English contributes a charming variety of colour contrasts in her "Summer Flowers".

Perhaps the most attractive of what may be termed the botanical works is Charles Oppenheimer's "Galloway Woodlands in February". This is a large picture with a background of typical rolling Galloway scenery. The woodland, the picture's main feature, is carpeted with snowdrops and the whole effect makes a charming picture one would like to possess.

Botanical and geological interests are combined in Malcolm Milne's "Val Fleuri", where the alpine flowers decorate the high valley. The other pictures which may interest the geologist cover various aspects of the science. Antony Ayrton's "Alpine Landscape" and Hilda Carlisle's "A Welsh Farm" illustrate a variety of mountain scenery.

which is supplemented by the stark but ominous grandeur of "Tulloch, Inverness-shire", by Oliver Lall, R.A. Less rugged aspects of the British countryside are portrayed by Charles Oppenheimer in "The Red Roofs of Whitby", by Miss Amy Brown in "East Anglia" with its very characteristic landscape, and particularly in J. McIlpatrick's quiet "Glamis Village". More informative geologically are Gerald Kelly's "River Lugno from Montallegro" with its clearly-shown valley forms, and Stephen Denison's "Lime Works at Tharfedale" with a quarry section. Sidney Lee, R.A., portrays varieties of bedding, an anticline and other folds, faulting and weathering in "The Road by the Cliff". The meander of a stream is well illustrated in "Pastoral" by George Henry, R.A.

Typical and pleasant coastal, cliff and rock scenery is shown by William Matthews in "Tantallon", by Julius Olsson, R.A., in "Rocks, Antibes", and by A. Raine Barker's "Bridport".

Applied geology is not forgotten, for there are quarry in Kent (588), the sandpit, Coldharbour (233), and "Cement Works in Surrey", by G. W. Leach. The last picture reveals that the industrial activity is less disturbing aesthetically than might be imagined.

Geologists, geographers and all Americans will be interested by Norman Wilkinson's "San Salvador". In this bay, Columbus landed on October 21, 1492.

If the mineralogists have but two pictures assigned to them, they may be reminded that quality is sometimes better than quantity. In any event, Gerald Brookhurst, R.A., is responsible for the two pictures, both of which are characteristically exquisite portraits. In the first, "Mrs. Hubert Raphael" is portrayed wearing scintillating emeralds and diamonds, while in the second, a portrait entitled "Mrs. Harrison", the amethystine brilliance of necklet, brooch, bracelet and ring is striking and attractive and reveals the masterly skill of the artist in his medium.

The zoologists have been served not quite so lavishly as might have been expected. Mr. Funnings has, however, made his usual and appealing testimonies to equine grace. Miss Winifred Austen, in one of the very few dry points, portrays equine leisure. There are dogs and cats in oils, greyhounds in wash and in bronze, and an antelope in wood. Mrs. Lilian Andrews contributes a swan and family in pastel, and Philip Bonnard, R.A., shows "Flying Swans", a piece of such distinction. Mrs. Daisy Smith has a delicate water-colour study of kookaburras.

The zoo aspect is supplied by "The Birdhouse" by Percy Shakespeare, with its toucans and para-

keets; and "Elephant in Regent's Park" by Henry Carr. "An August Evening in Suffolk", by Bertram Priestman, R.A., with its black-and-white cows, is peaceful; Mr. John Platt's "Bull across the Path", a colour woodcut, is more aggressive.

The march of time in applied science is amply demonstrated by Sir Muirhead Bone's impression in chalk "Building the *Queen Elizabeth*" and Charles Cundall's detailed picture of the launch of the same vessel. The launch of the *Mauritania* is the subject of a wood-engraving by Marjorie Biscomb. The less spectacular sides of industry are represented by "Tin Miners" (383) and "Coke Ovens" (437). The march of science is depicted in "Television Rehearsal" by Harry Rutherford; "Chelsea Power Station" by Gerald Ackermann, and, in a different sense, in "Pylons", where Miss Evelyn Sauer shows the feet of the pylons embedded in beautiful highland scenery.

The architecture section contains plans of much interest to many men of science. The new science buildings of the University of Oxford (1046), new or recent buildings of the University of London (1047), the Imperial College of Science (1082) and research laboratories at Berkhamsted (1079) are a few on exhibition.

Portraits of scientific men are not numerous, but the few are well worthy of note. There are Charles Wheeler's bronze bust of Col. W. A. Bristow and the marble bust of the late Sir Robert Mond by William King. Lord McGowan and Lord Weir are the subjects of splendid portraits by Harold Knight, R.A., and T. C. Dugdale, A.R.A., respectively. Malcolm Osborne, R.A., provides a dry point of Prof. Alexander Low, of Aberdeen, while an attractively academic portrait is Edward Halliday's painting of Prof. W. E. S. Turner. Others known in scientific and university circles who are portrayed include John Murray, principal of the University College of the South-West, Exeter (oil painting by R. G. Eves); Dr. A. W. Pickard-Cambridge, vice-chancellor in 1930-38 of the University of Sheffield (oil painting by George Harcourt); Sir William Elderton (oil painting by Harold Knight); the late Dr. A. C. Woolner, vice-chancellor of the University of the Punjab, Lahore (statue by Gilbert Ledward); and the late Lord Moynihan (bust by Sir W. Reid Dick).

If for any reason these aspects of science should prove of little attraction, or should they pall, it may be comforting to know that the Academy also bears testimony to another science, an applied science which is, one believes, still also a pure science, that the month of May particularly welcomes. It is brilliantly dealt with in No. 264, Mr. Charles Cundall's "Test Match at Lord's".

W. E. SWINTON.

Obituary Notices

Sir William Ramsay

BORN at Glasgow on March 15, 1851, and educated at Aberdeen Gymnasium, the University of Aberdeen, St. John's College, Oxford, and the University of Göttingen, William Mitchell Ramsay married early and spent the years 1878-85 in persistent and fruitful travel, first in Greece, then in Asia Minor, with the wise encouragement from 1880 onwards of Sir Charles Wilson, who came from the Survey of Western Palestine to be British consular-general for Anatolia, and with a travelling scholarship and later a research fellowship from Exeter College, Oxford. To the methods of historical geography followed by Hamilton and by Leake, Ramsay added the critical study of local coinage in its topographical distribution, and of the Byzantine and ecclesiastical administrations of Asia Minor, many of the centres and regions of which were inherited from Hellenistic and even much earlier times. Though he travelled in most parts of Anatolia, Ramsay's special region was Phrygia, and his largest coherent publication dealt with its "Cities and Bishoprics" (1895, 1897). For the methods of pioneer research, however, his "Historical Geography of Asia Minor" (1890) is a turning-point, and the patronage of the Royal Geographical Society, which published it, and later awarded Ramsay its Victoria Medal, was never better bestowed.

On the establishment of the Lincoln and Merton professorship of classical archaeology and art in Oxford, in 1885, Ramsay was an obvious first choice, and though he passed on in the following year to his old University of Aberdeen, where the facilities for summer travel were greater, he left his mark in Oxford in a succession of classical archaeologists and historical geographers, of whom the best known was David Hogarth of Magdalen, his constant travelling-companion. From Aberdeen he continued to direct and advise even after his retirement from the chair of humanity in 1911, when frequent ill-health had been aggravated by reckless exposure to austere conditions of travel. But Ramsay never stopped working: only last summer, on one of his busy visits to Oxford, he was as keen and clear-headed as ever, and full of problems and projects.

Ramsay's output of published work was larger than the titles already noted indicate; the only difficulty was to keep track of it, for his articles, large and small, are scattered among a score of periodicals in both hemispheres. It might have been larger on the geographical side, had he not devoted much of his middle life to more popular expositions of the early history of Christianity, in its relations with the Roman administration: "The Church in the Roman Empire" appeared in 1893, "St. Paul, the Traveller and the Roman Citizen" in 1895; and so on at frequent intervals until 1914.

Other interests arose from Ramsay's intimate experience of Turkish administration, before and after the revolution of 1909, and from his academic activities at Aberdeen. His essay on "The Imperial Peace, an Ideal in European History" (1913) has a fresh significance to-day. On the four hundredth anniversary of his University in 1908, Ramsay was knighted; he was an honorary fellow of Exeter, Lincoln and St. John's Colleges, an original member of the British Academy, and one of the founders of the Hellenic Society. From Pope Leo XIII he received a gold medal in 1893 in recognition of his contributions to the history of Christianity, and other marks of recognition were conferred on him by many universities and academies. J. L. M.

Mr. H. J. George

HERBERT JOHN GEORGE, whose sudden death occurred on April 19 at the comparatively early age of forty-six years, was fellow, tutor in chemistry, and senior bursar of Jesus College, Oxford, and University lecturer in chemistry.

George was educated at Cardiff High School and entered Jesus College as scholar in natural science in 1911 after a short period at University College Cardiff. He gained a first class in chemistry in the June before the Great War broke out. In the War he served in the Royal Welch Fusiliers in Gallipoli where he was wounded, and then in Mesopotamia and India. Later he was transferred to a department of the Ministry of Munitions.

In 1919 George returned to Oxford as research fellow and lecturer of his old college and became an official fellow and tutor a few years later. Since then Dr D. L. Chapman and he have been in charge of the teaching of chemistry to the large number of men whose centre was the Leoline Jenkins Laboratories of Jesus College. He was an excellent college tutor; he took great pains with his pupils. As University lecturer he took charge of colloid chemistry and lectured effectively to large classes on this for many years.

George's absorption in his tutorial work and latterly in administrative duties (he was successively librarian, junior bursar and senior bursar of his College and also an Oxford City councillor) did not leave him the time for research work that his abilities warranted. He published work on the adsorption of gases on glass surfaces, on the theory of strong electrolytes, on organic derivatives of thiophosgene and on other subjects. At the time of his death he was working on the constitution of thiophosgene derivatives and on the accommodation coefficients of metals. The results of these researches will be printed in due course. A. S. R.

News and Views

Prof. A. H. Gibson

At a meeting of the Institution of Civil Engineers on May 2, the James Alfred Ewing Medal was presented to Prof. Arnold Hartley Gibson, professor of engineering in the University of Manchester. This is the second award of the medal, which is presented for specially meritorious contributions to the science of engineering. Awards are made by the council of the Institution of Civil Engineers on the recommendation of the presidents of the Institution of Civil Engineers and of the Royal Society. Prof. Gibson was educated at Rishworth Grammar School and at the University of Manchester. In 1909 he was appointed professor of engineering of the University of St. Andrews, where he stayed until 1920, except that during the Great War he served in the Royal Field Artillery and was seconded in 1916 to the Royal Aircraft Factory, where he afterwards had charge of the investigation and research work on aero engines. He was president of Section G (Engineering) of the British Association in 1921, and was a member of the Board of Trade Committee on water-power of the British Isles; of the Air Ministry Engine Research Committee; and of the Severn Barrage Committee. He has written a number of papers on hydraulic engineering, including such subjects as experiments with tidal models, the resistance to rotation of disks in water at high speeds, formation of standing waves in an open stream, wave impact on engineering structures, etc., and, among other awards, has received a Wroughton Prize and a Telford Premium for papers published by the Institution of Civil Engineers.

Sir Frederic Kenyon, G.B.E., K.C.B.

THE anniversary meeting of the Society of Antiquaries of London on April 27 marked the retirement of Sir Frederic G. Kenyon from the office of president, which he had held since 1934, the statutory period of five years. His term of office has covered a period in the history of the Society of enhanced activity in the field—the excavation of Maiden Castle is a permanent landmark in the study of British prehistory—in the promotion of archaeological studies, and in efforts to preserve the antiquarian remains of Great Britain. Sir Frederic's wise leadership and tactful conduct of the Society's affairs have been more than worthy of the great tradition of the long line of his predecessors. His own special interests as an eminent authority on early classical and Biblical texts from papyrological and other sources have in no way been allowed, in the performance of his official duties, to colour, though they may have added inspiration to, his judgment in the broader fields of archaeological research. Sir Frederic Kenyon was director and principal librarian of the British Museum (Bloomsbury) from 1909 until 1930. Since his retirement, he has devoted himself strenuously to the advancement of learning and research by taking part in the ad-

ministration of several learned societies and other bodies, including the British Academy, the Society for the Promotion of Hellenic Studies, and the Society for the Protection of Science and Learning. Sir Frederic is succeeded as president of the Society of Antiquaries by Mr. Alfred William Clapham, secretary since 1929, and secretary of the Royal Commission on Historical Monuments, England, since 1933. Dr. R. E. Mortimer Wheeler will succeed Mr. Clapham as secretary of the Society.

Prof. Karl von Terzaghi

THE forty-fifth James Forrest Lecture of the Institution of Civil Engineers was delivered on May 2 by Prof. K. von Terzaghi, who took as his subject "Soil Mechanics: A New Chapter in Engineering Science". Prof. von Terzaghi was born at Prague in 1883 and, after attending the Technical University of Graz, was engaged on projects for hydro-electric developments and other construction-projects in Austria, Hungary and Russia until 1912, when he proceeded to the United States and was chiefly engaged in the study of modern dam construction and problems of engineering geology in connexion with the projects of the United States Reclamation Service. During the Great War he served in the Austrian Army until in 1916 he was transferred to the Technical University of Constantinople to take over the chair of foundation and highway engineering. From 1918 until 1925 he was professor and head of the Department of Civil Engineering of the American Robert College in Turkey. During this period, he was engaged on research in connexion with the physical properties of the most important types of soils and published in 1925 his book "Erdbeckenmechanik", which is acknowledged as the basis of modern soil mechanics. Between 1925 and 1936, Prof. von Terzaghi was lecturing at the Massachusetts Institute of Technology, the Technical University in Vienna, the Technical University in Berlin-Charlottenburg and at Harvard University. He was president of the first International Conference on Soil Mechanics and Foundation Engineering, which was held at Harvard University in 1936. In addition to his contributions to civil engineering, Prof. von Terzaghi has advanced knowledge in the field of physical chemistry and geology, his best-known work perhaps being his mechanical theory of swelling of gels.

George Miller Beard (1839-1883)

DR. GEORGE BEARD, an eminent American neurologist and psychiatrist, was born at Montville, Connecticut, on May 8, 1839, the son of a Congregationalist minister. He studied medicine at Yale, where he qualified in 1862, and four years later joined the staff of the College of Physicians and Surgeons of New York. In the course of his comparatively

short life he engaged in numerous activities, but the subjects in which he was chiefly interested were electrotherapy, hypnotism, functional nervous diseases, longevity and the reform of medical education. As a mental expert he took part in several famous trials and notably that of President Garfield's assassin Guiteau, whose case he reported in the *Journal of Nervous and Mental Disease* of January 1882. Of his numerous other writings the most important are "Medical and Surgical Electricity" written in conjunction with A. D. Rockwell (1875), "Neurasthenia (Nervous Exhaustion) with Remarks on Treatment" (1879) and "American Nervousness: Its Causes and Consequences", which was translated into German. He also contributed many articles to the *North American Review* in which he popularized scientific knowledge, and was the founder of the *Archives of Electricity and Neurology*, which had only a short existence (1874-76). He was one of the originators of the National Association for the Protection of the Insane and of the American Neurological Society. He died on January 23, 1883.

Preservation of Wild Geese and Wild Duck

THE Wild Birds (Ducks and Geese) Protection Bill, which passed its final stages in the House of Lords on May 2, and will come into force as an Act on August 1, marks a decided step forward in the efforts being made to conserve the world's stock of Anatidae. During its passage through Parliament, the Bill has been strengthened by amendments put forward by the promoters, the International Committee for Bird Preservation (British Section). The Bill, when first introduced in November 1938, was framed with the view of securing its rapid passage as an unopposed measure; but as opposition was encountered the promoters, while compromising on certain points, were able to gain considerably on others. The main terms of the Bill in its final form are: the extension of the 'close season' for wild geese and wild duck (of any species whatsoever, the merganser and goosander only being excepted) from February 1 to August 11; the addition of wild geese of all species to the schedule; and the prohibition of import of wild geese and wild duck from February 1 to August 11. Heretofore wild duck have enjoyed the benefit of being scheduled birds (by the Act of 1880), that is, protected from owners and occupiers of land on their own land—during the close season—but wild geese have not. The new measure, therefore, greatly increases the protection afforded to wild geese. However, in order to safeguard the interests of farmers, for, in certain cases, wild geese are considered to damage crops, a clause gives power to county councils to apply to the Secretary of State for Home Affairs to remove wild geese from the schedule in any area in the county concerned.

COUNTY councils also have the right to make similar application to extend the shooting season for wild duck and wild geese on the shore and land contiguous to it to a date not later than February 21. This clause is admittedly a concession, but the duck

it will affect are mainly widgeon. Though quite a number of widgeon nest in Scotland, their breeding season is during the second half of May, and a majority of birds are those passing through on their way north to breed, where the season is later and usually not until June. Allowing these birds to be shot until a later date would not have so much deleterious effect as would the shooting of early nesting species. Further, county councils retain the right to make application to extend the statutory close season, but not, as heretofore, to diminish it. The prohibition of import of wildfowl during the breeding season is an extremely important point, as it cuts off the demand from the London market of ducks caught in decoys in certain European countries at this time. Thousands of ducks have been caught annually in decoys on the Continent during the breeding season, and this has been a serious drain on the stock of European wildfowl; by means of the new Act this drain will now be effectively curtailed.

Sir Ambrose Fleming and the Thermionic Valve

WELCOMED by the Provost (Sir Allen Mawer), Professor R. O. Kapp and an appreciative audience, Sir Ambrose Fleming once again visited, on April 5, University College, London, where for more than forty years he occupied the chair of electrical engineering. The occasion was the formal presentation to the College by Mr. R. McV. Weston of a convenient exhibition case to hold early Fleming and other valves in the possession of the Electrical Engineering Department, including those presented recently to the Department by Mr. Weston and Sir Ambrose himself. After the case had been unveiled, with the appropriate aid of a torch, photocell, valve amplifier and relay, Sir Ambrose gave a remarkably clear and vigorous address on the history of the valves displayed. The story began when he investigated the reason for a white line on the clearer glass in the deposit of evaporated carbon from the filaments of early Edison-Swan lamps after many hours of use. He concluded that some of the carbon particles became charged and were driven off with high velocity from one end of the filament, throwing a 'shadow' of the other side of the hairpin loop on to the glass. Edison, in America, hung a metal plate within the loop, and found that when connected through a galvanometer to the positive end of the filament, a current flowed to the plate but not when connected to the other end.

EDISON left the subject with the discovery of the effect; but Fleming continued his experiments, which led to the construction of a bulb containing a filament at each end. With one filament hot, negatively charged particles would flow through the bulb to the other filament, if the latter was a few volts positive but not if negative. This was the first 'rectifying valve', and here Sir Ambrose left the work to concentrate on his teaching duties. It should be emphasized that this work was before the discovery of the electron by Sir J. J. Thomson. During the next decade, Sir Oliver Lodge, Marconi and others were

experimenting with wireless telegraphy, using coherers and magnetic detectors. In 1899, Sir Ambrose was appointed scientific advisor to the Marconi Company, and soon came up against the problem of finding a more stable detector, suitable for operating a morse rinter. In November 1904, he removed from the cupboard the rectifying valve, set up a high-frequency generator on the lecture bench, and was successful in using for the first time a thermionic valve detector of electromagnetic radiation. Very soon, special valves were being designed for this purpose. The cabinet of valves, occupying a prominent position in the College Engineering Department, will be a constant reminder of Sir Ambrose Fleming and of the rapid developments during the last thirty-five years.

Million-Volt X-Ray Tube

A PAPER on a million-volt X-ray tube which has been installed and is in operation for treatment at St. Bartholomew's Hospital was read before the Institution of Electrical Engineers by Allibone, Bancroft and Innes at a meeting held on April 13. A description was given of the design, equipment, lay-out and operation of the unit. Briefly, it may be said that the tube embodies the principles of the all-metal X-ray tube designed by Dr. Allibone for lower voltages, and the elaboration set out in the recent paper arises from the scale of voltages used. The X-ray tube consists of a steel tube 14 in. in diameter and 17 ft. long; the central portion of it, from which the X-ray beam emerges, traverses the treatment room and projects into each generator room. The generator rooms each house 500 kv. d.c. generators. The X-ray tube and thermionic rectifiers used in the d.c. generators are evacuated continuously by oil diffusion pumps, and the whole apparatus is readily demountable. Removable filament assemblies are fitted to the rectifiers and facilitate rapid replacement of filaments; a special cathode with six interchangeable filaments has been developed for the X-ray tube to avoid frequent admission of air into the tube during filament replacements. The tube is now used continuously at 1000 kv. and has been operated experimentally at 1100 kv. Curves relating X-ray output with voltage and filtration by metallic filters are given, and a radiograph is included to illustrate the capabilities of the tube if applied to industrial radiography.

Revised Broadcasting Wave-Lengths

AFTER sitting for some six and a half weeks during March and April at Montreux, the international broadcasting conference has terminated with the issue of a plan for the revision of the wave-lengths and power of broadcasting stations in the European zone, which includes Iceland and the Mediterranean basin. The 'Montreux Convention', as it is known in broadcasting circles, was signed by the representatives of thirty-one States, and provides for certain changes in wave-length and power of European broadcasting stations to come into effect on March 4,

1940. The changes to be made affect all the British stations, including those at Start Point, Clevedon and Norwich, which are not yet in regular operation. Details of the changes indicating the manner in which they may affect British listeners to broadcasting were outlined in recent issues of *The Times* and the *Wireless World*. Power limitations have been imposed by the Convention, varying from 500 kw. for long-wave stations by day only to 10 kw. for stations operating on the shortest wave-lengths of the medium wave-band. Although Great Britain has been allocated the exclusive use of only three wave-lengths, it is pointed out that our geographical position on the outer fringes of Europe is such that we can share wave-lengths with other countries in a way that would be impracticable in central Europe. Generally speaking, it may be said that the plan provides an improved state of affairs in the long-wave band, and also in the middle-wave band so far as home reception is concerned. In view of the developments of broadcasting, and the increase in number and power of stations during recent years, the Montreux Conference would appear to have achieved a satisfactory result if it has succeeded in avoiding any deterioration in the service now provided in all countries.

Further Extension of the Ashmolean Museum, Oxford

A FURTHER extension of the Ashmolean Museum in the University of Oxford was opened by Lord Crawford and Balcarres on April 25, towards the cost of which the Worshipful Company of Drapers has contributed the sum of £10,000. The Master of the Company, Sir Auston Harris, in the course of his remarks at the opening ceremony, said that while the City Companies can no longer vie with the munificent gifts of wealthy Englishmen, or with great American corporations, this gift would serve as another mark of the respect and esteem which an ancient City Company bears towards an ancient University. The extension is on the north-east corner of the building, and provides for the Museum's Egyptian collections, which it has now been possible to arrange in chronological order, a lecture room, and a storage basement. A set of smaller rooms on six floors has been built between the new wing and the Tylorian Institution. Here are students' work-rooms, a room for the keeper, Mr. E. T. Leeds, and rooms for the preparation of exhibits. This is the third extension added to the buildings in five years, and marks the final stage in the plans for the enlargement of the accommodation to relieve pressure on the Museum's space. The first extension was the provision of the Weldon Gallery in 1934, and the second was the addition of the Griffith Institute, which was opened in January last. The gallery in which the Egyptian collections were formerly housed has now been divided by screens into three rooms, to be devoted respectively to the European pre-historic period, covering the stone and bronze ages, the Minoan collection, by the gifts of Sir Arthur Evans now the finest in existence, and the Near Eastern Collections.

A Cornish Headland Fortified Site

SOME interesting results, it may be expected, will emerge from an archaeological exploration of a Cornish headland fortified site, which has been in progress under the direction of Dr. R. E. Mortimer Wheeler during the fortnight ending on April 24, when digging ceased. The site comprises a series of hut-circles within an enclosed area on Gurnard's Head, near Falmouth. The purpose of the investigation is to endeavour to trace evidence of connexion in the first century B.C. between these Cornish headland forts and the contemporary or earlier inhabitants of the sites on the south-west coast of Brittany examined by Dr. Wheeler's expedition last year. The fortified enclosure here is formed by three ditches running across the neck of the peninsula, protecting it from attack on the landward side. The hut-circles, according to a report in the *Western Independent* of April 23, begin close to the inner rampart, of which the wall was in three steps, recalling the structure of the hill-fort of Kerouradeo, near Quimper in Brittany, which has been described by Dr. Wheeler as fortified by three lines, with an inner rampart faced by dry stone walling, of which the innermost facing was stepped in three stages and surmounted by a timber palisade. A feature of the construction of the hut-circles, which is said particularly to have impressed the excavators, is the large size of the placed wall-stones. The discovery of a spindle whorl of pottery attests the presence of women, even though the hut-circles do not appear to have been places of permanent occupation. A number of sea-rolled stones include sling-stones; and two sherds of pottery show fragments of the spiral decoration of the first century B.C. A sherd with 'duck' pattern recalls a find at Ohm Castle, four miles away, made by Mr. Leeds in a fort resembling the forts of northern Spain, and interpreted by him as a relic of connexion due to ancient metal working.

Dermatology and Folk-lore

At a meeting of the St. John's Hospital Dermatological Society on April 28, Dr. J. D. Rolleston read a paper on this subject. After a few remarks on folk-lore in relation to skin diseases generally, in which he alluded to their supposed causation, prophylaxis and treatment, he dealt with the individual skin diseases with which folk-lore was most concerned. No skin disease, he said, or indeed disease of any kind, had received so much attention in folk medicine as warts, the literature on the subject even exceeding that on whooping cough or 'ague'. Next in importance in popular estimation came shingles, and then baldness, boils, burns, cosmetic defects such as freckles and wrinkles, congenital abnormalities, ringworm, urticaria, cancer of the skin and chilblains, in the order named. As in his previous paper on "Folk-lore and Medicine" (see *NATURE*, January 21, p. 111) Dr. Rolleston discussed the various preventive and therapeutic measures used in folk-lore under the following headings: (1) transfer of the disease to other persons, animals or inanimate objects; (2)

animal and plant remedies; (3) religious influence including invocations to patron saints; (4) the healing power of water in the form of wells, spring-fountains and streams; (5) the mystical power of odd numbers; (6) repellent and disgusting remedies including coprotherapy, for the object of driving on the evil spirit supposed to be the cause of the disease; (7) miscellaneous cures, such as the doctrine of signatures, the influence of the moon and fastin saliva.

Archæology and the Bible.

THE striking manner in which post-War archaeological investigation in the Near and Middle East has contributed to Biblical studies is concisely reviewed by Prof. S. H. Hooke in "Archæology and the Old Testament" (London, Thomas Murby and Co., 1938. Pp. 32. 6d. net), one of an excellent little series entitled "After 400 Years", which deal with various aspects of the Bible in the light of modern scholarship. Whereas at one time the efforts of the archaeologist in the interests of Biblical studies were directed mainly to the search for texts which might confirm the Hebrew record, modern excavations in Mesopotamia, in Syria and in Palestine and Egypt have not merely provided a measure of corroboration for the Biblical narrative of the course of events, but also—and to many this may seem of major importance—they have given the Scripture records a historical setting and cultural background both within the boundaries of Palestine and in relation to neighbouring peoples and empires, which has elucidated a multitude of obscurities in the Biblical historical narrative as well as in tradition in ritual and in belief. Thus Prof. Hooke, speaking of the recent investigations of Sir Leonard Woolley at Ur, of Dr. Dorothy Garrod in Palestine, and of others elsewhere, is able to say that "during the last thirty years archaeology has reconstructed the stage . . . on which the drama of the history of the Hebrew people was played . . . those great ancient civilizations, which surrounded and profoundly influenced that small country of Canaan". Making this his starting point, he passes on to show the manner in which the attitude of instructed opinion on Biblical questions has been profoundly modified by recent discovery in regard to the history of writing and its beginnings, early law and legal codes, the conquest of Palestine, the religion, ritual, and mythology of Canaan, the condition of Palestine at the time of the Lachish letters, the Hittites and the empire, and like matters.

New Air Speed Record

THE absolute air speed record of more than 46 miles an hour, set up by Herr Dieterle in Germany recently (reported in *NATURE* of April 15, p. 633) has now been broken. Herr Wendel, flying a Messerschmitt Me.109 R. fighter fitted with a Mercedes-Benz engine and a V.I.M. metal airscrew, claims to have attained a speed of 755 kilometres (469.11 miles) an hour. Reports claim that this aircraft is a new type of fighter, and the published rating of the engine

1,175 horse-power. A previous edition of this machine, the Messerschmitt Bf 109, with an engine of 950 horse-power, is credited with a maximum speed of 15 miles an hour, and this performance is about what might be expected for this class of fighter aeroplane with its necessary equipment. The great increase in speed of the new machine with so small an increase in rated power suggests that the term 'fighter' is a misnomer, and that the machine, while its design may be based on such a class, is almost certainly a specially fitted one which would be impracticable for the carrying of standard military equipment. Also the engine must have been giving considerably more than its rated power, which suggests that it was running under conditions that could not have been maintained in practical service work. Although this does not mean that the German Air Force now possesses a single-seater fighter of such performance, the setting up of the record is an achievement upon which the German aircraft industry is to be deservedly congratulated.

Engineering Research at the City and Guilds College

A SHORT general account has been issued by the City and Guilds College, Imperial College of Science and Technology, of researches in progress at the College which are mainly financed by an annual grant of the Clothworkers Company given to further engineering research. This research report for 1937-38 contains a brief account of the fluid motion research in the Department of Aeronautics. In the Department of Civil Engineering experimental work on the static loading of a 10-ft. span voussoir arch has been completed which has shown that the generally accepted method of design is unduly pessimistic since even lime mortar joints can resist some tensile stress, and with cement mortar the first sign of failure is at a considerably higher load than that given by the classical theory. An investigation of stresses in suspension bridges is in progress, and in addition to various structural researches the problems of river meander, tidal phenomena, wave research and tests of bituminous jointing compounds for liquid-retaining concrete structures have received attention in the Department. The Department of Electrical Engineering has constructed a high-frequency Wheatstone bridge and also a high-frequency Schering bridge. Besides its work on heat transmission, the Department of Mechanical Engineering has been responsible for work on heat dissipation from surfaces by natural convection in gases and liquids, including mercury, on heat transfer from gases flowing through packed solids, radiation from non-luminous gases, convection in pipes at low velocities, evaporation and convection, gumming tests on lubricating oils with the Helmore-Griffiths oil-testing machine, the mechanical properties of metals near their melting-point and on internal combustion engines.

Post-graduate Studies in the University of Bombay

THE Deccan College, which was abolished some years ago, is apparently to be revived by the Government of Bombay as an institution for post-graduate

work in arts. The scheme has given occasion to a candid friend of higher education in India in general and the University of Bombay in particular to direct attention in an article recently published in the *Mahratta* to some of its shortcomings, and to make suggestions for ensuring that they do not vitiate the work of the proposed Deccan College Institute. The existent provision for post-graduate instruction in the University is described as farcical and the standards of undergraduate work in India generally, and particularly in Bombay, as so low that the attainments of a B.A. or B.Sc. are, more often than not, at or below the level of a good freshman in a British university. "Research" or "direction of research" is too often a pretext for shirking genuine work, and much nonsense is talked about the evils of "over-lecturing" and "spoon-feeding". What is wrong with higher studies is a deficiency of strenuous, orderly, conscientious, healthily motivated work under competent direction and close supervision. It is suggested that the new Institute should make good the deficiency so far as possible by putting graduates through a discipline which they ought to have already experienced, including the regular and frequent submission of written work and its patient examination by instructors intent on eliminating the indolent and incapable. The proposed fields of study are mathematics, philosophy, English, philology, Indian languages, history and economics. In view of the growth of unemployment among the educated classes and the evils attendant on the existence of an unemployed and unemployable university proletariat the comment suggests itself: higher education for—what?

The Geographical Laboratory

A USEFUL pamphlet by Prof. Griffith Taylor, entitled "The Geographical Laboratory" (University of Toronto Press, 1938), sketches with a varying amount of detail a three years course in geography for North American universities. Much of it, however, would be equally applicable to students in Europe, and there should be no difficulty in adapting the more special American section to other requirements. The course is carefully graded, leading from map reading, simple surveying and standard projections to the treatment of statistics, the study of graphs and correlation coefficients and problems of navigation. The matter for the allied lecture courses is also indicated. The courses express an ideal which in their comprehensiveness might be difficult of fulfilment, but the pamphlet should certainly prove a useful guide to both teachers and students.

Conference on Photography

THE Manchester and District Branch of the Institute of Physics is arranging to hold a conference on "Photography" on July 3-4 in the Physics Department, the University, Manchester. The meetings will begin at 2.30 p.m. on the first day and will terminate at 4.0 p.m. on the second day; they are open without formality of any kind to non-members as well as to members of the Institute of Physics. The events

already arranged include lectures and discussions on theories of the photographic latent image, experimental work bearing on these theories, important properties of photographic materials, applications of photography to scientific research, and colour photography. Lectures will be given by Prof. N. F. Mott, Dr. W. F. Berg, Dr. J. O. M. Brentano, Dr. D. A. Spencer, Dr. E. R. Davies and Dr. S. O. Rawling. Full particulars will be announced at a later date.

The Royal Institution

THE anniversary meeting of the members of the Royal Institution was held on May 1, during which the annual report of the visitors was received and adopted. Matters mentioned in the report included the appointment of Prof. W. L. Bragg, Cavendish professor of experimental physics at Cambridge, to succeed the late Lord Rutherford as professor of natural philosophy in the Institution, and of Prof. E. N. da C. Andrade to succeed Sir Henry Miers as chairman of the Library Committee. A legacy of £1,000, free of duty, has been received from the late Mr. P. A. Molteno, and the first payment has been made by the Asiatic Petroleum Co. Ltd. of an annual grant of £100 in aid of the researches at the Institution. The following officers were elected at the meeting: *President*, Lord Eustace Percy; *Treasurer*, Sir Robert Robertson; *Secretary*, Major Charles E. S. Phillips.

Recent Earthquakes

Two earthquakes of considerable severity have been recorded by observatories in England recently. The first was recorded at Kew on April 21 at 4 h. 39 m. 56 s. (dilatation) and the second on April 23 at 16 h. 32 m. 24 s. G.C.T. The former is thought provisionally to have had an epicentre in north-eastern Asia, and to have had a depth of focus of some 500 km.; its occurrence is confirmed by a message from Dr. O. Somville of the Royal Observatory at Uccle, Belgium.

Comet Jurlof-Achmarof-Hassel (1939 d)

MUCH interest was shown in this comet, which was easily visible in field glasses, and it has been under observation since April 15, when it was discovered, until the present time. It had a tail about 4° in length, but on April 22 this suddenly disappeared. Observers are certain that the tail was not diminishing in brightness an hour before its disappearance, and it is remarkable that it should have vanished so suddenly. It is receding from both earth and sun and so is diminishing in brightness; but it may be possible to find it with a small telescope until the middle of May. An ephemeris for a few dates is given below:

	R.A.	N. Dec.
May 7	5h 46.3m	33° 01'
9	5 54.8	30 28
11	6 03.1	29 31
13	6 08.3	28 08

Its distances from the earth and sun on May 9 are 116 and 78 million miles respectively.

Announcements

PROF. EMILE DE WILDEMAN, professor of botan and agriculture in relation to the Belgian Congo i the Colonial University of Belgium, Anvers, has bee elected *correspondant* for the Section of Botany of th Paris Academy of Sciences, in succession to the lat Prof. V. Grégoire.

THE following officers of the North East Coast Institution of Engineers and Shipbuilders have recently been elected: *President*, Major T. Russel Cairns; *Vice-Presidents*, Mr. Robert Haswell, Comdr E. R. Micklethorn, Mr. H. B. Robin Rowell; *Honorary Treasurer*, Mr. W. H. Pilmour; *Secretary*, Mr. T. S Nicol.

THE Challenger Society for the Promotion of th Study of Oceanography will be making furthe grants in aid of research during the current year. The general committee is prepared to consid applications for small grants in aid of research i marine biology, the work preferably to be carri out at one of the recognized laboratories. Applica tions, accompanied by details of the proposed re search, should reach the Honorary Secretary, Mr J. R. Norman, British Museum (Natural History) S.W.7, before May 22.

IN compliance with the requirements of a gif under the will of the late Francis Amory, of Beverly Massachusetts, the American Academy of Arts and Sciences announces the offer of a septennial prize to be known as the Francis Amory Septennial Prize for outstanding work with reference to the alleviation or cure of diseases affecting the human genital organs. If there is work of a quality to warrant it, the first award will be made in 1940. The total amount o the award will exceed ten thousand dollars, and may be given in one or more awards. Further informati can be obtained from the Amory Fund Committee c/o the American Academy of Arts and Sciences 28 Newbury Street, Boston, Mass.

CATALOGUE 51, published by E. P. Goldschmid and Co. of 45 Old Bond Street, London, W.1, include a number of works illustrating the history of scienc and a few rare and important old medical books. The scientific works consist of first editions of book by Brahe, Copernicus, Galileo, Hutton, Huyghens, Kepler, Malpighi, Mendel, Newton and Pasteur while the medical works are represented by first editions of Auenbrugger, Claude Bernard, Liston Purkinje, Semmelweis and Steno. John Raphael Smith's oil portrait of Edward Jenner (1800) is als included, and modern but rare works such as th first edition of Freud's "Traumdeutung" (1900), Einstein's inaugural thesis (1905), Sir Charles Sherrington's "Integrative Action of the Nervous System" (1906), and Johannes Schmidt's "Contributions to the Life-History of the Eel" (1906). The catalogue is well illustrated and annotated.

Letters to the Editor

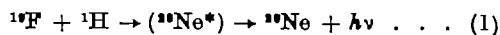
The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 766.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Emission of γ -Rays from Fluorine Under Proton Bombardment

THE work of many experimenters¹ has proved that the excitation curve of the γ -ray emission from fluorine under proton bombardment exhibits a series of sharp resonances. Such resonant effects in the emission of γ -radiation are usually ascribed to the process of proton capture, and on this basis the γ -radiation from fluorine would be ascribed to the reaction:



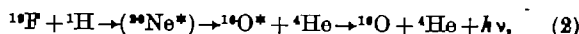
Measurements of the energy spectrum of the radiation reveal the presence of a single line² of quantum energy 6.0×10^6 ev., whereas the total energy available according to reaction (1) is 13.1×10^6 ev. for the lowest resonance at 330 kv. This discrepancy could be explained if the de-excitation of the excited ${}^{10}\text{Ne}^*$ nuclei occurred by successive emission of two quanta of about 6×10^6 ev. energy, the full transition being forbidden, and we have therefore sought for evidence of the simultaneous emission of γ -ray quanta. Using a pair of γ -ray counters exposed to the radiation, the rate of occurrence of coincident impulses was found to be 0.2/min., whereas the minimum rate to be expected on the above view was 35/min. It seems therefore improbable that equation (1) provides the correct explanation of the γ -ray emission, even if the de-excitation occurred in successive stages.

Burcham and Smith⁴ have shown that in the bombardment of fluorine with protons an emission of α -particles of range 0.8 cm. takes place and that, for bombarding energies in the region of the first resonance of the γ -ray excitation curve, the α -particle emission exhibits similar resonant excitation.

A possible explanation of all of the foregoing facts may be obtained by assuming that the emission of a quantum of energy 6.0×10^6 ev. from the intermediate ${}^{10}\text{Ne}^*$ nucleus results in the formation of a less excited ${}^{10}\text{Ne}^{**}$ nucleus which afterwards disintegrates into ${}^{16}\text{O}$ and ${}^4\text{He}$ nuclei. The resonant features of the γ -ray emission might then have their normal explanation, whilst the observed resonant effect in the α -ray emission would be explained by the assumption that the ${}^{10}\text{Ne}^{**}$ nuclei which are unstable with respect to the emission of α -particles are only formed as a result of the γ -ray emission.

On this view, however, as also for the process (1), it is to be expected that the quantum energy of the emitted γ -radiation would increase by finite steps as the bombarding energy of the protons is increased to such values that the γ -ray emission occurs from the higher levels of excitation of the intermediate nucleus. By placing aluminium screens between a pair of Geiger-Müller counters, we have determined the maximum range of the secondary elec-

trons projected by the γ -radiation. The measured end-point values at bombarding voltages of 330 kv., 670 kv. and 860 kv. indicated values for the quantum energy of the γ -radiation identical within the experimental error of ± 50 kv. Further evidence that the quantum energy remains unchanged at these resonances has been obtained by the use of a recently constructed magnetic γ -ray spectrometer. By this method the relative values of the quantum energy were the same within the experimental error of 100 kv. The absolute value obtained for the quantum energy was 6.5×10^6 ev. In view of these facts, we suggest that the γ -ray emission is the result of the formation of excited ${}^{16}\text{O}^*$ nuclei according to the process:



the same excited state of ${}^{16}\text{O}$ (at 6.5×10^6 ev.) being produced for each resonance of the γ -ray excitation curve.

The total energy which is available, according to equation (2), as kinetic energy of the ${}^{16}\text{O}$ and ${}^4\text{He}$ nuclei is 8.5×10^6 ev. when the ${}^{16}\text{O}$ nucleus is formed in its ground state and resonant excitation of the α -particles of maximum energy is not therefore to be expected. When, however, the ${}^{16}\text{O}$ nucleus is left with an energy of excitation of 6.5×10^6 ev., the kinetic energy of the resulting particles is only 2.0×10^6 ev. and this value is sufficiently low to suggest that broadening of the resonant level due to this α -particle emission would not destroy the resonant features.

The resonant nature of γ -ray emission is usually explained by assuming that the proton is captured into a state from which de-excitation by the emission of an α -particle with the full energy of excitation is for some reason forbidden, the intermediate nucleus remaining excited until de-excitation by the emission of γ -radiation can occur. The above results show that these resonant states of ${}^{10}\text{Ne}^*$, from which the emission of an α -particle with the full energy is forbidden, decay by the emission of an α -particle of lower energy, rather than by the emission of γ -radiation, the residual oxygen nucleus being left in an excited state. It is probable, therefore, that the time required for this emission of a low-energy particle is considerably shorter than the time required for the emission of γ -radiation, but not so short that the resonant features could not occur. The delay needed for this latter condition may crudely be pictured as the time of leakage of the α -particle through the potential barrier of the excited ${}^{16}\text{O}^*$ nucleus. It has been shown that the height at which the penetration occurs is, for the resonance at a bombarding energy of 330 kv., about 2.0×10^6 ev. above the virtual ground state of the excited ${}^{16}\text{O}^*$ nucleus, and one might therefore reasonably expect a further energy range of about 2×10^6 ev. in which the breadths of the resonant

levels show a progressive increase with bombarding energy as the top of the potential barrier is approached.

It is interesting to notice that whilst resonant phenomena associated with the emission of particles from elements bombarded with α -particles have frequently been observed, such processes have hitherto, with one exception, not been found for bombardment with protons or deuterons.

P. I. DILL.

S. O. CURRAN.

J. H. STROTHERS.

Cavendish Laboratory,
Cambridge.
April 23.

¹ Halstad and Tuve, *Phys. Rev.*, **48**, 306 (1935). Bernet, Herb and Parkinson, *Phys. Rev.*, **54**, 398 (1938). Curran, Dee and Petrášilka, *Proc. Roy. Soc., A*, **160**, 300 (1938).

² Halpern and Crane, *Phys. Rev.*, **55**, 306 (1939).

³ Delmaso, Fowler and Lauritsen, *Phys. Rev.*, **51**, 537 (1937).

⁴ Burcham and Smith, *NATURE*, in the press.

Production of Neutrons by the Fission of Uranium

As a result of the discovery of the fission of the uranium nucleus after absorption of a neutron, we have made experiments to see if other neutrons are emitted in the process, and to measure their number. The results are comparable with those recently published by Joliot¹ and others.

Our apparatus consists of four concentric copper spheres (a), (b), (b'), (c) of radii 7.5, 10.5, 11.5, 12.5 cm., at the centre of which a source of radon plus beryllium of the order of 200 mc. was placed. The space between (b) and (b') was an air gap left for structural reasons. In the first set of experiments, the inner sphere (a) was filled with paraffin wax and the space between (b') and (c) with boron carbide. The apparatus was placed in a tank filled with water, and the activity detected by a dysprosium detector about 15 cm. from the surface of the outer sphere. Measurements were taken with the space between (a) and (b) empty, giving a count v , and full of uranium oxide (U_3O_8), giving a count u . In the second set of experiments the paraffin wax was removed, and the source surrounded with cadmium so that only fast neutrons were used. Again, experiments were made with, u_1 , and without, v_1 , the uranium oxide. Finally, experiments were made with the tank empty and the paraffin wax in place, but no boron carbide, to determine the absorption of the layer of uranium oxide for slow neutrons.

We considered that the production of neutrons might be due either to the slow or fast neutrons, or to both, and our experiments enable us to separate the two effects.

We found the following counts: $u = 0.81 \pm 0.015$; $v = 0.75 \pm 0.02$; $u_1 = 1.24 \pm 0.03$; $v_1 = 1.11 \pm 0.025$; while the absorption for slow neutrons corresponds to a cross-section of 5.9×10^{-24} , assuming a cross-section² of scattering of the order of 40×10^{-24} for these neutrons.

Let v be the number of fast neutrons produced by the fission of one uranium nucleus when caused by a slow neutron, and σ_f the cross-section for this process; and v^1 , σ_f^1 be the corresponding quantities for fission caused by fast neutrons; let σ_0 be the effective cross-section for all capture processes, including fission and resonance, for slow neutrons (for our purposes the resonance neutrons count as slow, but owing to their small 'numerosity' the effective cross-section for the resonance process will be considerably less than the

cross-section at resonance (25 volts)). Let σ_0' be the corresponding quantity for fast neutrons. We find the following results: $v^1 \sigma_f' - \sigma_0' = (4.0 \pm 1) 10^{-24}$ cm.²; $v \sigma_f = (2.1 \pm 1.6) 10^{-24} + 0.78 \sigma_0'$; $\sigma_0 = (5.9 \pm 1) 10^{-24}$. In calculating $v \sigma_f$ we have assumed that the number of fast and slow neutrons which reach the surface of our paraffin sphere are respectively 50 per cent and 20 per cent of the number emitted by the source³.

It will be seen that there is a net increase in the number of fast neutrons considered separately. As regards the slow neutrons the result is less certain there is apparently a decrease for these neutrons considered separately unless σ_0' is taken as at least 3×10^{-24} . We believe, however, that our method tends to give too large a value for σ_0 owing to scattering. It is in fact larger than that used by Joliot in his recent paper¹, $(8.7 - 1.2) \div 1.6 = 4.7$. If we assume Joliot's result is due to fission by slow neutrons, the value of σ_0' becomes at least 4×10^{-24} .

We hope shortly to make similar measurement with thorium.

J. L. MICHIELS.

G. PARRY.

G. P. THOMSON.

Imperial College of Science
and Technology,
London, S.W.7.
April 28.

¹ v. Halban, Joliot and Kowarski, *NATURE*, **123**, 470, 680 (1939). Haermy and Rosenberg, *C. R.*, **208**, 808 (1939). Dodd, v. Halban, Joliot and Kowarski, *C. R.*, **208**, 906 (1939).

² Dunning, Pegram, Fink and Mitchell, *Phys. Rev.*, **48**, 335 (1935).

³ Fink, Dunning and Pegram, *Phys. Rev.*, **40**, 642 (1939); and "Kempfyak", 18 (Springer, 1935).

Absorption Method for Determining the Range of Recoil Atoms

THE determination of the recoil ranges of atoms resulting from radioactive disintegrations has hitherto been restricted almost entirely to gases, on account of the extremely short range of recoil atoms in solids. In silver, for example, the range of α -particle recoil atoms is of the order of a few hundred angstroms whilst that of β -particle recoil atoms is many thousand fold less. It is clear, therefore, that absorption measurements and subsequent range determination in solids are possible only if the thickness of the absorbing layer can be varied by amounts corresponding to a small number of molecular layers. It occurred to us that the built-up molecular films prepared by the method of Blodgett and Langmuir¹ might serve as adjustable absorption screens of this kind; we have now demonstrated the feasibility of this idea and have obtained preliminary quantitative results.

In the first instance, we have confined our attention to α -particle disintegrations which immediately precede a β -particle disintegration, and have devised two methods, (1) suitable for thorium A, radium C and actinium A, and (2) convenient for thorium C radium C' and actinium C.

In method (1), a built-up film is prepared, containing a known number n of molecular layers of barium stearate deposited on stainless steel, and therefor having a known thickness. The film is exposed for a short time to a source of radio-thorium, when thorium A (half-life 0.14 sec.) is deposited on the outermost layer of the film and decays immediately into thorium B. Some of the recoil atoms are ejected downward

to the metal, the proportion actually reaching the metal being a function of n . This proportion is determined by comparing the β -ray activity of the specimen (measured with a Geiger counter) after dissolving off all the films in a suitable solvent, with the corresponding activity before dissolution. An absorption curve can then be obtained by varying n .

Method (2), which has been applied to thorium C, proceeds by trapping the atoms which recoil outwards: a deposit of thorium A obtained as in method 1) is 'blanketted' by covering with a number n' of barium stearate layers. Thorium B, formed by the decay of the thorium A, disintegrates into thorium C atoms, 35 per cent of which emit α -particles with the simultaneous production of recoil atoms of thorium C'. In the absence of blanket layers, a large fraction—nearly one half—of these recoil atoms are ejected out into the air and are lost. The blankets capture a fraction, dependent upon n' , of these atoms recoiling outwards, thus raising the β -ray activity of the specimen (due to thorium C') above its 'no-blanket' value. As the number of blanketing layers is progressively increased, the proportion of trapped recoil atoms, and consequently the β -ray activity, increases until it attains a saturation value corresponding to the capture of all the recoil atoms within the films. The value of n' at which this saturation value is just reached gives the desired recoil range.

Preliminary measurements show that the range of recoil atoms from thorium A is of the order of 60 layers of barium stearate—approximately 1500 Å. or 2×10^{-5} gm./cm.²—and that the range of recoil atoms from thorium C is somewhat less than this. The values are 10–20 per cent lower than would be expected from previously measured ranges in air and silver, which give for thorium A 2.2×10^{-5} and 3.5×10^{-5} gm./cm.² respectively, but it must be borne in mind that the built-up films are oriented whereas the substances previously employed were isotropic.

We are now engaged on accurate determinations for the elements mentioned above, and in addition are adapting the technique to α -particle disintegrations in which the product recoil atom also emits an α -particle. The method should yield information concerning the passage of heavy charged particles through solids and should serve to elucidate the phenomenon of aggregate recoil.

E. E. WIDDOWSON.
S. J. GREGG.

University College,
Hull.
April 11.

J. Amer. Chem. Soc., **57**, 1007 (1935); *Phys. Rev.*, **51**, 964 (1937).

Mass and Mean Life-Time of the Meson

ACCORDING to the new field theory of nuclear forces and β -decay, the mesotron with the charge $-e$ (or $+e$) can transform into a negative (or a positive) electron and an antineutrino (or a neutrino) even in vacuum, the mean life-time of the former due to this process being proportional to the energy¹. In previous papers², the proper life-time τ_0 , that is, the mean life-time at rest, of the mesotron was calculated by assuming the interaction of it with the light particle, which was equivalent to that in Fermi's theory of

β -decay. The result was

$$\frac{1}{\tau_0} = \frac{g'^2}{\hbar c} \cdot \frac{m_U c^2}{\hbar} \left(\frac{2}{3} \lambda_1^2 + \frac{1}{3} \mu_1^2 \right), \quad (1)$$

where g' is a small constant with the dimension of the charge, m_U the proper mass of the mesotron and λ_1, μ_1 are dimensionless constants of the order of 1. Thus we obtained a value

$$\tau_0 = 1.3 \times 10^{-7} \text{ sec.}, \quad (2)$$

by taking $m_U = 200 m$, $g' = 4 \times 10^{-17}$, $\lambda_1 = \mu_1 = 1$. Similar calculations were made for the case equivalent to the Konopinski-Uhlenbeck theory of β -decay, but the value of τ_0 thus obtained was smaller by a factor of the order $(m/m_U)^2$ than (1).

On the other hand, the proper life-time has been determined by several authors³ from experiments on cosmic rays following the suggestion of Euler and Heisenberg⁴. Their results all point to a value

$$\tau_0 = 2 \sim 4 \times 10^{-8} \text{ sec.}, \quad (3)$$

which is in qualitative agreement with the theoretical value (2) corresponding to the Fermi interaction, but is in contradiction with that corresponding to the Konopinski-Uhlenbeck interaction. On account of the importance of the problem, it is worth while considering the former case more closely.

According to Kammer⁵, we assume that the interaction between two heavy particles at a distance r in the S state is given approximately by

$$V_{12} = \frac{1}{r} \left\{ \frac{1}{8} + \frac{5}{24} \left(\frac{\vec{\sigma}^{(1)} \cdot \vec{\sigma}^{(2)}}{\sigma^{(1)} \sigma^{(2)}} \right) \right\} \frac{g^2 e^{-\alpha r}}{r}, \quad (4)$$

where $\alpha = m_U c / \hbar$ and g is the constant with the dimension of the charge; $\vec{\sigma}^{(1)}, \vec{\sigma}^{(2)}$ are spin vector and isotopic spin vector of the i th particle respectively. The numerical values of the constant

$$a = g^2 M / \hbar^2 \alpha = (g^2 / \hbar c) (M / m_U), \quad (5)$$

which changes slowly with m_U , can be determined for several values of m_U by using the results of numerical solution of the deuteron wave equation with the potential of the form (4)', where M is the mass of the heavy particle.

Next, the constant g' is determined by comparing the mean life-time of the β -radioactive nucleus obtained in the previous paper² with the corresponding formula in Fermi's theory. The result is:

$$\frac{g'^2}{\hbar c} = \frac{\pi}{5} \frac{G^2}{a} \frac{M}{m} \left(\frac{m_U}{m} \right)^2, \quad (6)$$

for case (i) $\lambda_1 = 0, \mu_1 = 1$;

$$\text{and} \quad \frac{g'^2}{\hbar c} = \frac{\pi}{2} \frac{G^2}{a} \frac{M}{m} \left(\frac{m_U}{m} \right)^2, \quad (7)$$

for case (ii) $\lambda_1 = 1, \mu_1 = 0$;

$$\text{where } G^2 = 0.9 \times 10^{-4} \cdot \frac{\hbar}{m c^2} = 1.2 \times 10^{-22}$$

according to Bethe and Oritchfield⁶.

Hence, for case (i), (1) reduces to

$$\frac{1}{\tau_0} = \frac{\pi}{15} \frac{G^2}{a} \left(\frac{m_U}{m} \right)^4 \frac{m c^2}{\hbar}; \quad (8)$$

and for case (ii) to

$$\frac{1}{\tau_0} = \frac{\pi}{3} \frac{G^2}{a} \left(\frac{m_U}{m} \right)^4 \frac{m c^2}{\hbar}. \quad (9)$$

These expressions show that the proper life-time of the mesotron increases rapidly with decreasing mass m , the numerical values for several cases being summarized in the accompanying table.

m	100 m	125 m	160 m	200 m
τ				
Case (i)	10^{-8}	0.4×10^{-8}	1.2×10^{-8}	0.5×10^{-7} sec.
Case (ii)	0.2×10^{-8}	0.8×10^{-8}	0.2×10^{-7}	0.1×10^{-7} sec.

Thus the theoretical life-time is always a little too short to account for the cosmic ray phenomena. However, the discrepancy between theory and experiment diminishes if we take a value of m nearer 100 m than 200 m , and μ_1 large compared with λ_1^{-1} .

HIDEKI YUKAWA.
SHOICHI SAKATA.

Department of Physics,
Osaka Imperial University,
Osaka.
March 9.

¹ Bhabha, *NATURE*, 141, 117 (1938).

² Yukawa, Sakata and Taketani, *Proc. Phys.-Math. Soc. Japan*, 20, 319 (1938). Yukawa, Sakata, Kobayasi and Taketani, *ibid.*, 993. The latter will be referred to as IV.

³ IV, § 6.

⁴ Blackett, *Phys. Rev.*, 54, 973 (1938); *NATURE*, 142, 902 (1938). Rossi, *NATURE*, 142, 903 (1938). Hirschfeld and Fröen, *O.N.*, 207, 853 (1938). Johnson and Pomerantz, *Phys. Rev.*, 55, 104 (1939). Clay, Jonker and Wismann, *Physica*, 6, 174 (1939).

⁵ Euler, *Naturwiss.*, 26, 332 (1938); *Z. Phys.*, 110, 450 (1938). Euler and Heisenberg, *Abh. exakt. Naturwiss.*, 17, 1 (1938). See also Ferretti, *Nuovo Osservato*, 18, 431 (1938).

⁶ Kemmer, *Proc. Camb. Phil. Soc.*, 34, 354 (1938). See further, IV, § 2.

⁷ Sachs and Goepfert-Mayer, *Phys. Rev.*, 58, 991 (1938). Wilson, *Proc. Camb. Phil. Soc.*, 34, 365 (1938).

⁸ IV, § 5.

⁹ Bethe and Critchfield, *Phys. Rev.*, 54, 248 (1938).

¹⁰ According to Breit and Kopp (Phys. Rev., 54, 652; 1938), the K -electron capture of ^{226}Ra can be explained satisfactorily only if the condition $\lambda_1 < \mu_1$ is fulfilled. See further, Bethe and Critchfield, *loc. cit.*

Diffraction of a Current of Chemical Molecules

A CURRENT of particles of mass m and velocity v , that is, de Broglie wave-length,

$$\lambda = \frac{h}{mv},$$

will be scattered at incidence on a diffraction grating; in the case of a line grating and of a normal incidence, the scattering will take place in such directions δ_μ that

$$\sin \delta_\mu = \mu \frac{h}{mva},$$

a being the grating constant.

Two currents of particles having masses m and m' , respectively, and the same velocity v , will be scattered in directions

$$\sin \delta_\mu = \mu \frac{h}{mva} \quad \text{or} \quad \sin \delta'_{\mu'} = \mu' \frac{h}{m'va}. \quad (1)$$

Let us assume that the particles m and m' are combined in pairs. When the bond is a strong one, the scattering of the pairs will probably take place in accordance with the limit value formula

$$\sin \delta'_{\mu'} = \mu' \frac{h}{(m + m')va}. \quad (2)$$

We do not know in what manner the passage from case (1) to case (2) is effected. Now if we consider

that work can be produced at the diffraction process, and that with very weak bonds we have to do still with case (1) for reasons of continuity, we can presume that these weak bonds will be broken by the grating.

From this it seems evident that weak chemical bonds ought to be capable of being broken up by the process of diffraction.

WIKTOR KREJCZY.

ul. Gdańska 154m.7,

Łódź.

March 20.

Presence of Less Common Elements in Rocks

ONE of the latest patterns of the Hilger spectro meter has just been installed in the Chemistry Department of this College, and a systematic search for certain of the less common elements, more particularly the rare earths, in various rocks has been initiated. Incidentally, the spectral lines of nickel have been detected from dark green inclusions in various calcites, notably those from Cannington Park near Bridgwater, and from Weston-super-Mare. The presence of the element was confirmed by the glyoxime test.

The Cannington Park calcite, given us by Mr. H. E. Balch, curator of the Wells Museum, proved particularly interesting. The nickel appeared to be present as carbonate, possibly as xaraitite, along with copper carbonates, malachite and azurite. The characteristic spectral lines of vanadium were also detected and the existence of both elements confirmed chemically. Several other elements appear to be present also, and these we are endeavouring to confirm chemically.

The nickel in the Weston calcite was associated with silica, possibly as garnierite or genthite.

Incidentally, tellurium was similarly detected in the insoluble residue left after digesting sulphur from Krisuvik, Iceland, with carbon disulphide. Its presence was confirmed by reduction and recognition of its characteristic appearance under the microscope.

The problem of the distribution of the less common elements in our rocks and soils is one of great interest; when further data have been accumulated, it may well become one of extreme importance.

J. NEWTON FRIEND.

JOHN P. ALLOIN.

Technical College,
Birmingham.

March 20.

'Intraglobular' Reaction in Protein Solutions

IN a letter¹ dealing with my hypothesis of 'intraglobular' reactions, Gralén and Svedberg state that the sedimentation constant of the product of the reaction of egg albumin with glycine ethyl ester measured by them remained practically the same as that of ordinary egg albumin, whereas the diffusion constant decreased to an extent corresponding to a 65 per cent increase of the volume of albumin globules. They believe that these results contradict the hypothesis of the existence of 'intraglobular' reactions.

Careful examination of Gralén and Svedberg's experimental results appears to me, however, to lend the best support to my hypothesis as well as to Wrinn's theory, although in my papers the necessary calculations have not been completed.

Without denying the fact that a portion of glycine ester must be bound to the surface of the albumin molecule (to test this point the adsorption of denaturated albumin at 0° C. was measured), it is necessary to establish that this reaction can take place only between glycine ester and free NH_2 -groups of the basic amino-acids, constituting the albumin, with the formation of a new peptide bond. If this were otherwise, the cyclization reaction of glycine ester would lead to the formation of peptides along with 2-5-dioxopiperazine, which is not observed in reality. Saline bonds between an NH_2 -group of glycine ester and free COOH groups of the albumin are excluded by the fact that they are very weak and are hydrolysed in the process of dialysis; such a hydrolysis has also not been observed.

According to data published by Bergmann and Hermann³, the number of basic amino-acids (arginine, lysine and histidine) in a molecule of egg albumin amounts to 28, while the number of amino- and carboxyl-groups in the side chains of these amino-acids is equal to 52. Hence it follows that out of the total number of glycine ester molecules which are bound to one molecule of egg albumin, only 52 are bound to the surface. This is, however, sufficient to create the surface of the albumin globule a spherical shell with a thickness equal to the length of one glycine molecule, that is, c. 4.5 Å., provided the glycine molecules are distributed symmetrically over the whole surface and are hydrated in the ordinary way. This corresponds to a 60 per cent increase of the volume of the globule, in excellent agreement with Gralén and Svedberg's measurements of the diffusion constant.

The invariability of the sedimentation constant is also explained very easily. If instead of determining the volume of the globule from the total volume of the albumin (as I did roughly initially), this volume is reduced, following Wrinch⁴, by 40 per cent, assuming the thickness of the globules to be equal to 3 Å., then the number of dioxopiperazine molecules that can be accommodated inside the globule will amount to 150 instead of 250. We have found that each albumin molecule is bound with 200 dioxopiperazine molecules. Since, however, 52 of them are bound to the surface of the globule, we find a good agreement in this case also. Owing to the fact that the density of dioxopiperazine differs very little from that of water supplanted by it, the sedimentation constant will remain the same, as has actually been observed by Gralén and Svedberg.

D. L. TALMUD:

Institute of Physical and
Chemical Researches,
Leningrad.
March 12.

NATURE [142, 519 (1939)]

Science, 85, 187 (1937).

Phil. Mag. (7), 26, 709 (1938).

The Cyclol Theory and the Structure of Insulin

It has been proposed that the insulin molecule has the C_2 cage structure. This structure fits the chemical and physico-chemical facts and those relating to cell molecular weight, space group and cell dimensions¹. The view that this structure is inconsistent with certain experimental vector diagrams constructed afterwards has been advanced. Thus Crowfoot, for reasons nowhere stated, writes: "from the cyclol

structure one would expect many more peaks in the Patterson synthesis than do actually occur"². Alternatively, Bernal states that "the distribution of atoms in the cyclol skeleton is far too continuous to give rise to any definite peaks and no distribution of side chains can do other than increase the blurring of the picture"³. I can find no basis for either of these statements. The question of the vector map of the (C-C-N) units of the C_2 skeleton (the main features of which are readily appreciated by looking at very simple diagrams of certain idealized structures already published⁴) has been specifically raised by Bernal^{3,5}. This map has now been constructed by Riley and Fankuchen⁶, who use it to disprove two propositions, neither of which to my knowledge has been asserted, namely, (1) the insulin molecule consists of these 288 (C-C-N) units, and (2) these units and six points at the corners of a C_2 skeleton have the same vector map. This map cannot be regarded as a contribution to the study of insulin, since chemical requirements alone dispose of any idea that the insulin molecule has the composition (C-C-N)₂₈₈. However, the authors claim that it disproves also the hypothesis that insulin is a C_2 structure consisting of 288 ((C(OH)CHR)-N) units. To reach this result, they contend, following Bernal³, that a decision regarding all C_2 structures (which exceed 10^{100} in number) can be reached on the basis of a vector projection of their (C-C-N) units (which in the case of insulin represent 28 per cent by weight of the crystal) no matter what these 288 R groups may be, no matter how they may be arranged, no matter what may be the composition or arrangement of atoms in intermolecular spaces. This contention, in view of the fact that vector maps are not additive, can scarcely be correct. The issue raised, namely, my claim regarding the relation between the C_2 structure and the particular vector projection of insulin which they discuss, remains unchanged. This claim runs "the 18 peaks per molecule are given in the correct positions, on the assumption that there are concentrations of atoms at the six slits"⁷.

Apart from statements regarding uniqueness, dealt with in another place⁸, the remaining criticisms of interpretations of the experimental vector diagrams in terms of C_2 structures⁹ depend upon assuming definite intensities for groups of unknown chemical composition. Such intensities are necessarily arbitrary (cf. those given merely for purposes of illustration, but not made use of, in one of these investigations⁹). Crude maps based upon arbitrary intensities do not permit the assertion that the cyclol model leads to results incompatible with the X-ray evidence. On the contrary, C_2 not only fits all the deductions from this evidence the reliability of which has not been questioned¹⁰, but also it has provided the first hint as to a possible interpretation of the vector diagrams, previously left uninterpreted³, a hint which Bernal appears to have made use of in the 18-point model for insulin which he has since proposed¹¹. (This model has already been adversely criticized^{12,13}.) For with the C_2 structure in mind, it was seen^{1,9,14} that certain outstanding features of the diagrams can be interpreted in terms of the system of electron density deviations, $3s + 3s' = 0$, namely, six regions of high electron density at the corners of an octahedron of side 29–30 Å. and a low density region at its centre. Now it so happens that C_2 is a fabric cage with six special regions or slits which lie

approximately at the corners of an octahedron, and that this octahedron is of side $8\sqrt{6}a = 29.4$ Å. Thus "on the assumption that there are concentrations of atoms at the six slits", presumably belonging to special *R* groups or water of crystallization, the *O_c* structure, which necessarily has a low density region in its interior, gives a simple and unforced interpretation of certain features of the vector diagrams.

The investigations under discussion—and equally criticisms of them—have proceeded on the assumption that the experimental vector diagrams give a true representation of the situation in the insulin crystal. But it must be remembered that, quite apart from any lack of accuracy in the observations, the fact that the number of observations is incomplete means that the actual vector map prepared from them is necessarily a very distorted version of the true one. Further, in this particular case, the supply of data (59 relative measurements of amplitude) is certainly very meagre. Indeed the opinion has been expressed that "they are so inadequate that it is hardly worth while trying to make any kind of detailed analysis from the intensity data at present"¹⁴. In these circumstances, it is necessary to await more extensive data. Meanwhile, it may perhaps be wiser to limit deductions from the present X-ray data to the space group, the cell molecular weight and the dimensions of the unit cell. With these data, as with the general chemical and physico-chemical data, the *O_c* structure (as was shown at the outset¹) is in good accord.

New York.

DOROTHY WRINCH.

¹ Wrinch, *Science*, **85**, 568 (1937); *Trans. Faraday Soc.*, **33**, 1306 (1937).

² Crowfoot, *Proc. Roy. Soc. A*, **104**, 580 (1938).

³ Bernal, *NATURE*, **143**, 75 (1939).

⁴ *Phil. Mag.*, **27**, 98 (Jan. 1939).

⁵ *Physical Society*, Dec. 20, 1938.

⁶ Riley and Fankuchen, *NATURE*, **143**, 648 (1939).

⁷ Wrinch, *J. Amer. Chem. Soc.*, **60**, 2005 (1938).

⁸ Langmuir and Wrinch, *Proc. Phys. Soc.* (forthcoming).

⁹ Wrinch and Langmuir, *J. Amer. Chem. Soc.*, **60**, 2247 (1938).

¹⁰ Robertson, *NATURE*, **143**, 74 (1939).

¹¹ *Proc. Roy. Soc. B*, **127**, 36 (1939).

¹² Langmuir, *Physical Society*, Dec. 20, 1938 (in course of publication).

¹³ Wrinch, *NATURE*, **140**, 956 (1938).

¹⁴ Robertson, *Physical Society*, Dec. 20, 1938.

History of the "Widmanstätten" Structure

My attention was recently directed by Dr. R. T. Gunther to a paper by G. Thomson (= W. Thomson, F.R.S.), which appears to have been generally overlooked, describing the Krasnojarsk meteorite, a pallasite containing abundant nickel-iron with about 10 per cent of nickel.

The particular interest of this paper, which is dated February 6, 1804, and published in the *Atti Accad. Sci. Siena*, **9**, 37 (1808), lies in the fact that Thomson studied the action of dilute nitric acid on the nickel-iron; the resulting etch figures are fully described and figured, and it is clear that Thomson anticipated the work of von Widmanstätten (or Widmanstatten), which was carried out in 1808 and published in 1812.

MAX H. HEY.

Department of Mineralogy,
British Museum (Natural History),
London, S.W.7.

March 29.

¹ (See also *NATURE* of April 22, p. 667).

Active Form of Vitamin B₁ in Tissues

THOUGH there has been a strong indication since the work of Lohmann and Schuster¹ that the active form of vitamin B₁ in pigeon brain tissue is phosphorylated, the failure to obtain much activity with oocarboxylase in the catatorulin test with 'brei' (alices has made it impossible to make a firm decision². We are now able to report that with the use of two types of finely ground 'avitaminous' brain preparations (in presence of fumarate) we can get either (1) a preparation which shows good catatorulin effect with small amounts of oocarboxylase (0.26 γ max. and practically no effect with vitamin B₁, or (2) one which still retains some catatorulin effect with large amounts of vitamin B₁ (10 γ) as well as good effect with small amounts of oocarboxylase. Both preparations are rather unstable; the medium used is as in previous experiments.

As there can be little doubt that these ground preparations permit of better access to active centres and as synthesis of oocarboxylase can be found when vitamin B₁ is added to preparation (2), we consider it to be now proved that the active form of vitamin B₁ in brain is phosphorylated; the failure in the ordinary catatorulin test (as was previously suggested)³ is due to impermeability of the brei to oocarboxylase, the effect of vitamin B₁ being produced after phosphorylation.

Full details will be presented elsewhere.

I. BANGA.

S. OCHOA.

R. A. PETERS.

Department of Biochemistry,
Oxford.
April 1.

¹ Lohmann and Schuster, *Biochem. Z.*, **204**, 188 (1937).

² Peters, *Biochem. J.*, **31**, 2240 (1937).

³ Ochoa and Peters, *Biochem. J.*, **32**, 1501 (1938).

Growth Activation of Cell Colonies *in vitro* by Extracts of Adult Tissues

AN extensive growth of cell colonies *in vitro* is only obtained if tissue extracts are added to the culture medium. It has been generally accepted (Levi¹, Verne², Willmer³) that extracts of growing tissues (embryonic and neoplastic tissues) and extracts of organs with active cell formation (for example bone-marrow) chiefly possess these growth-activating properties. Extract of embryonic tissue is considered to be the best growth activator (Willmer³).

Experiments were undertaken to determine whether the property of cell-growth activation is especially characteristic of proliferating tissue as opposed to mitotically inactive, stable tissue.

We investigated the growth-promoting effect of aqueous extracts from various tissues of adult chickens and compared the action of these extracts to each other as well as to extracts of seven-day-old chick embryos.

The stimulating effects of tissue extracts were quantitatively tested on fibroblast colonies in Carre flasks, prepared according to the standard technique. The growth of cell colonies was observed and measured over a period of seven days. During this time the added tissue extracts were not renewed.

Our experiments proved that extracts of tissues of adult animals including mitotically inactive tissues markedly increase the rate of growth of cell cultures

tracts from heart, smooth muscle, striated muscle, brain, lung, liver, kidney, testes, ovary, oviduct, and spleen proved to be very active. Extracts of spleen and bone-marrow are effective, but not more so than extracts of other tissues. Liver, and to a less extent kidney, differ somewhat in their growth-promoting action from other organs. Extracts from these two organs show a marked initial stimulation followed after three days by a slowing down of the rate of growth and degeneration of the cells resulting in a complete stoppage of growth by the fourth to sixth day.

The growth-promoting action of all extracts used with the exception of liver and kidney extracts varies somewhat within relatively small limits and is extremely pronounced. A comparison of the cell growth activating effects of adult tissue extracts with those of embryonic extract of the same concentration shows that under our experimental conditions the growth-promoting properties of extracts of adult tissues are definitely greater than those of embryonic tissues. Extracts of brain and heart, for example, increase the growth rates of fibroblasts two to three times as much as embryonic extract.

It can be concluded that the ability to stimulate growth of cell colonies *in vitro* is not a specific property of extracts of proliferating tissues, but that growth-stimulating substances are found in abundance in most animal tissues and organs.

We wish to mention here that our work confirms the earlier, much overlooked experiments of Carrel⁴ and Walton⁵ who already in the years 1913 and 1914 indicated that extracts of certain adult tissues stimulate cell growth somewhat.

Details of our experiments are being published elsewhere.

R. S. HOFFMAN.
E. TENENBAUM.
L. DOLJANSKI.

Department of Experimental Pathology,
(Cancer Laboratories),
Hebrew University,
Jerusalem.
March 24.

Ery. Anat., 31, 125 (1934).

"La Vie cellulaire hors de l'organisme" (Doty and Oie., Paris, 1937).

"Tissue Culture" (Metzger and Co., London, 1933).

J. Exp. Med., 17, 14 (1913).

J. Exp. Med., 20, 554 (1914).

Pasteur Reaction in the Lactic Acid Bacteria

THE lactic acid bacteria show three well-defined types of Pasteur reaction which can be correlated with the respiratory mechanisms of the three main groups into which these bacteria (cocci and rod forms) can be classified.

	Group I	Group II	Group III
Catalase	0	0	0
Respiration	0	+	+
Cyanide inhibition	-	0	+
Hydrogen peroxide formation	-	+	0
Methylene blue stimulation	++	+	0
Glycolysis aerobic	+++	++	+++
" anaerobic	+++	+++	+

The experiments were made in the Barcroft-Warburg apparatus.

Organisms in Group I cannot use molecular oxygen to oxidize sugars, etc.¹, although 'protoplasmic respiration' (autoxidation) can be detected. There is

correspondingly no Pasteur effect. Lactic and pyruvic acid dehydrogenases are present in organisms of Group II² and an appreciable Pasteur effect is noticeable.

Group III (heterofermentative) types are peculiar in that apparently a negative Pasteur effect is present. This group grows almost equally well anaerobically and aerobically, so that its respiratory mechanism would not appear to be a very efficient means of obtaining energy for growth. Considerable amounts of acetic acid are produced aerobically, but in addition more lactic acid (estimated chemically) is produced aerobically than anaerobically. This is believed to be a very rare, if not a unique, phenomenon.

These findings form the basis of a classification which will be published shortly.

J. G. DAVIS.

National Institute for
Research in Dairying,
University of Reading.
April 4.

¹ Davis, *Biochem. Z.*, 237, 357 (1933).

² Davis, *Biochem. Z.*, 235, 90 (1933).

Mauicetus: a Fossil Whale

IN 1937, I published in the *Transactions of the Royal Society of New Zealand* an account of a portion of a skull of an extinct whale found in the Upper Oligocene of New Zealand. To this skull I gave the generic name of *Lophocephalus*. Soon after the appearance of the article, my attention was directed to the fact that this same title had been bestowed already on three animals of widely different groups, namely, on a gregarine, on a beetle and on a fish; hence it is necessary to substitute another generic name for this whale. I propose to use the name *Mauicetus*. This name definitely associates the whale with New Zealand, for the Maoris have many legends about that mythical demi-god Maui.

W. B. BENHAM.

University of Otago,
Dunedin, N.Z.
March 13.

Ancient Egyptian Astronomy

IN a recent communication to NATURE¹, Dr. H. Chatley points out that in my former communication² I did not take account of a whole group of important papers of well-known scholars, and he adds some remarks on stars and planets in ancient Egypt. I think Dr. Chatley must have overlooked my first sentence, where I speak on "Egyptian calculating astronomy". We were, in fact, speaking on entirely different problems.

Dr. Chatley even makes statements concerning the historical estimation of the Egyptian "theoretical" astronomy (*sic venia verbo*). I want to take up this problem, for it seems to me of importance to prevent misstatements taking up a firm position also in this field from the very beginning. Dr. Chatley says: "It seems very doubtful if one can safely attribute much mathematical ability to the ancient Egyptians on the basis of the demotic texts to which Dr. Neugebauer refers. From the time of the foundation of the Museum at Alexandria, Greek methods appear to have been adopted." I do not know who attributed to the ancient Egyptians in this connexion "much

mathematical ability". In the letter of mine this statement is not made and in the paper quoted there on p. 116, note 1, concerning the Egyptian calculation of the new moons, I did say explicitly (p. 403): "Compared with the methods of the Babylonians and Greeks, this method here is very simple and shows no consideration of the anomalies of the motion of the moon and the sun, very carefully studied both by the Babylonian and Greek astronomers". It seems to me, indeed, to be the most important result of the discovery of an Egyptian "theoretical" astronomy, that it represents a state of development just as "primitive" as the Egyptian mathematics. Even the fact that those texts to which I was referring belong to the Roman period and for all that do not at all show the least influence of Greek methods, seems to me of the highest interest. This makes an exact parallel to an analogous position in mathematics, where the Egyptian mathematics, too, retains its primitive

character, quite uninfluenced by the Babylonian and by the Greeks. The striking recent investigation of Cumont on Egyptian astrology³ in this field proves also the splendid isolation of the work of the Egyptian astrologers from the world of the Greek masters—a fact evidently overlooked by I. Chatley, else he would not speak so securely of "purely Greek astrology".

I can also only repeat the conclusion of my preceding letter, that now it is possible for the first time to make a complete comparison of Egyptian, Babylonian, and Greek astronomy, as was possible in the history of mathematics a little earlier.

O. NEUGEBAUER.

Brown University,
Providence, Rhode Island.

¹ NATURE, 143, 336 (1939).

² NATURE, 143, 116 (1939).

³ Cumont, F., "L'Égypte des Astrologues" (Bruxelles, 1937).

Points from Foregoing Letters

THE emission of gamma-rays of six million electron-volts energy when fluorine (mass 19) is bombarded with protons, may be explained, according to P. I. Dee, S. C. Curran and J. E. Strothers, by the formation of excited oxygen nuclei (mass 18). Excited neon nuclei (mass 20) are first formed, and these give up alpha-particles of low energy, thus changing into oxygen nuclei.

Experiments by J. L. Michiels, G. Parry and G. P. Thomson on the production of neutrons as a result of the fission of the uranium nucleus show that the processes of fission by fast and possibly by slow neutrons lead to a net gain in the number of neutrons.

E. E. Widdowson and S. J. Gregg have developed methods for obtaining the absorption curves and ranges of the recoil atoms from certain α -particle disintegrations, using built-up films of barium stearate to provide sufficiently thin absorbing screens.

The mean life-time of the meson due to spontaneous disintegration, according to H. Yukawa and S. Sakata, depends critically on its mass, and the discrepancy between theory and experiment becomes smaller as the mass decreases, although the theoretical life-time is always smaller than the experimental value $2 \sim 4 \times 10^{-6}$ sec.

From considerations of the work which can be produced when a current of molecules is scattered at incidence on a diffraction grating, W. Kroczy concludes that weak chemical bonds may be broken by the process of diffraction.

Spectroscopic analysis of various limestones and other rocks is being systematically undertaken in the Chemistry Department of the Central Technical College, Birmingham. Mention is made by J. Newton Friend and J. P. Alloh of the presence of nickel and vanadium in calcites from Cannington Park near Bridgwater and from Weston-super-Mare. Tellurium was found in sulphur from Krisuvik, Iceland.

D. L. Talmud re-interprets the findings of Gralén and Svedberg on the sedimentation constant of the product of egg albumin with glycine ethyl ester, and states that the experimental data do not disprove,

but rather support, the hypothesis of intraglobular protein reaction based upon Wrinch's cyclol model for proteins.

D. M. Wrinch discusses objections to the C_4 structure for insulin, which were brought forward; the strength of 'vector maps', and states that reliance can be placed upon such vector maps because the number of observations used in their preparation is incomplete.

Max H. Hey points out that a paper by V. Thomson, hitherto generally overlooked, shows that Thomson anticipated Widmanstätten's discovery of the etch-figures on meteoritic iron by some years.

I. Banga, S. Ochoa and R. A. Peters state that they have now obtained preparations from avian amniotic pigeon brain which show either catatorulin effects with coocarboxylase and not with free vitamin B_1 or with both. The catatorulin effect is the one given to the oxygen uptake induced in avitaminosis brain by vitamin B_1 addition. They consider it to be proved that the active form of vitamin B_1 in brain tissue is phosphorylated.

The aqueous extracts of the many adult tissues and organs investigated by R. S. Hoffman, J. Tenenbaum and L. Doljanski are said to stimulate growth of fibroblast colonies *in vitro* to a high degree. Under their experimental conditions, the stimulatory action of these extracts was in most cases greater than that of embryonic extract. It was concluded that the ability to stimulate growth of cells *in vitro* is, therefore, not a specific property of extracts of proliferating tissues, but that growth-stimulating substances are found in abundance in most animal tissues and organs.

Working on the metabolism of the lactic acid bacteria J. G. Davis has found that the three main groups into which these bacteria can be classified according to respiration mechanisms show correspondingly three different types of Pasteur reaction. Group III (heterofermentative) shows an apparent negative Pasteur effect.

Research Items

British Decorated Axes in the Early Bronze Age

A STUDY of the diffusion of British decorated axes of the Early Bronze Age by B. R. S. Megaw and Miss E. M. Hardy (*Proc. Prehist. Soc.*, N.S., 4, Pt. 2; 1939) indicates the importance of these axes in the material culture of the British and Irish Bronze Age and that of western and northern Europe. Fundamentally there are only two types: Type I, without flanges, ranging from 6 to 12 inches in length; and Type III, with strong cast flanges, normally from 6 to 8 inches in length. Type II, though in size following Type I, has straighter sides, and low flanges are absent. The ornament is wholly geometrical in character. Ornamented axes have been found only in the British Isles, south Scandinavia, Saxony, France and Holland. The greatest number occurs in the British Isles, being concentrated in north-east Ireland, east Scotland, Yorkshire, the East Anglian fens and the valleys of the Boyne, the Lagan and the Thames, all districts favourable to early settlement. Type I occurs most frequently in Ireland, Type III—though there is a considerable number in Ireland—concentrates in south-east England. Distributional study suggests the possibility that metal-working in the north and west may have started in the west and, carrying Type I, spread from Ireland and the 'highland zone' of Britain to the Continent, reaching Scandinavia via the Moray Firth, rather than via Caithness; while local development suggests the possibility that Irish craftsmen have settled in the Baltic. It is possible, or even probable that Type III originated on the Continent in northern Italy or Bohemia, whence it reached Scandinavia and Southern Britain and ultimately Ireland. This diffusional development illustrates the thoroughly cosmopolitan character of the Early Bronze Age, while a comparison of the character of the ornament with that of the schist plaques from Portuguese passage graves strengthens the attribution of an Iberian origin to Irish metallurgy. The practice of decorating the axe may derive from the spread of the cult of the sacred axe to the west and north.

Gold Pendant from Ancient Columbia

A GOLD object of unusual size and importance has been presented to the collections of the Ethnographical Department of the British Museum (Bloomsbury) by the National Art-Collections Fund. It is a pendant of ancient Colombian provenance in the form of a ceremonial knife with curved edge, similar in form to ancient copper knives from Peru and Ecuador; but the place of the handle is occupied by a highly conventionalized human figure, wearing an elaborate headdress with open-work geometric ornament. H. J. Braunholtz, who has figured and described the pendant (*Brit. Mus. Quarterly*, 13, 1, 1939), cites a parallel from gold objects of the Chimú period found in the Lambayeque Province of northern Peru in 1936. In the present example the headdress is flanked by smaller beaked figures, repeated below, while to the arms are attached animals resembling monkeys with birds' heads. The central figure wears a large circular nose-pendant and three bead necklaces. The legs are constricted below the knee with tight bands, a feature found in ancient Columbian

figure vases. Similar bands are still to be seen worn by living South American tribes. A peculiar character in the figure is the large number of fingers (fifteen on each hand) and toes (thirteen and fourteen). In general aspect the figure is unique, but it presents Peruvian and Panamanian affinity—additional evidence of the strong cultural connexions between north and south indicated in the Chimú period, if not earlier. Its date probably falls between A.D. 1000 and 1400. A record in ink on the specimen indicates its place of discovery as Popayan in the Cauca River valley. This is south of the area of the Quimbaya culture, which produced some of the finest gold work of pre-Columbian America. Though the entire surface is covered with gold, this is superficial only, and encloses a core of base metal with a specific gravity of 9.7, indicating a silver-copper alloy in equal parts. The method by which the pure gold was applied cannot be determined without minute microscopic analysis; but probably it was a form of amalgam plating.

Blood Groups in Man

PROF. R. RUGGLES GATES (*Z. Rassenkunde*, 9, 58; 1939) summarizes the data on the distribution of blood-groups A and B among the races of man. Blood group A is found in the chimpanzee and gorilla and in primitive races of man, but blood group B is not found in these relatives of man and to a very small extent in the primitive races. Since the proportions of A and B vary greatly in different races occupying similar environments, it is suggested that mutation, not selection, is the cause of the different distributions. Blood group B probably has arisen by mutation after the evolution of man, whereas A may have been derived from the early ancestors. As in plants and animals, parallel mutations at different mutation rates in different races may occur in man.

Sulphanilamide in Experimental Brucellosis

B. D. CHINN (*J. Infect. Dis.*, 64, 78; 1939) carried out experiments *in vitro* showing that sulphanilamide has a bactericidal and bacteriostatic effect on *Br. melitensis*, *Br. abortus* and *Br. suis*. He also found that the drug had a protective action in 100 per cent of guinea pigs inoculated with these organisms when treatment was started immediately after inoculation. Sulphanilamide had also a definite therapeutic effect in guinea pigs infected with *Brucella* when treatment was begun a week after inoculation. 50–100 per cent of the animals, according to the type of organisms injected, were negative pathologically and culturally after treatment, while untreated animals were all positive for *Brucella* and showed characteristic lesions. Infections in guinea pigs due to *Br. abortus* and *Br. suis* responded more satisfactorily to sulphanilamide than did *Br. melitensis* infections.

Anaphylaxis in the Rhesus Monkey

L. M. Kopeloff and N. Kopeloff (*J. Immunol.*, 36, 83; 1939) demonstrated the following anaphylactic phenomena in the rhesus monkey after intravenous

injection of horse serum: severe and fatal shock, Arthus reactions, and functional and pathological changes, including delay in clotting time of the blood, reduction in the number of blood platelets, emphysema, oedema and hæmorrhage of the lungs, oedema and hæmorrhage of the intestinal tract, and occasional hæmorrhage in other internal organs. Precipitins to horse serum were present after repeated injections. No correlation was found between the titre of the serum and the degree of sensitivity as measured by shock. The authors (*ibid.*, 38, 101; 1939) also produced severe and fatal anaphylaxis in monkeys by intravenous injections of egg-white. Repeated injections proved more effective for sensitization than single injections. Fatal anaphylaxis usually occurred within six minutes of the injection of egg-white, and was usually preceded by respiratory difficulty, unconsciousness and collapse. Post mortem, occasional emphysema of the lungs with petechial hæmorrhages was found. After shock the blood platelets were reduced to about a third or less of their original number and the coagulation time was appreciably delayed.

Adaptation of a Black Sea Fish to Changes of Salinity

THE Black Sea is inhabited by *Atherina pontica oichvaldi*, a teleostean fish, which is probably a descendant of the Mediterranean species *A. hepsetus*. If this phylogeny is correct, the Black Sea species already shows adaptation to very special conditions, for the average salinity there is only 18 per cent, and it is subject to sudden and serious changes, whereas the salinity of the Mediterranean remains steadily about 35 per cent. Eugen A. Pora has made tests to determine the limits of the adaptability of *A. pontica* to saline conditions (*Ann. Sci. Univ. Jassy*, 24, 319; 1938). He finds that it cannot survive in the salinity of the Mediterranean, its presumed original habitat, but is limited to a range from 12 to 20 per cent. In low salinities the smaller individuals die more quickly than the larger, in high salinities the order is reversed; and in both cases the incidence of death seems to depend upon the size of the gills in relation to body size. The smaller individuals have a large branchial area in relation to the body, the larger individuals have a relatively smaller branchial area; the former die more rapidly in low salinities from a loss of body salts, the latter die more rapidly in high salinities on account of histological changes in the gill filaments which bring about asphyxiation.

A New Mysid Crustacean from the Black Sea

At present only three species of *Hemimysis* are known from European waters: the deep-water *H. abyssicola* from Norwegian fjords, *H. larmannae*, a widely distributed littoral form ranging from north-west Europe to the Mediterranean and Black Seas, and the adaptable *H. anomala* confined to the Caspian and Black Seas, but penetrating even to the fresh waters of the latter basin. To that short series Mihai Băcesco adds a fourth species from the Black Sea (*Ann. Sci. Univ. Jassy*, 24, 425; 1938). It is a beautiful species with many chromatophores, brilliant red with yellow or orange markings, and the rapidity of colour change from full colour to almost clear transparency is remarkable, even under the local environmental change caused by agitating the water of the aquarium. The discovery of this

new species, *H. serrata*, raised the number of forms recognized from the Black Sea to three, out of known total of four, and the author makes the suggestion that the Black Sea basin, or more generally the Ponto-Caspian region, may be the evolutionary cradle for the genus *Hemimysis*, as it is for the related genus *Paramysis* and perhaps also for *Diamysis*. It cannot yet be safely said that the new species is endemic to the Black Sea for the mysid fauna of the eastern Mediterranean has been little studied and upon such study must await the determination of the relationship of the forms occurring in the close waters of eastern Europe.

Plant Behaviour

THE Masters Lectures of the Royal Horticultural Society for 1938 were given by F. J. Chittenden who chose "The Behaviour of Plants" for the title of his discourse (*J. Roy. Hort. Soc.*, 64, Pts. 2 and 3; February and March 1939). His first lecture dealt mainly with periodicity of development of garden plants. Shortening the normal period of dormancy of plant shoots can be accomplished in several ways. Mr. Chittenden reviewed the various methods with a combination of historical background, practical outlook and scientific exactitude, which is not often accomplished. He furthermore mentioned the simple expedient of plunging the dormant plant in a bath of warm water, a method of breaking the rest period which seems to have been forgotten of recent years. Dutch work upon periodicity of the common bulb was marshalled in such a way that many suggestive points of view emerge from the text. There are, however, many plants which could better represent the conception of 'short-day' flowering plants than the lecturer's choice of *Dahlia*, though his descriptions of earlier flowering in London than in New York are none the less interesting. The second lecture was chiefly devoted to a consideration of plant hardiness. The maidenhair tree, *Ginkgo biloba*, was cited as one of the hardiest plants under wide extremes of climate both recent and geological. *Primula nivalis*, on the other hand, has evidently such a narrow range of hardiness that it is extremely difficult of cultivation. Damage by early frosts in such southern plants as *Amaryllis Belladonna* is regarded as incomplete acclimatization in the northern hemisphere, but several interesting examples are given of quick adaptation to the reversal of climatic sequence involved in transplantation from north to south or vice versa. Many plants, as *Primula malacoides*, are also more variable in cultivation than they were in the wild state, whilst others are not. Generalisations are not possible between plant species; each one has its own innate characteristics, which must form the subject of separate experiments before adequate horticultural control can be expected.

Colchicine and Wheat Hybrids

E. R. SHARS (*J. Hered.*, 30, 38; 1939) describes the production of fertile polyploid generic hybrid by the aid of colchicine. The seeds resulting from the crosses *Triticum monococcum* × *Aegilops uniaristata*, *Ac. caudata* × *Ac. umbellulata* and *Ac. speltoides* × *Ac. umbellulata* were immersed in a solution of colchicine for twenty-four hours. As much as one third of some of the mature plants were found to be tetraploid $2n = 28$ and fertile, whereas the remainder of the plants was diploid and sterile.

Sex Chromosomes of *Cricetus auratus*

THE small rodent, the golden hamster, has an XY pair of chromosomes of equal size during mitosis but greatly differing in construction and appearance during meiosis (P. C. Koller, *J. Gen.*, 36, 177; 1938). This arises from the fact that the differential part of the X-chromosome remains during meiosis in a similar extended state to that of mitosis while the pairing segments of the X- and the Y-chromosomes are normally condensed. The centromere is localized in the pairing segments and chiasmata may be formed on either side of it. It is therefore to be expected that a number of characters may be controlled by genes on the sex chromosomes but may not show sex linkage. The differential segment of the X-chromosome shows 81.6 per cent pre-reductional segregation.

Effect of Pressure on the Rigidity of Rocks

THIS was the subject of a considerable amount of experimental work by Francis Birch and Dennison Bancroft of Harvard University (*J. Geol.*, 46, Nos. 1 and 2; 1938). They employed a method whereby a light circular cylinder of the specimen about 20 cm. long and 2 cm. in diameter was set into forced torsional oscillation by means of a driving armature at one end, and the resulting motion observed by another armature at the other end leading to an a.c. voltmeter. The whole was subjected to pressures of nitrogen gas varying between 1 and 4,000 kgm./cm². by placing it in a thick-walled steel tube. Using a water jacket, temperatures were varied between 30° C. and 100° C. Very large changes in rigidity were observed in many cases upon the application of the first few hundred atmospheres, but at high pressures the change of rigidity with pressure became nearly linear and small. Extrapolating from the results obtained, the authors discussed the materials and temperature conditions in the surface layers of the earth. The usually accepted values of the velocities of P and S waves in the granitic layer they suggested as being those in a granite with a low quartz content. For the intermediate layer they considered that their results were not inconsistent with some diabasic or gabbroic rock. In view of their small coefficients of decrease of rigidity with pressure and temperature, however, they found great difficulty in fitting in any of their rock types with the normal velocities of 7.8 m./sec. and 4.35 km./sec. respectively for the P and S waves in the underlying supposedly basic material.

Viscosities of Liquid Helium

SOME very puzzling results have been obtained for the viscosities of liquid helium. Some observers found a normal increase with decrease in temperature from 1.2° to 2.2° K. but below 2.2° K. the viscosity decreased rapidly. It has also been considered that at lower temperatures the viscosity fell below an experimentally determinable value. The suggestion has been made that a film is formed on a tube surface in which liquid helium is being evaporated under reduced pressure. W. F. Giauque, J. W. Stout and R. E. Barieau (*J. Amer. Chem. Soc.*, 61, 654; 1939) now describe some experiments which are very satisfactorily explained by the transfer of helium up the walls of the tube. Their own experiments indicate that the viscosity of liquid helium decreases from 2.0×10^{-4} poise at 2.266° K. to 1.0×10^{-7} poise at 1.468° K. The largest Reynolds number, which occurred at 1.468° K., was estimated to be about

200, instead of very much larger values formerly reported. At the lowest temperature of measurement the viscosity was found to be still decreasing rapidly, and it appeared to be approaching zero at the absolute zero of temperature.

Theory of Air-Conditioning Systems

AN instructive paper, by R. O'Neill Hobson, has recently reviewed the fundamental theory governing the operation of air-conditioning systems (*British Engineers' Export Journal*, April). These systems consist in the treatment, modification and control of all the physical and some of the chemical properties of air. They also involve the simultaneous control of temperature and humidity, purity and movement of the atmosphere within enclosed spaces. The demand in each industry varies from that of others over a wide range. The processing of cotton and artificial silk, for example, which requires a humidity point of at least 80 per cent, contrasts sharply with the manufacture of chocolates, where the maximum humidity should not exceed 25 per cent, or of match production, which needs no humidity at all. In the same way the temperature demands vary considerably. In a country where there is often a wide degree of temperature variation from dawn to dusk, as well as from day to day, ideal conditions can only be secured by a well-designed and efficient system. In those systems where both the temperature and the moisture content have to conform to set standards, the apparatus must be designed to duplicate as nearly as possible the changes which Nature makes on a large scale. Heat must be supplied to evaporate water, and heat must in turn be subtracted to effect the condensation of water vapour. It is essential to have the operation of the plant automatically controlled. Humidity control is of equal and sometimes of greater importance than temperature control. The large-scale air-conditioning and refrigeration installed in many South African gold mines enable gold companies to explore much greater depths.

Measurement of Radio Fields at Ultra-Short Waves

THE general development of the ultra-short band of wave-lengths below 10 m. for television broadcasting and for radio-telephone links, has given rise to a demand for accurate methods of measuring field intensity on these wave-lengths. The March issue of the *Journal of the Institution of Electrical Engineers* contains a paper by F. M. Colebrook and A. C. Gordon-Smith describing the design and construction of a measuring set developed at the National Physical Laboratory for wave-lengths of 7–11 m. (frequencies 27 to 43 Mc./s.) The apparatus consists of a high-gain intermediate-frequency amplifier (about 1 Mc./s.) associated with a signal-frequency and frequency-change unit of constant conversion efficiency. The e.m.f. of thermal agitation in the input tuned circuit of the intermediate-frequency amplifier is used as a standard signal for setting the amplifier to a known amplification. The whole apparatus is calibrated over its signal-frequency range by means of a small transmitter which gives a horizontally polarized radiation of calculable intensity. A loop aerial system is employed, coupled inductively through a suitable electric screen to the frequency-change circuit. The apparatus is suitable for measuring field intensities of any value down to about 1 microvolt per metre.

Location of Industry in Great Britain*

THE report on the location of industry which has now been issued by Political and Economic Planning (P.E.P.) is one of a series of contributions to this subject which has been made by P.E.P. since, in April 1935, it was decided to undertake a comprehensive study of regional development to provide a sound basis for the evolution of policy. Apart altogether from its recommendations, this report contains much that is new and gives by far the most comprehensive and scientific survey yet available of a problem which many factors besides those of the Special Areas and defence policy are forcing upon our attention.

After reviewing briefly the factors which led to the emergence of the problem, the report, by means of a series of diagrams, shows the recent changes in British industry and its present distribution by regions. The employment chart for all insured persons, including distributive and other workers, shows how, between 1923 and 1937, the south-east, Greater London, the south-west and the Midlands increased their proportion of total national employment at the expense of other regions, particularly Wales and the North. Since 1921, some 700,000 persons from other parts of Great Britain have migrated to Greater London. The net output figures show similar changes, with Greater London rising by nearly 50 per cent between 1924 and 1935 and South Wales declining almost as sharply. In 1935, Greater London had more workers actually employed than any other region, and at the same time a higher value of net output per head. Apart from their heavier burden of unemployment, the older industrial regions of the north-east, the West Riding and Lancashire have markedly lower net outputs per head than the south-east and east England or the Midlands. Between 1927 and 1937, the extractive group of industries reduced its use of labour by more than 30 per cent, textiles and clothing by 20 per cent, while heavy industry also slightly declined, but light and intermediate industries, building, transport, distribution and services expanded their personnel.

The region with fewest types of industry is south Scotland, in which 39 per cent of British industries are virtually unrepresented and a further 38 per cent have location factors below 0.45. Lancashire and Cheshire show most types of industry, while the West Midlands have the largest share of industrial concentration, nearly 20 per cent of their industries having location factors greater than 2. Between 1924 and 1935, Greater London maintained or increased its relative share of output in all industrial groups except two, and even in these its net output increased. Nevertheless, London is now getting no more than its proportionate share of new employment. In the last six years, the south-east and Midland divisions have made most advance, but the northern division has recovered nearly a third of the ground previously lost. Scotland, Wales and the north-east have held their own, the north-west continuing to lose heavily. The four southern divisions

now claim nearly 54 per cent of British employed workers as against less than 47 per cent in 1923, as London's employed population is now nearly half as high again as sixteen years ago.

Changes in employment in individual industries are also discussed, and the report then considers the factors which have determined the location of industries, including some discussion of the financing of new developments. A close survey of existing trading estates follows, while an analysis of the effect of the location of industry points out that about 43,000 acres of land are taken from the farms annually by industry, while at the same time the State has to spend large sums on cleaning up sites abandoned by industry in a derelict and unusable condition. Residential and university towns have their amenities ruined by new mushroom industries, while towns built for industry stand half idle. This analysis of social effects is followed by discussion of the different types of town in relation to industry, an analysis of the main considerations affecting industry and defence, of the need for balance in regional development and a discussion of the aims of national industrial policy.

The final chapter of the report outlines its proposal to meet the main needs not covered by existing machinery—the provision of a centralized research and information service and the effective co-ordination of action. The main proposal is the creation of a permanent Industrial Development Commission to guide the location of industry and advise the Government on the subject. The Commission would be charged with the licensing of new factories or extensions; where a licence was refused, it would be required to indicate broadly the areas and categories of industry in respect of which applications would not in principle be favoured. It would keep under review all factors affecting the efficient operation of industry or affecting economic development in different areas and the location of industry. Like the Commissioners for the Special Areas, it would have resources for giving limited financial help to overcome obstacles to industrial development in specific instances. The Commission would explore the problem of financing new enterprise, would take over the responsibility for supervising existing publicly owned trading estates and for the preservation or restoration of amenities.

The report also suggests that the Commission should take over the machinery for the Special Areas, and, particularly, that it should consider the problem of evacuation and re-settlement where necessary. Using Merthyr as an example, it is suggested that transfer as a community of such a town of 63,000 inhabitants at a total cost of £15 millions would represent a total cost to the State in interest and sinking fund of less than the £832,000 actually paid out in 1937–38 to keep much of Merthyr in idleness. It is proposed that the Commission should be responsible to Parliament through a senior Cabinet Minister without departmental duties, and its probable cost need not exceed that of the Special Areas Commissioners, whom the new industrial body would in time supersede.

*Report on the Location of Industry: a Survey of Present Trends in Great Britain affecting Industrial Location and Regional Economic Development, with Proposals for Future Policy. Pp. vi+314. (P.E.P., 1939.) 10s. 6d. net.

Control of Metamorphosis in Lepidoptera

J. BOUNHIOL has recently published a detailed account of his experiments on this subject, some of which have been published from time to time during the last few years (*Bull. Biologique de France de Belgique, Suppl.* 24, 1-199; 1938). Three species of moths were used in this study: the silkworm moth *Bombyx mori*, the wax moth *Galleria mellonella*, and the gipsy moth *Lymantria dispar* in the order of their importance. The paper begins with a description of the life-histories and the methods of rearing. There may be either four or five larval ecdyses in *Bombyx mori*, but careful measurements of the head diameter will show to which instar the larva in question belongs, and whether it is of the four- or five-moulting type. Equally necessary for the correct interpretation of the later experiments was an examination of the effect on the occurrence of metamorphosis of simple starvation begun at various times after the last larval moult. In the case of *Bombyx mori*, the larva must be able to feed for at least seven days for metamorphosis to take place. This is liable to be a complicating factor in experiments in which the aim is to inhibit metamorphosis by an operative procedure. For example, the author finds that section of the ventral nerve cord prevents metamorphosis if the cut is made before the seventh day after the last larval moult; but this, he suggests, is due merely to an interference with the normal nutrition. The same sort of thing has to be taken into account in considering experiments where regions of a larva are separated off by ligatures with the view of finding their importance in metamorphosis.

Perhaps the most interesting part of the work is

that dealing with the function of the corpora allata. Dr. Bounhiol describes the delicate surgical method which he has devised for removing these bodies in the larva of *Bombyx mori*. He finds that loss of both corpora allata in the last larval instar has no effect on the occurrence of pupation; but if, on the other hand, the operation be performed in the instar before the last, then pupation takes the place of the normally ensuing larval moult and a premature metamorphosis is induced. The same is even true of a still earlier instar and in this way a pupa was obtained which weighed a fortieth of the normal.

The result of corpora allata removal in *Bombyx mori* and the comparable effects following the same operation in the stick insect *Dirippus* (Pflugfelder, *Z. wiss. Zool.*, 149; 1937) are interesting when compared with the results of Wigglesworth on *Rhodnius* (*Quart. J. Micro. Sci.*, 79; 1936). Wigglesworth suggested that the corpora allata secrete a hormone inhibiting metamorphosis and another initiating moulting. In *Bombyx* the corpora allata possess the first function but apparently not the second.

Dr. Bounhiol also reports that he repeated and confirmed the experiments of Kopeč, who found that removal of the cerebral ganglia before a certain critical period prevented metamorphosis. Lastly, he discusses the factors controlling metamorphosis in insects and maintains that the view which most experimenters on this line hold, that pupation is initiated by a hormone circulated by the blood, is still unproved. This must be so until someone makes at least a cell-free extract and induces metamorphosis with it.

E. T. BURR.

Portable Gas Producers

MR. BOSWORTH GOLDMAN and Mr. N. Clarke Jones, in a paper presented to the Institute of Fuel on December 8, 1938 (*J. Inst. Fuel*, 12, 63, February, 1939), pleaded for recognition of the value of portable gas producers as a means of supplying mobile power as an alternative to petroleum. In the event of world petroleum resources becoming exhausted or of their being restricted in times of national emergency, other fuel would have to be used for vehicular propulsion. Producer gas plants are claimed to be between two and three times as efficient as any oil-from-coal process and yet they can utilise the same cheap and easily available home-produced fuel.

The theory of producer gas practice is based on the conversion of carbon into carbon monoxide, which when mixed with further oxygen is combustible in an engine. To achieve this, five units are necessary: generator, coolers, scrubbers and/or filter, air inlet device and gas throttle. These units are disposed about the vehicle and connected by pipes. They can be fitted to existing vehicles by modification of the existing engine or alternatively incorporated into a specially designed chassis.

A variety of solid fuels, such as anthracite, charcoal, low-temperature coke and peat may be used in these plants, but their efficiency is dependent on factors

of reactivity, size and grading, moisture content, ash and volatile content. Actually there are ample resources of suitable fuel available in Great Britain, but their utilization is hampered by the relative difficulty of obtaining supplies as compared with liquid fuels.

As regards performance, figures obtained for certain types of converted vehicles show that for acceleration and hill climbing this type of fuel is but little inferior to petrol. Moreover, it has been proved that maximum power on gas is obtained at a mixture strength slightly weaker than that theoretically required. In the case of petrol, maximum power is only achieved with a richer mixture than is theoretically needed.

For some time past these and other advantages have been fully appreciated on the Continent, and a considerable number of producer gas vehicles are in use. In Great Britain, however, their utilisation has been impeded by the Government's refusal to adjust existing regulations in such a way as to place producer gas propelled vehicles on a similar footing to steam and electricity. Co-operation is required between producer gas plant manufacturers, suppliers of the requisite fuel and members of the automobile industry, if this technique is to be developed and full advantage taken of its potentialities as a substitute for liquid fuel.

Temperature-indicating Paints

THE use of special paints, such as those containing metallic iodides, for application to bearings and other parts of machinery liable to over-heating in order to indicate such temperature increase through change in colour of the paint, has been known for some years (Pinnock, *J. Soc. Chem. Ind.*, 38, 78; 1919). These earlier preparations were, however, only suitable for comparatively low temperatures, and also the colour change as a rule was not permanent. Paints or thermo-colours adapted for use under much more exacting conditions have been developed in Germany by the I.G. Farbenind. Akt. Ges. in connexion with its fuel research work at Oppau, including aircraft engine design (F. Penzig, *Z. des V.D.I.*, 80-74; 1939).

The method of indicating temperature change and distribution, especially in aircraft engine cylinders, etc., by means of thermo-colours offers many advantages over the usual laborious method of taking several individual temperature measurements in various parts of the cylinder, piston, etc.; and in the case of air-cooled engines it provides invaluable information in the optimum design of air guide plates. It is also of great value in other cases of temperature determination, for example, in hot plates, radiators, drying chambers, etc.

It was desired to discover paints which would not only undergo sharp, distinct, and permanent colour change at fairly definite temperatures, but would also possess good adhesion at these high temperatures, up to 450° C. It is hoped, indeed, to evolve thermo-colours for use up to 650° C. or even higher; but those so far discovered are sufficient for present-day aircraft engine research. In regard to sharpness of change, it is obvious that intermediate tones are to some extent unavoidable since the change is due to thermo-chemical reaction; but with sufficient time the change is definite and complete. On the other

hand, allowance must be made for the fact that the longer the time exposure the lower the temperature within reasonable limits, at which the change occurs. Curves are given in the original showing temperature change at intervals of 30 min. up to 120 min. for the various paints. The time effect is greatest at the higher temperatures: for example, a thermo-colour which by definite colour change indicates a temperature of 360° C. in 30 minutes, falls to 290° C. in 120 min., whilst the curves at 40-80° C. are nearly horizontal.

No fewer than three hundred different preparations have been investigated at Oppau; but only a very limited number have been found of practical use. These are tabulated by number in the original. The following are some of the colour changes: No. 1, rose to blue, 30°; No. 3, light yellow to violet, 110°; No. 8, white to light brown, 340°; No. 9, violet to white, 440°. No. 20 has two different colour changes at 65° and 145°; whilst Nos. 30 and 31 have three distinct colour changes at temperatures ranging from 65° to 220° (No. 30), and 155-275° (No. 31). The temperatures are indicated with an accuracy within $\pm 5^\circ$, which is sufficiently accurate for the purpose in view. Where exact measurement is required at any particular point this can be done in the usual way with thermo-elements.

The binding agent or medium used presented some difficulty; it was eventually discovered that synthetic resin soluble in alcohol is the most satisfactory. It is added in finely powdered form to the pigment, and a paint of any desired viscosity may be prepared by stirring this mixture with the correct amount of alcohol. These paints dry very quickly; the resin does not undergo any colour change which would affect the desired result, and the paint coating has practically no influence on heat transfer from the cylinder or other part under test.

Testing High-Voltage Cables

THE use of high-voltage cables for the underground transmission of electric power is becoming more and more important from the point of view of economy, and also because as the network extends the damage caused by the breakdown of a cable, generally due to over-voltage, may be very serious. For the last ten years constant research has been proceeding, dealing with oils, papers and the general physics of cables. In the development of a cable suitable for extra-high voltage transmission there have been four main methods of attack. The first is to use oil-filled cable, the second external gas-pressure cable, the third internal gas-pressure cable (gas-filled cable), and the fourth the cables most commonly used with solid insulation known as 'solid cables'.

In a paper read to the Institution of Electrical Engineers on January 18, by T. R. Scott and R. C. Mildner, the results are described of researches extending over several years on a 3-core 30 kv. solid

cable which has since, without any fundamental change, been manufactured in considerable quantities and has given extremely satisfactory service. Single-core cable manufactured on identical lines was somewhat inferior in performance. At 60 kv. this difference became very noticeable, although on the basis of standard acceptance tests there was little or nothing to choose between multi-conductor and single-conductor cables. It became evident, therefore, that some form of final check approximating to 'trial on service' was necessary to ensure that unsatisfactory types of cable were not issued for commercial service. In view of the destructive nature of the test that was visualized, it was considered impracticable to install the cable in the network of an operating company. It was considered feasible to design a testing plant to reproduce all the conditions under which cable operated, and yet give the facilities which such research requires. It was realized that such a method

ould be slow to produce results and expensive to try out; but its value has been amply proved by the practical results achieved.

Solid-core 60 kv. cable was originally selected as the basic type. It was considered that this type of cable would always be able to compete on an economic basis with the other forms of cable that have been proposed, provided that it could be proved that it was capable of operating at a conductor temperature not more than 65° C. for a life not appreciably less than that of solid cables operating at lower voltages. Work on solid-type 60 kv. cables also provided an excellent basis not only for effecting improvements in the performance of similar cables working at 30 kv. and lower voltages, but also for extending the investigation to 132 kv. All experimental cables were 'processed' in the factory under closely observed, but essentially practical, conditions, and their characteristics have been watched carefully throughout their useful life. The paper gives a preliminary survey of the work carried out to date.

It is hoped that the results obtained will assist in allaying certain fears which obviously influence cable users. The authors state that as the result of the experience gained in their tests the successful operation of solid-type cable at 60 kv. has been firmly established. The employment of this form of cable in preference to the other types which have been proposed, should rest on a purely economic basis in which the cost of the installed line and its maintenance is added to the charges to be attributed to the electrical losses involved in operation. In this latter respect the stability of the dielectric need be in no way inferior to that of other types. It is pointed out that the deterioration due to the electric discharges in vacuum spaces (gas pockets) can be reduced to negligible proportions at the proposed working stresses by drawing attention to the quality of manufacture. In this matter the authors' experience suggests that 'uniformity of impregnation' is the main object to be aimed at rather than getting the purest material. As the 'geometric factor' of the cables tested varies widely, it is concluded that the maximum electric stress in the cable is the crucial factor in its behaviour in operation.

University Events

BIRMINGHAM.—The following honorary degrees are to be conferred at the degree congregation on July 1: LL.D. on Mr. A. C. Beatty, Lord Porter, and Sir Charles Grant Robertson; D.Sc. on Dr. E. B. Bailey, and Sir William Bragg; D.Litt. on Prof. Arnold J. Eynon.

CAMBRIDGE.—The tenth course of Scott Lectures is being given in the Cavendish Laboratory by Prof. M. S. Blackett, at 4.30 p.m. on May 4, 5 and 8. The subject of the lectures is "Cosmic Rays—New Results and Further Problems".

W. S. Tai, research student of Gonville and Caius College, has been elected to the Sheepshanks exhibition.

LONDON.—The Farnham House Laboratory of the Imperial Institute of Entomology, at Farnham Royal, Bucks, has been approved as an "Institution having recognised Teachers" for the instruction of students pursuing courses of advanced study or research.

Science News a Century Ago

Ptolemy's Catalogue of Stars

At a meeting of the Astronomical Society held on May 10, 1839, Francis Baily, in a paper bearing the above title, said: "The catalogue of stars, which goes under Ptolemy's name, will always be interesting to the astronomer, as containing the first record of the state of the heavens. The point to which, in the present view of the case, I am most desirous of directing attention is, how far the existing edition of this work may be considered as faithful transcripts of the catalogue as it issued from Ptolemy's hands. This important question can only be decided by a careful examination of various manuscripts, and by comparing the discordant readings with the actual positions of the stars, as determined by modern observations." Having referred to the five sources of information, he went on: "Having carefully compared the position of every star, as given in each of the several copies alluded to, I have found that out of 1,028 stars, of which the catalogue consists, there are above 780 (or more than three-fourths) of them that are discordant, either in longitude or latitude, and this not merely in 10, 20, or 30 minutes, which is no uncommon difference, but sometimes to an amount involving whole degrees."

The Atlantic Voyage of the *Ironides*

In October 1838, Airy, at the request of the owners of the iron sailing ship *Ironides*, had made improvements in the method of correcting her compasses. Shortly afterwards, the ship sailed for South America. After her return, the *Mechanics' Magazine* on May 11, 1839, said: "Thus, the first sailing vessel constructed of iron which has ever been dispatched to encounter the risk of a transatlantic voyage, and which left Liverpool some five months since, for the Brazils, entered the Mersey on the 1st of May. The homeward passage from Aricati was accomplished in forty days, which is considered to be no despicable achievement, as during the whole trip light winds prevailed. The return of the *Ironides*, has completely established the practicability of navigating the ocean safely and surely in ships constructed of iron. The compass, whose action it was predicted would invariably be deranged, worked correctly; and the superiority of the material of which she is built is proved by the fact, that from the day on which she sailed for Pernambuco, during the time she remained at the Brazils, and in the course of her voyage home, on no one occasion was it necessary to use the pumps; in fact her hull is absolutely and literally water tight."

The Asiatic Society

Among the reports read at the sixteenth anniversary meeting of the Asiatic Society on May 11, 1839, was one by the Right Hon. Holt Mackenzie referring to the work of the Committee of Commerce and Agriculture. It commenced by acknowledging the valuable services of Dr. Royle (secretary) and Mr. Solly (chemical analyst). Attention, it said, had been given to the introduction into India of improvements in cotton cultivation; the value and quality of various oil seeds grown in India and the vegetable tallow of Canara; and information had been collected regarding cocutcheon, kino, hemp, tea, iron, cochineal, timber, wool, silk and other things.

Societies and Academies

Paris

Academy of Sciences (C.R., 208, 953-1060, March 27, 1939).

M. ROY: Diagram of the flow of a gas through a rotary tuyere.

J. KUNTZMANN: Classes in a multigroup.

T. PRYOVITCH: Value at infinity of the integrals of certain differential equations.

W. BARRETT: Certain discontinuous groups of displacements.

R. MOINEAU: The autopropulsive and hyper-sustaining flapping wing.

D. BELORIZKY: Collisions in the problem of three bodies and in space.

G. PETIAU: Electromagnetic magnitudes of the theory of the photon.

J. MARIANI: Quantum of length and the spin of elementary particles.

J. GUASTALLA: Surface manometer with pendulum suspension [for the measurement of the pressure of surface films].

M. JOLY: Existence of two forms of superficial protein films. Very stable films of low viscosity, and very viscous films which 'age' with time are distinguished.

P. VERNOTTE: Convection of heat, from a plane in which there is any distribution whatever of temperature, by an indefinite fluid of two dimensions in which there is any distribution of velocities: application to the law of natural convection.

G. DUYOURET: Specific heats of iron between 1.5° and 20° K.

R. GUILLIEN: Dielectric constant of ammonium sulphate in the neighbourhood of the λ -point. Dielectric constant and electric absorption have a maximum at the λ -point.

F. CARBENAY: High-frequency radio communication along power lines.

R. AUDUBERT and R. RALBA: Photogenic effect and electronic activation of the radical $N \equiv N$.

L. ABONNENC: Diamagnetism of the rare gases of the atmosphere—argon, krypton, xenon.

A. DUFOUR and F. PRUNIER: An effect observed with a Sagnac disk in rotation when a part of the optical circuit is not in rotation.

A. PINKABA: Influence of molecular interaction on the magnetic birefringence of polar liquids.

J. VERHAEGHE and M. VAN EYCK: Circular magnetic dichroism of cobalt sulphocyanides.

A. COTTON: Note on the preceding paper.

M. DODÉ, H. VON HALBAN, JUN., F. JOLIOT and L. KOWAREKI: Energy of neutrons liberated in the nuclear partition of uranium. The experiment described, while showing the neutrons produced are distinct from the incident neutrons, does not demonstrate the possibility of chain reactions.

M. BRUTZOUS: Thermochemistry of combinations of nitrogen.

MILN. M.-L. DELWAULLE: Study of the Raman effect of equilibrium reactions in the formation of mercuric chlorobromide and bromocyanide.

F. FRANÇOIS: Study of the system mercuric cyanide, mercuric chloride and methyl alcohol. Formation of an addition compound of mercuric chloride and methyl alcohol and evidence by the Raman effect of a chlorocyanide.

E. TOPOBESCU: New method of studying the polarization of galvanic piles.

H. VOLKRIINGER, MMRS. M. FREYMANN and FREYMANN: Influence of temperature on the Raman spectrum of ammonium nitrate and sulphate.

(To be continued.)

Amsterdam

Royal Netherlands Academy (Proc., 42, No. 2, 1939)

F. K. TH. VAN IJERSON: The pressure of the rock on the coal near the coal face. A mathematic consideration of the problem by the methods of the theory of elasticity.

L. S. ORNSTEIN and W. DE BRAAF: Remarks on the paper of V. Zwetkoff, "Ueber die Lichtzerstreuung in anisotropen Flüssigkeiten".

R. FÜRTH, L. S. ORNSTEIN and J. M. W. MILAT: On the theory of liquids. A provisional mathematic treatment of the theory of liquids regarded as quasi-crystalline structures containing many 'holes' faults.

A. J. KLUYVER and E. L. MOLT: On the production of acetylmethylcarbinol by *Bacterium coli*. The bacterium has been shown capable of producing small amounts of acetylmethylcarbinol under the conditions of the Voges-Proskauer test, so that the theoretic basis of the latter test for distinguishing *B. coli* from *B. aerogenes* loses much of its significance.

E. DUBOIS: On the insignificance of cranial vault-height in phylogenetic brain growth.

B. G. ESCHER: Moon and earth. Geologic considerations on the development of continents and oceans, the limitation of granitic magma to the continents, the composition and morphology of the moon.

H. FREUDENTHAL: New continuation and mapping theorems.

O. S. MEYER: Integral representations of Whittaker functions.

J. TEGHEM: On a type of Diophantine inequalities.

P. G. MOLENAAR: A complete system of differential co-variants of the first order of the binary cubic differential form.

H. D. KLOOSTERMAN: On the singular series in Waring's problem and in the problem of the representation of integers as a sum of powers of primes.

I. LIFSCHITZ: On dissymmetrical synthesis in the case of complex metallic salts (3).

W. P. POSTMA: Some remarks on the influence of nitrate reduction on the respiration of roots.

F. C. J. ZEIJLMAKER: Carboxylase and α -carboxylase in the germination of *Avena*. The total amount of co-carboxylase remains constant during germination.

J. C. MOOI: On the enzymes taking part in the conversion of alanin and of asparaginic acid by *Aspergillus niger*.

C. J. JARSKI: An oestrus cycle in *Lobelia reticulata* (Petus).

W. RIMM: The hemispherical wall of the newborn bear and the evolution of the nerve cell.

G. P. FRITS: (1) The growth curves of the dimerizations and of the weight of the seeds of *Phaseolus vulgaris*. (2) A second group of observations regarding dimension and form with the growth of the seeds of *Phaseolus vulgaris*.

Moscow

Academy of Sciences (C.R., 21, Nos. 1-2, 1938).

S. FENIKOFF: Deformation of a surface with the tension of lines of a family.

A. G. PINSKER: Extension of semi-ordered spaces.

M. S. EIGHENSON: Surface brightness of the light sky and the infinity of the astronomical universe.

M. N. PODASHEVSKY and A. M. POLONSKY: Luminescence of alkali-halogenid crystals.

J. S. SHUB: Influence of heat treatment in a magnetic field upon the distribution of the spontaneous regions of a ferromagnetic monocrystal.

D. BLOKHINTSEV and B. DAVYDOV: Some contributions to the theory of solid rectifiers.

K. S. WULFSON and M. I. LOMBERT: Dispersion of light in crystals of quartz.

A. I. ALIOZHANIAN and S. J. NIKITIN: β -ray spectrum of RaC and energy-levels of excitation of αC^1 nucleus.

D. IWANENKO: Simple applications of the Proca potential.

A. SOKOLOV: Nature of heavy electron.

D. I. MIRLIS and A. I. GLUCHOVA: Kinetics of etching and the linear-selective corrosion of metals in polyphase systems.

W. STERN, B. KRAVETZ and A. SOKOLIK: The action of carbon dioxide on self-combustion of the mixture hexane-air.

M. G. KREIZMANN: Isolation of the enzyme transferring the amino-group of glutamic acid.

A. V. VLADIMIROV and G. V. LIASKOVSKAJA: Age and daily variations of citric acid content in leaves of *Nicotiana rustica*.

G. D. AFANASSIEV: Indications of rare metal mineralization in the south-east of the Altai mountains.

A. I. ZUTIN and M. T. PAVLOVETZ: Age differences in spontaneous mutation in males of *Drosophila melanogaster* of different origin.A. I. ZUTIN: (1) Influence of a change of thermal regime upon the frequency of lethal mutations in *Drosophila melanogaster*. (2) Combined effect of a change of thermal regime and subsequent temperature contrast upon the frequency of lethal mutations in *Drosophila melanogaster*.

G. D. KARPECHENKO: New tetraploid barleys—he hulled and the naved.

V. I. PATRUSHEV: Blood-value of cross-breeds between the wild *Ovis Polii Karelini* Sew. and the domestic sheep.

A. SOKOLOVSKAJA and O. S. STRELKOVA: Polylloyd in the high mountain regions of the Pamir and the Altai.

L. M. DOBOKHOV: (1) Dynamics of carbohydrate accumulation in plant leaves as influenced by different content of carbon dioxide in air. (2) Effect of carbon dioxide upon transpiration and stomatal apparatus in plants.

V. G. ALEKANDROV and O. G. ALEKANDROVA: Structure of the furrow in wheat kernel.

L. M. DOBOKHOV: Alteration of physiological processes in tomato under the influence of *Cladosporium fulvum* Oke.

V. I. PATRUSHEV: Blood value of Yaroslavl cattle in correlation with body weight and yield of milk.

K. K. FLEROV: Remains of Ungulata from Betpak-dala.

Forthcoming Events

[Meeting marked with an asterisk is open to the public.]

Monday, May 8

ROYAL SOCIETY OF ARTS, at 8.—Prof. E. C. Dodds: "Modern Chemistry, Modern Medicine and Modern Food" (Cantor Lectures. Succeding lectures on May 15 and 22).

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Dr. D. Thomson: "Journeys in Arnhem Land".

Tuesday, May 9

ST. MARY'S HOSPITAL, LONDON, W.2, at 5.—Dr. V. D. Allison: "The Mode of Spread of Acute Streptococcal Infections".

UNIVERSITY COLLEGE, LONDON, at 5.30.—Sir Philip Hartog: "The Newer Views of the Work of Priestley and Lavoisier" (succeding lecture on May 16).*

ILLUMINATING ENGINEERING SOCIETY (at the Institution of Mechanical Engineers), at 7.—Annual General Meeting.

P. Good: Presidential Address.

Wednesday, May 10

INSTITUTE OF METALS (at the Institution of Mechanical Engineers), at 8.—Dr. Olaf Bloch: "The Photographic Emulsion and its Contribution to Science and Industry" (Annual May Lecture).

Thursday, May 11

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Annual General Meeting.

Captain B. S. Cohen: "The Long-Distance Telephone Call—A Triumph of Engineering and Co-operation" (Faraday Lecture).

Friday, May 12

ROYAL ASTRONOMICAL SOCIETY (in the lecture room of the Royal Society), at 5.—M. Bernard Lyot: "Study of the Solar Corona and Prominences without Eclipses" (George Darwin Lecture).

ROYAL INSTITUTION, at 9.—Prof. J. Garstang: "Discoveries in Cilicia".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

LECTURER IN METALLURGY AND CHEMISTRY in the Oxford Schools of Technology, Art and Commerce—The Chief Education Officer, City Education Office, 77, George Street, Oxford (May 8).

JUNIOR LECTURER IN ELECTRICITY ENGINEERING and JUNIOR LECTURER IN METALLURGY in the University of the Witwatersrand—The High Commissioner for South Africa, South Africa House, Trafalgar Square, W.C.2 (May 13).

LECTURER IN BIOLOGY in the Kingston-upon-Thames Technical College—The Principal (May 15).

WOMAN EXAMINER in the Metallurgical Section of the A.I.D. Test House, Cardington, Beds.—The Under-Secretary of State, Air Ministry, Berkeley Square, London, W.1 (Ref. ICS/R&O. 88. May 16).

LECTURER IN ELECTRICAL ENGINEERING in the Croydon Polytechnic—The Education Officer, Education Office, Katharine Street, Croydon (May 18).

PROFESSOR OF ELECTRICAL ENGINEERING in the University of Birmingham—The Secretary (May 23).

JUNIOR SCIENTIFIC OFFICER in the Forest Products Research Laboratory—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (May 23).

JUNIOR SCIENTIFIC OFFICER in the Road Research Laboratory—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (May 23).

ASSISTANT LECTURER IN MATHEMATICS in the University of Manchester—The Registrar (May 23).

ASSISTANT LECTURER IN ELECTRICAL ENGINEERING in the Manchester Municipal College of Technology—The Principal (May 21).

ASSISTANT IN MORPHOLOGY AND ASSISTANT IN CLINICAL PATHOLOGY in the British Post-graduate Medical School, Duane Road, W.12—The Dean (June 5).

ASSISTANT CHIEF (male) in the Engineering Department of the General Post Office—The Engineer-in-Chief (Staff Branch), General Post Office, Alder House, Aldersgate Street, London, N.C.1 (June 9).

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

- Development Commission. Twenty-eighth Report of the Development Commissioners, being for the Year ended the 31st March 1938. Pp. 184. (London: H.M. Stationery Office.) 3s. net. [313]
- National Physical Laboratory. Report for the Year 1938. Pp. iv+147. (London: H.M. Stationery Office.) 2s. 6d. net. [313]
- Quarterly Journal of the Royal Meteorological Society. Vol. 65, No. 279: The Phenological Report, 1938. Pp. 76-122. (London: Royal Meteorological Society.) 3s. [313]
- Researches published from the Wards and Laboratories of the London Hospital during 1938. Pp. iv+37 Papers. (London: H. K. Lewis and Co., Ltd.) 7s. 6d. net. [34]
- University of Leeds. Thirty-fourth Report, 1937-38. Pp. 184. Publications and Abstracts of Theses by Members of the University during Session 1937-38. Pp. 31. (Leeds: The University.) [44]
- Report of the Marlborough College Natural History Society for the Year 1938. (No. 87.) Pp. 180+6 plates. (Marlborough: Marlborough College.) 3s.; to non-members, 5s. [44]
- Imperial Forestry Institute. Institute Paper No. 16: A Forestry Tour in 1937. By Dr. L. Chalk. Pp. 71. (Oxford: Imperial Forestry Institute.) 2s. 6d. [44]
- Metallurgy as a Career. Pp. 8+2 plates. (London: Sir John Cass Technical Institute.) [44]
- Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 7, No. 2, September 1938. Compiled by Agnes Elizabeth Glennie, assisted by Gwen Davies. Pp. v+373-604. (London: H.M. Stationery Office.) 5s. net. [64]
- Annual Report of the Council of the Yorkshire Philosophical Society for the Year 1938, presented to the Annual Meeting, February 13th, 1939. Pp. 51+17+2 plates. (York: Yorkshire Museum.) [64]
- Report of the Rugby School Natural History Society for the Year 1938. (72nd issue.) Pp. 60. (Rugby: George Over, Ltd.) [64]
- Scientific Proceedings of the Royal Dublin Society. Vol. 23 (N.S.), No. 8: Atmospheric Pollution in Dublin during the Year 1938. By A. G. G. Leonard and Bridget P. McVerry. Pp. 83-94. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) 1s. [64]
- Air Ministry: Aeronautical Research Committee. Reports and Memoranda, No. 1834 (3432): An Analysis of the Stresses in a Flat Plate with a Reinforced Circular Hole under Edge Forces. By C. Gurney. Pp. 25. (London: H.M. Stationery Office.) 3s. 6d. net. [114]

Other Countries

- Proceedings of the American Academy of Arts and Sciences. Vol. 73, No. 3: The Lower Permian Insects of Kansas, Part 8. By Frank M. Carpenter. Pp. 29-70+2 plates. 1.25 dollars. Vol. 73, No. 4: Studies on the Fauna of some Thermal Springs in the Dutch East Indies. By Charles T. Bruce. 80 cents. (Boston, Mass.: American Academy of Arts and Sciences.) [313]
- Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 90. Additions to our Knowledge of African Leeches (Hirudinea). By J. Percy Moore. Pp. 297-360. Studies in African Acryridinae (Orthoptera, Acrididae), Part 2: New Genera and Species, and Critical Notes on Previously-known Forms. By James A. G. Rehn. Pp. 361-388. The Orthoptera of the Philippine Islands, Part 1: Phasmidae; Orthoptera. By James A. G. Rehn and John W. H. Rehn. Pp. 390-488. (Philadelphia: Academy of Natural Sciences.) [313]
- Bulletin of the Selenological Society of America. Vol. 29, No. 1: Descriptive Catalog of Earthquakes of the Pacific Coast of the United States, 1769 to 1938. By Sidney D. Townley and Maxwell W. Allen. Pp. 298. (Berkeley, Calif.: University of California Press.) 2 dollars. [313]
- U.S. Department of the Interior: Office of Education. Know your School Leaflet No. 47: Know your Board of Education. By W. S. Deffenbaugh. Pp. iii+9. 5 cents. Know your School Leaflet No. 48: Know your Superintendent. By W. S. Deffenbaugh. Pp. iii+9. 5 cents. Know your School Leaflet No. 49: Know your School Principal. By W. S. Deffenbaugh. Pp. iii+9. 5 cents. Know your School Leaflet No. 50: Know your Teacher. By W. S. Deffenbaugh. Pp. iii+12. 5 cents. (Washington, D.C.: Government Printing Office.) [313]
- U.S. Department of Agriculture. Technical Bulletin No. 669: The Band Wireworm and Its Control in the South Carolina Coastal Plain. By J. N. Tenhet and M. W. Howe. Pp. 29. (Washington, D.C.: Government Printing Office.) 10 cents. [313]
- Pennsylvania State College School of Agriculture and Experiment Station. Bulletin 871: Phosphorus Deficiency among Cattle in Pennsylvania. By B. B. Forbes and S. B. Johnson. Pp. 25. (State College, Pa.: School of Agriculture and Experiment Station.) [313]
- Journal of the Indian Institute of Science. Vol. 22 A, Part 4: Supersonic Velocity in Gases and Vapours. Part 7: Specific Heats of the Vapours of Dichloromethane, Chloroform, Carbon Tetrachloride and Ethylene Dichloride. By S. K. Kulsharni Jaiskar. Pp. 69-78. (Bangalore: Indian Institute of Science.) 18 rupees. [34]
- Published Papers and Addresses of John Campbell Merriam. (Publication No. 500.) Vol. 1. Pp. viii+668. Vol. 2. Pp. vi+687-1298. Vol. 3. Pp. viii+1299-1944. Vol. 4. Pp. viii+1945-2072. (Washington, D.C.: Carnegie Institution.) [34]
- Co-operation in Research. By Staff Members and Research Associates of the Carnegie Institution of Washington. (Publication No. 501.) Pp. ix+788. (Washington, D.C.: Carnegie Institution.) [34]

- Proceedings of the United States National Museum. Vol. 86, No. 3061: Annotated List of Tennessee Mammals. By Remington Kellogg. Pp. 245-304. (Washington, D.C.: Government Printing Office.) [1]
- Advisory Committee on Education. Staff Study No. 2: Organization and Administration of Public Education. By Walter D. Coking and Charles H. Gilmore. Pp. ix+183. (Washington, D.C.: Government Printing Office.) 20 cents. [1]
- South Australia. Department of Mines. Mining Review for the Half-Year ended 30th June 1938. (No. 68.) Pp. 101+10 plates. Annual Report of the Director of Mines and Government Geologist for 1937. Pp. 8. (Adelaide: Government Printer.) [1]
- Meddelande från Lunds Astronomiska Observatorium. Ser. 2, 108 (Historical Notes and Papers, Nr. 14): The Luni-Solar Calendar by Lewis A. R. Wallace. Pp. 12. (Lund: Astronomiska Observatorium.) [1]
- Sveriges Geologiska Undersökning. Ser. C, No. 418: Neue Untersuchungen innerhalb des Grangesbergfeldes. Von Nils H. Magnusson. Pp. 45+1 plate. 2.00 kr. Ser. C, No. 420: Skjediment från Bergslagen (Kolbäckens vattenområde). Av G. Lundquist. Pp. 186+8 plates. 2.50 kr. Ser. C, No. 422. Nedre Klarälvdalens postglaciala utveckling. Av B. Sandegren. Pp. 38+1 plate. 1.00 kr. (Stockholm: P. A. Norstedt and Soner.) [1]
- U.S. Department of the Interior: Office of Education. Leaflet No. 54: Federal Funds for Education, 1937-38. Pp. iii+27. (Washington, D.C.: Government Printing Office.) 10 cents. [1]
- Annales scientifiques de l'Université de Jassy. Première partie (Mathématiques, physique, chimie), Tome 24, Année 1938, Fascicle 2. Pp. 263-514+ii. Second partie (Sciences naturelles), Tome 2, Année 1938, Fascicule 2. Pp. 287-408+ii. (Jassy: l'Université Jassy.) [1]
- Report of the Aeronautical Research Institute, Tokyo Imperial University. No. 172: Calculation of Induced Velocity by Helic Vortices and Its Application to Propeller Theory. By Sandi Kawad. Pp. 58. 80 sen. No. 173: On the Effect of the Density of the Air upon the Pitot-static Tube Coefficient. By T. Sasaki and K. Hato. Pp. 59-90. 55 sen. (Tokyo: Kogyo Tohko Kabushiki Kaisha.) [1]
- Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 44, Part 2. Studies on the Infection of *Paracaulis Oryzae* Br. et Sav. on Maltreated Rice Plants. By Y. Tochinal and S. Komiy. Pp. 33-76. (Tokyo: Maruzen Co., Ltd.) [1]
- Sveriges Geologiska Undersökning. Ser. C, No. 415. Deep Bore through the Cambro-Silurian at Fåla Härad, Gotland. By Per Thorlund and A. H. Westergård. Pp. 56+4 plates. 2.00 kr. Ser. C, No. 416: The Injection Metamorphism of the Muruhaten Region as Problems suggested Thereby. By Torsten Du Rosta. Pp. 88. 2.00 kr. Ser. C, No. 417: Hauptzüge der Tektonik und Stratigraphie der mitleren Kaledoniden in Schweden. Von B. Asklund. Pp. 90. 2.00 kr. Ser. C, No. 421: On Swedish Cambrian Amphipoda. By A. H. Westergård. Pp. 16+3 plates. 1.00 kr. (Stockholm: P. A. Norstedt and Soner.) [1]
- Festschrift zum 60. Geburtstage von Prof. Dr. Emilrik Strand. Vol. 5. Pp. 760+11 plates. (Riga: Statematheisis Zoologisches Institute London: H. B. Knowles.) 24s. 6d. [11]
- Parliament of the Commonwealth of Australia. Twelfth Annual Report of the Council for Scientific and Industrial Research for Year 1937-38. Pp. 90. (Canberra: Government Printer.) 4s. [11]
- Sudan Government: Department of Agriculture and Forests. Annual Report, Part 2: Being the Report of the Agricultural Research Service for the Year ended 31st December 1937, relating to Experimental Results obtained in the Crop Season 1936-37. Pp. 140. (Wau Medani: Agricultural Research Service.) [11]
- Third Annual Report of the Indian Institute for Medical Research 1937-38. Pp. viii+62. (Calcutta: Indian Institute for Medical Research.) [11]
- Smithsonian Miscellaneous Collections. Vol. 98, No. 2: The Sun spot Period. By H. Holm Clayton. (Publication 3354.) Pp. ii+18+plate. (Washington, D.C.: Smithsonian Institution.) [11]
- Agriculture and Animal Husbandry in India, 1936-37. Pp. viii+503. (Delhi: Manager of Publications.) 7 rupees; 11s. [11]

Catalogues, etc.

- Dulan's Botanical Catalogue. (No. 277.) Pp. 40. (London: Dulac and Co., Ltd.) [11]
- The Microd Gas Generator. (GT 1235 A.) Pp. 2. British Standard Scientific Glassware. (GT 1241.) Pp. 2. THQ (Tetrahydroxyquinone) (GT 1946.) Pp. 4. (London: Griffin and Tatlock, Ltd.) [11]
- Wild Barfield Heat-Treatment Journal. Vol. 3, No. 20, March. Pp. 29-51+v. (London: Wild-Barfield Electric Furnaces, Ltd.) [11]
- Catalogue of Modern Chemical Apparatus: Selected for Analytical, Educational and Research Laboratories in the practice of Inorganic Organic, Physical and Microchemistry and Bacteriology and their Industrial Applications. (Catalogue No. 15 B.) Pp. 1144. (London: Griffin and Tatlock, Ltd.) [11]
- Engineering and Industrial Instruments. (General Bulletin N.10. Pp. 60. (London: Negretti and Zambra.) [11]
- Catalogue of Physical Laboratory Apparatus and Equipment Twenty-fifth edition. Pp. xvi+824. (London and Birmingham W. and J. George, Ltd., proprietors of F. E. Becker and Co.) [11]
- Written Safelights for the X-Ray Darkroom. Pp. 4. (London: Kodak, Ltd.) [11]
- Catalogue of Publications. Pp. 130. (Den Haag: Dr. W. Junk.) [11]
- Mullard Cathode Ray Tube Unit, Type B. 100. Pp. 2. (London: Mullard Wireless Service Co., Ltd.) [11]
- Cambridge Automatic Regulators, Electrically Operated. (Folde No. 97.) Pp. 6. (London: Cambridge Instrument Co., Ltd.) [11]

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No. 3628

Establishment of New Industries

THE major proposals of the report on the location of industry recently issued by Political and Economical Planning (P.E.P.) have already been outlined in these columns (NATURE, May 6, p. 770). From discussions of the report and its contents, however, it is apparent that a number of points raised by it are being overlooked. Among such matters of special interest to scientific workers is the suggestion that the proposed Industrial Development Commission should be empowered to advance money for the promotion of new industrial enterprise. This problem is discussed in some detail.

To a large extent the provision already made by the Special Areas (Amendment) Act of 1937, the Nuffield Trust and the Special Areas Reconstruction Association, Ltd., meets the need of new industry enterprise which is concerned with the manufacture of an established product or of a product not already made in Great Britain. The manufacture of an entirely new product or the establishment of a novel process is another matter, and the comments of the report on this subject may well raise doubts as to whether the Committee on Industrial Development, in its report issued in 1932, was not much too confident that there was no gap in our existing structure for the finance of development and research.

The present report does not consider that the difficulties in the way of developing entirely new processes or inventions are altogether the fault of financial institutions. Moreover, the few companies which have been formed specially to deal with new inventions do not appear to have had any great measure of success; the necessary link between invention and finance has not yet been bridged.

One of the major difficulties is the aggregate cost of 'vetting' new propositions, which frequently exceeds the profits to be anticipated on the small proportion of successful ones. The high cost is due to the difficulty of finding any firm or organization capable of dealing with the wide range of industries into contact with which a concern attempting to finance new processes is usually brought. The difficulty has been recognized, of course, for many years, and in November 1935 the Chancellor of the Exchequer made an important statement putting the Department of Scientific and Industrial Research, the Medical Research Council and the Agricultural Research Council at the disposal of banks, issuing houses and brokers to furnish them with reports on the scientific merits of the methods or substances for the development of which it might be proposed to make a public issue.

While, however, the three research organizations in question could undoubtedly be of far greater use to industry and finance, it is at least open to doubt whether they possess invariably the necessary combination of commercial and technical outlook. The nature of their responsibilities limits them to making a complete and exhaustive report on a technical subject. What is often required, however, is a quick opinion based on sound judgment and wide knowledge as a basis for a decision whether to proceed with further investigation or to reject the project at an early stage. The commercial prospects as well as the technical soundness of the process must be taken into account, and the appreciation required must consist not merely in the verification of technical claims but also in forecasting the demand for the new product, and the forces which determine it,

the output of competitive products, the location of manufacture, the areas or industries in which they are sold, relative costs and selling prices, patent aspects, and other economic and technical factors.

At least it may be held that the establishment of the information service recommended in the P E P report should assist in dissipating the very serious lack of technical knowledge in financial circles, which may be regarded as responsible for its failure to restrain or check the excessive over-capitalization of new companies. Moreover, if the view is correct that the evolution of better facilities for the finance of new industries would be an important contribution to the problem of the Special Areas, it should be of no less service to areas which are in danger of becoming depressed through their dependence on a limited number of industries. It is therefore considered that stimulation of private enterprise in co-operation with Government enterprise may offer a solution. The proposed Industrial Development Commission accordingly should explore with business men the possibilities of setting up one or more specialized institutions to deal with the financing of new enterprises generally, and should be empowered to subscribe a proportion of the capital of any such institution. If the machinery then erected became effective and wide enough in its scope, the necessity for direct financing by the Commission of individual enterprises would be materially reduced and might eventually disappear.

There is yet another direction in which the report suggests the need for investigation by the proposed Commission. Any truly scientific policy of industrial development must take account also of both the preservation and restoration of amenities. Even with the examples of the depressed areas in front of us, as well as the encroachment on amenities which on a smaller scale is taking place all over the country, it is no simple matter to decide just how best to provide the necessary safeguards without unduly hampering industrial expansion.

The report itself recommends that the Commission should be given discretionary powers to attach conditions to licences, obliging manufacturers to provide for the safeguarding of local amenities or their restoration, if damaged or destroyed. This is one of the most important services that the Commission could render to the community; the widespread destruction which has resulted in the past from unrestricted development

by private enterprise is sufficient indication of the need for preventing such destruction in future.

The mere institution of licensing powers should assist, for the Commission would consider this factor along with others in handling applications for licences. The efforts of public authorities to preserve amenities through town planning regulations should be substantially reinforced by this factor alone. Public policy, however, can do little or nothing to deal with the root cause of such nuisances as arise from the decline of the industry or enterprise itself and its eventual abandonment. It is possible, nevertheless, to take steps in advance to prevent the repercussions on local society as a whole from becoming too drastic. The report suggests that one way of dealing with this problem would be by means of a sinking fund.

This again is a matter for investigation by the Commission. Any such fund should be earmarked for the restoration of local industrial and social amenities, where necessary, in the future transfer or liquidation of any factory. The other aspect of this question—the extensive salvage operation which are already necessary to restore certain areas to a condition in which they can again become usable for industrial and social purposes—equally falls within the orbit of the Commission. Restoration of such areas should have an early claim on any Government funds available for general public works purposes, and the Commission would be the most suitable body through which the planning of restoration projects and the distribution of funds to local authorities could be carried out. In this respect, indeed, it would develop the pioneer work of the Commissioners for the Special Areas.

The suggestions of the report regarding these two problems, which are by no means so far separated as might appear at first sight, well illustrate its admirable balance. The care for industrial development is never allowed to overshadow the fact that the efficient utilization of the resources of the nation involves safeguarding the health and social well-being of its citizens and the natural amenities of the country. The exposition given in the report of the need for further scientific investigation in these matters, no less than the vision it gives of the possibilities if industrial development and the erection of new towns are viewed in their true perspective as creative social enterprise, will be widely welcomed. Nor does the report leave scientific workers in any doubt that they may well be called to make a decisive contribution, if these possibilities are to be realized.

Agricultural Development in Great Britain

Policy for British Agriculture

by the Rt. Hon. Lord Addison of Sittingborough.
p. 304. (London: Victor Gollancz, Ltd., 1939.)
6d. net.

THE agricultural policy of the Labour party, as presented in Lord Addison's book, has as its objective the restoration of British agriculture. In the case of Lord Astor and Mr. Seeböhm-Treutwein, Lord Addison believes that agricultural production in Great Britain should be stimulated by the adoption by the Government of a policy of improved nutrition. Recent reports on nutrition are quoted to show that the poorer sections of the population are inadequately fed, and it is calculated that in order to bring the food standard of the community up to a reasonable level it would be necessary to double our production of milk and to increase our production of eggs, fruit, vegetables and meat by 60, 78, 60 and 40 per cent respectively.

Quoting Scandinavian experience, Lord Addison considers that livestock production in Great Britain should be based on arable rather than pasture farming, and recommends that there should be a large extension of arable acreage (back to the total of the 'seventies) including a large additional home production of wheat. In fact, he considers that our wheat acreage should be doubled, although how this is to be achieved at a guaranteed price he recommends—37s. 6d. a

quarter instead of the present figure of 45s.—does not emerge.

All these increases in production would, on Lord Addison's hypothesis of an adequate standard of nutrition, leave unaffected our existing imports of food, and would, in fact, call for a considerable addition to our present importation of animal feeding stuffs.

Other recommendations include the nationalization of the land, the fixing of guaranteed prices to farmers, the re-organization of marketing and the payment of higher wages to agricultural workers.

Little is said about the cost of Lord Addison's proposals, but he is critical of the present "mixture of tariffs, quotas and quantitative regulation" which "is now being sought to be atoned for by a system of subsidies". He considers that the only self-respecting and permanent procedure is to have a price system under which the consumer is given an adequate income to pay a reasonable price to the producer.

Much contained in Lord Addison's book is controversial and many of his pronouncements are statements of belief rather than of fact. The methods by which his various proposals are to be put into operation are largely omitted, and the reader may be left with the impression that, although Lord Addison is undoubtedly sincere in his efforts to help British agriculture, he is inclined to over-estimate the benefits and to under-estimate the dangers of the policy he proposes.

God or Mammon?

Christianity and Economics

by Lord Stamp. Pp. xii+194. (London: Macmillan and Co., Ltd., 1939.) 5s. net.

THE purpose of Lord Stamp's book is "to review the contacts between the ideals of Christianity and the working of the economic machine". He begins with a chapter on the economic condition of Palestine at the time of Christ, and draws a far from idyllic picture "of over-population, intense industry to keep going, heavy taxation and much discontent". From a careful examination of His recorded teaching, Lord Stamp establishes the conclusion that "Christ did not condemn the institutions and relationships of His day". His teaching is thus for the modern no ready-made guide, with easy application to the

economic life of his own age". The vital link between Christianity and economic life is rather to be found "in the logical extension or consequence of certain germinal, and even explosive, ideas of conduct and interrelationship which Christ taught"; and the essence of those ideas is that they are "personal and voluntary, and not prescribed by any external system or laws".

But Lord Stamp does not confine his treatment of the subject to a study of Gospel precepts and background. His chapter on "Christian Doctrine on Economic Affairs in the Past" gives the history of the actual relationships between Christianity and economics as these have developed and existed in the past. Amongst other things, he shows how the authoritarian economic ethics of the Middle

Age was subjected to intolerable strain by the sudden rise in prices consequent upon the flow of precious metals into Europe on the discovery of the New World. During the second half of the sixteenth century, the total stock of gold and silver was quintupled.

Passing on to Christian principles and their practical application, Lord Stamp enumerates the following: (1) the brotherhood of man; (2) the principle of stewardship; (3) the doctrine of the good neighbour; and (4) the equality of the value of each individual soul. On the application of these fundamental principles to the conditions of modern life, Lord Stamp gives much valuable guidance.

Lest his work should be regarded too much in the light of a merely personal view, Lord Stamp includes a careful examination of three recent representative pronouncements of organized Christian bodies: first, the Encyclical *Quadragesimo Anno*; second, the findings of the Conference of

Protestant Churches on Church, Community and State, held in Oxford in 1937; third, a pamphlet published by the Industrial Christian Fellowship on "The Church and the New Economic Order." He finds in them "a common basis of criticism and condemnation, despite differences of emphasis".

In his final chapter, Lord Stamp raises some significant questions. If we can only avoid poverty by exploiting the machine and by organizing men in industrial subservience to it, "it seems as if material abundance and spiritual poverty are inverse related", as Christ virtually taught. We then confidently assume "that we can have all the material riches that a pagan society teaches us to produce, equally from a truly Christian order. So is it really possible to make the best of both worlds?"

Lord Stamp has given us a good book with a clear grasp of facts, principles and values.

J. C. H.

The Flora of North-east Ireland

A Flora of the North-east of Ireland

By Samuel Alexander Stewart and Thomas Hughes Corry. Second edition. Flowering Plants, Vascular Cryptogams and Charophytes, by Dr. Robert Lloyd Praeger; Mosses and Liverworts, by William Rutledge Megaw. Pp. lix + 472. (Belfast: The Quota Press, 1938.) 10s. 6d.

THE great botanical interest of the flora of Ireland is due not only to the position of the island as a western outpost of the Eurasian continent, but also to the peculiar elements of which the flora is composed and to the differences shown by the flora and vegetation when these are compared with the botanical features of Great Britain. North-east Ireland is, in some respects, less interesting botanically than the western districts but there are compensating features. The matter is stated thus in the introduction to the work at present under notice: "The position of the area is such that it is removed from the regions occupied by the most marked plant-groups to be found in Ireland—the flora of the south-west and west, with its fascinating admixture of Mediterranean, Pyrenean and North American plants; the Central Plain, with its rich assortment of lime-loving and swamp-loving species; and the south-east and east coasts, which connote the presence of species, mostly of southern facies, favouring sandy and gravelly soils. But as will be seen, certain members of all these groups

penetrate into the north-east. On the other hand, as a glance at a map might suggest, this region is rich in plants of Scottish type, which here reach their maximum in the country."

The introduction to this new edition makes instructive and pleasant reading. It contains many facts regarding the ecological distribution of the more distinctive species, and the contents are arranged as to facilitate the researches of botanists desiring to visit the best botanizing areas for special studies. There is also much information regarding the historical development of botanical knowledge of north-east Ireland. The bulk of the book is arranged after the style of "county floras", the sequence of species being that of the Bentham and Hooker system. Valuable historical and distributional notes are included and many references to literature are given. The value of including the critical species of *Rubus* with the proviso that probably the names "cannot all hold permanently" may be doubted. An appendix gives a list, with comments, of casual plants and of those recorded in error.

The inclusion, as Part 2, of the mosses and liverworts is a welcome innovation in Irish county or district floras. A topographical index is also a very useful scheme which might well be widely adopted by authors of similar works. There is an index to plant names and black and white maps of the counties of Down, Antrim, and Londonderry.

W. B. TURBILL.

A Guide to Plant Genetics

Recent Advances in Plant Genetics

by Dr. F. W. Sansome and Dr. J. Philp. Second edition, revised and rewritten by Dr. F. W. Sansome. Pp. xii + 412. (London: J. and A. Churchill, Ltd., 1939.) 18s.

WHEN this book first appeared, it filled a gap by providing a valuable summary of the more modern aspects of plant genetics. The new edition, which has been revised and partly rewritten by Dr. Sansome, preserves the main features of the previous one. There is an entirely new chapter on variegation and chimeras, and the first two chapters have been rearranged with considerable gain in coherence and clarity. Though not designed as a text-book, and in spite of the limitations imposed by the authors in their preface, it forms a very satisfactory introduction for the student of genetics. Through a logical sequence it succeeds in giving a proper perspective of the principles of modern genetics. The new edition should be even more useful than the first.

Within the limits set, the student of genetics and the general biologist have a very fair guide to inheritance in plants. But the field of study is enormously wide and varied and it is obviously impossible to give the substance of every recent addition to knowledge of it within the limits of the book. The student is aided by a bibliography containing about 1,500 titles and a "Key to literature" in which the more important papers and review summaries are classified under subject headings. By means of the "Key" the uninitiated can rapidly trace the literature on, for example, corn seedlings, cotton genetics or chromatid segregation.

The predominant role in modern genetics of the cytological method is reflected in this book. Nuclear behaviour is described first, the results of pedigree breeding afterwards. This applies to each of the sections dealing with the broad mechanical aspects of heredity, namely segregation, linkage, polyploidy and structural change. The correlation achieved is rather better than that in the previous edition.

Attention is directed also towards physiological aspects of genetics. A consideration of factor interaction leads on to a useful discussion of the biochemical work on flower pigments. Later we are introduced to the balance theory of gene action and interaction.

The continued omission of any treatment of selection or of population mechanics is to be regretted. These form by far the best introduction to a study of evolution, only specialized aspects of which are covered in the present book. The evolutionary approach is principally through the results of interspecific hybridization and in relation to polyploidy and structural hybridity (especially as in *Oenothera*).

The chapter on the constitution of the gene now includes sections on the position effect, gene size estimations and the effects of X-rays. Somatic crossing-over and mosaicism in maize endosperms are also given a place here, but scarcely seem at home with the rest of the company. There is no mention of reverse mutation, and the account of the effects of X-rays is very defective and inaccurate. It is without a reference to the contributions of Timoféeff-Ressovsky, Zimmer and Delbrück on the mechanism of spontaneous and radiation-induced mutation. They have shown that a spontaneous mutation must be regarded as a chance chemical change which has a very low reaction rate and consequently a very high van t'Hoff coefficient.

A few errors have crept in. The most serious is a confusion (p. 18) between character and factor. The statement "that the immediate products of meiosis are qualitatively different in respect of one pair of alternative (allelomorphic) characters" is clearly unsound. Moreover, it contradicts the (correct) statement on p. 16 "that the chromosomes carry determiners . . . which control the transmission and behaviour of inherited characters". This tendency to a looseness of phraseology sometimes leads to an untrue statement. For example, that "Beaded wing in *Drosophila* is a dominant lethal" (pp. 69 and 275). Two of the constitutions for linkage in autotetraploids (p. 192) are wrong, namely those for asymmetrical coupling and for triplex coupling.

The final chapter evaluates the newer work on genetics. Further attack on the nature and action of the gene seems likely to lead more and more into physiological by-ways. No one can predict how advances will be made; but it is interesting to reflect that our present understanding of gene action has come from such varied experiments as the implanting of *Drosophila* eye-buds into larval abdomens, the crossing of radishes with cabbages and the regeneration of diploid moss-plants from injured capsules. D. G. CATCHELSEA.

The Claims of Logical Positivism

The Logical Syntax of Language

By Prof. Rudolf Carnap. Translated by Amethe Smeaton (Countess von Zeppelin). (International Library of Psychology, Philosophy and Scientific Method.) Pp. xvi+352. (London: Kegan Paul and Co., Ltd., 1937.) 25s. net.

An Examination of Local Positivism

By Dr. Julius Rudolph Weinberg. (International Library of Psychology, Philosophy and Scientific Method.) Pp. vii+311. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., 1936.) 12s. 6d. net.

THE analysis of mathematics has given rise to important schools of philosophical thought in recent years. Progress has indeed been such that it is now almost impossible to discuss certain fundamental problems of knowledge without taking into account their results. The various phases of the epic controversies between them are highly technical: hence their interest for the mathematician as well as for the philosopher.

Until recently, three irreconcilable doctrines concerning the relationship between logic and mathematics were in the field. The logicist thesis, which is illustrated mainly by the monumental work of Russell and Whitehead, makes pure mathematics a branch of logic. For the formalist school, pure mathematics is the science of the formal structure of symbols; and all inferential systems can be treated as games played in accordance with certain rules, provided the expressions used are stripped of their meaning and considered in their structural relationships. The intuitionist thinkers, who follow mainly Brouwer and Weyl, maintain that pure mathematics is founded on a basic intuition of the possibility of constructing an infinite series of numbers, with the consequence that a large portion of higher mathematics is beside the universe of logical theory.

Logical positivism goes beyond logicism and metamathematics, in considering that the logical characteristics of sentences and the logical relations between them are solely dependent upon the syntactical structure of the sentences. In this way, logic becomes a part of syntax, provided that the latter is conceived in a sufficiently wide sense and formulated with exactness.

This claim is developed technically in the standard work of Prof. Rudolf Carnap; while Dr. J. R. Weinberg's book may serve both as an

introduction and as a critical analysis of various theories connected with this new movement, which may be considered as one of the striking intellectual developments of our time. Indeed, its revolutionary character has given rise to violent controversies which still divide philosophers into rival camps.

The fundamental position of logical positivism is its stand against all forms of metaphysical, transcendental thought and expression. In this aggravates the empirical strain which is noticeable in the works of Bacon, Berkeley, Hume and Mill. The main difference of this school from the more traditional views of logic, is that the latter are concerned not only with sentences, but also with the relations of meaning between sentences whereas the former contends that logic has nothing to do with meaning, and is concerned only with the formal treatment of sentences.

According to logical positivism, there are only two kinds of significant statements: matters of fact, which have an empirical content and which are verifiable in principle, and necessary truths, tautologies which follow from definitions regulating the use of symbols. Outside these two kinds of statements, all propositions are meaningless, however attractive their intrinsic depth or complexity may be. What makes it difficult at first to expose the real nature of a proposition is the fact that it is usually expressed as a grammatically correct sentence; thus grammar leads to a host of verbal obscurities and pseudo-problems which, it is contended, have often passed as profound philosophical utterances. By inquiring into the meaning of propositions, confusions, paradoxes, misleading terminology which implies the existence of certain entities corresponding to words, are solved analytically and thus are given their proper value.

As Dr. Weinberg points out, logical positivism has first striven to give a careful analysis of two types of propositions: those of physical science (and their common-sense counterparts), and those of mathematics, which are shown to be reducible to logical statements free of intuition. The minute and exhaustive elucidations of concepts and expressions by Moore, Russell and various other logicians, and the outline of the work of Russell and Whitehead ("Principia Mathematica") and Wittgenstein ("Tractatus Logico-Philosophicus") are then given a methodical and critical exposition. Dr. Weinberg shows the shortcomings of logicism and explains how Wittgenstein's views lead to

lipism. His treatment of probability and induction is less convincing: thus, he says that the three main types of probability are species of a simpler one, but he does not state it.

The portion of the book devoted to logical syntax forms an excellent introduction, though perhaps not a convincing one, to the standard work of Prof. Carnap, which we may, however, consider on its own merits. A word should be said, first of all, about the excellence of the translation made by Countess von Zeppelin of a most difficult and intricate text. This translation has on the occasion of improving many points of the original German work. The publishers also have spared no efforts and ingenuity in presenting such a book, with its host of complicated symbols, in a clear and attractive way.

The starting point of Prof. Carnap's system is at the distinction between the usual syntactical rules and the logical rules of deduction is that between formation rules and transformation rules, both of which are formulated, it is claimed, in syntactical terms. Prof. Carnap is thus led to build up the syntax of two languages: what he calls 'language I' covers a narrow field of concepts and shows how the syntax of a language may be formulated within that language itself; 'language II' is richer in modes of expression, and helps to formulate all the sentences of classical mathematics and classical logic. In both 'languages', the investigation is not limited to the mathematico-logical part of language, but is also concerned with empirical sentences (protocol-sentences ultimately). Finally, the treatment of the syntax of these two languages leads to an outline of a general syntax applicable to any language whatsoever; though it is admitted that this attempt is very far from attaining the desired goal.

The theoretical value of these constructions is to be found in their attempt to reach the most general forms of reasoning, and to express them as accurately as possible. But such a purpose, which is apparent in the material treatment of logical syntax, is formally defeated by the adoption of the principle of tolerance, according to which the business of logical syntax is not to set up prohibitions, but to arrive at conventions (p. 51). Thus we are told that "everyone is at liberty to build up his own logic, i.e., his own form of language, as he wishes. All that is required of him is that, if he wishes to discuss it, he must state his methods clearly, and give syntactical rules instead of philosophical arguments" (p. 52). Now, common sense could admit the form of such a aim, if it be made for a game. But it is difficult to allow it for the study of logic proper, which goes beyond the actual use of any specific language, whether natural or artificial.

However great the skill and ingenuity displayed by Prof. Carnap in the construction and defence of his 'languages', one cannot help questioning their practical use. For example, the artificial character of 'language I' (pp. 58-78) is shown by the fact that it introduces a number of new symbols and expressions which increase the burden of ordinary language; and that it still has to justify their meaning and use with a series of 'explanations' bristling with words of everyday usage. Again, the comparison of the primitive sentences and rules of 'language II' with those of other systems (p. 96) shows fully how relative and conventional this language II, as well as other systems, can be. The fact that 'language II' is able to give an interpretation of the fundamental notions of classical mathematics, such as the real numbers (p. 147) and classical physics (p. 149) scarcely dispels any feelings about its artificiality: for after all, it is difficult to justify an abstract construction which is totally devoid of meaning, with the simple excuse that it would provide a means of translating into a coherent system of symbols the main achievements of the positive sciences.

Such a construction might be accepted if it were final both with regard to consistency and generality, or if it could be justified on strict psychological as well as ontological grounds. But such can scarcely be the case of logical syntax, though it is bound to find outside itself the justification of its principles and development. For this reason, "Principia Mathematica" is considered as old-fashioned; and Prof. Carnap himself seems already to have moved further than the position outlined in his "Logical Syntax of the Language": there is no reason why progress should not be continuous, the more so as novelty is implied in the very process of analysis itself.

Without prejudicing the permanent logical interest of logical positivism, we cannot help thinking that the ultimate basis of its difficulties lies in its rather discouraging philosophical implications. The zest with which the extreme formalists develop their technique urges them to throw overboard the whole body of values which has so far justified philosophers in undertaking their arduous journey across the stormy seas of the mental sciences. Thus the major branches of philosophy are made to melt down to logic alone: metaphysics is bundled out into the expanse where lyrical verse already occupies a place of honour; while psychology is forced to find refuge with the empirical sciences. If logical positivism had its own way in the active field of the mental sciences, logicians alone would survive the catastrophe which would befall philosophy.

THOMAS GREENWOOD.

South-West Africa in Early Times

Being the Story of South-West Africa up to the Date of Maharero's Death in 1890. By Dr. Heinrich Vedder. Translated and edited by Dr. Cyril G. Hall. Pp. xvi+525+12 plates. (London: Oxford University Press, 1938.) 15s. net.

ALTHOUGH this book, originally published in German, is in name a history, the author's conception of the scope of his subject has necessitated a very full treatment of the ethnology and racial movements of the native peoples, Bushmen, Herero, Nama, Bergdama and Ovambo. Full use has been made of much valuable, but unpublished and inaccessible material, especially the remarkable collection in twenty-seven volumes of records of the "Sources of the History of South-West Africa", which has been taken into safe custody by the Administration.

The author's sifting of the material provided by his authorities is cautious and thorough. His discussion of the famous rock-engravings and cave paintings deserves attention. In the light of his experience of the native peoples, and his tests of their reactions, he is of the opinion that, while the engravings are the work of an ancient and vanished race, the paintings are relatively modern, and in all probability the work of the Bushman.

The English edition omits certain quotations of original documents, and curtails accounts of the development of certain vanished mission stations, while adding illustrations and maps. As a summary and critical account of unpublished material, the book is of considerable value to the student of the history of the South African native peoples and their relations one to another, as well as to the white man.

A Catalogue of Vertebrates of Japan

By Yaichiro Okada. Pp. vi+412. (Tokyo: Maruzen Co., Ltd., 1938.) 12s.

THIS valuable work presents every appearance of careful compilation to show the composition and range of the components of Japan's vertebrate fauna. It indicates, by the way, the intensity of systematic work in Japan since von Siebold's "Fauna Japonica" was completed in 1860, for the fauna at present contains 3,823 vertebrates, whereas in 1860 only 646 were known. The classes were represented now and then as follows: mammals 375 (57); birds 873 (201); reptiles 158 (18); amphibians 76 (11); cephalocorda 1 (0); cyclostomes 7 (0); fishes 2,251 (359). A rough glance through the contents shows that of non-migratory land forms, mammals, reptiles and amphibians, a very high proportion of the subspecies are peculiar to Japan and the neighbouring Korea and Formosa, whereas aquatic species and birds are more widely distributed. But it is surprising to find that among the mammals and birds only three mammals, the common house mouse, the mongoose and a deer, and three birds, are regarded as having been introduced from other countries. All the cosmopolitan rats are listed as original natives of Japan. The thoroughness of Prof. Okada's work is suggested by the extent of the index, which itself occupies 93 pages.

J. R.

J. Chr. Fabricius Systema Glossatorum

Im Anhang: K. Illiger, Die neueste Gattung Eintheilung der Schmetterlinge aus den Linnéischen Gattungen Papilio und Sphinx; J. Chr. Fabrici Rechenschaft an das Publicum über seine Classification der Glossaten. Herausgegeben von Felix Bry (Sammlung naturwissenschaftlicher Facsimile-Druck Band 1.) Pp. xii+112+13+4. (Neubrandenburg: Gustav Feller, 1938.)

THE "Systema Glossatorum" was the last work of the great Danish taxonomist, J. Chr. Fabricius, and is of fundamental importance to those who are concerned with the nomenclature of butterflies. It is, furthermore, a publication of the greatest rarity, and apparently only two examples exist of the original in the Latin language (1807). The present work reproduces in facsimile the original text of Fabricius, which is thus now rendered accessible to all and sundry who are concerned with taxonomy. As supplements there are also included facsimile reproductions of Illiger's "Gattungs-Eintheilung der Schmetterlinge" and Fabricius's brief *Rechenschaft* his classification of Glossata.

A. D. I.

Faunistischer Führer durch die Coleoptere Literatur

Die wichtigste Käfer-Literatur nach geographisch Gebieten geordnet. Von S. Schenckling. Band Europa. Lieferung 1. Pp. 64. 6 gold marks. Lieferung 2. Pp. 65-128. 6 gold marks. (Neubrandenburg: Gustav Feller, 1938.)

THIS work aims at being a guide to the most important faunistic literature on the Coleoptera which is arranged according to the geographic regions. Volume 1, it is announced, will consist of about ten *Lieferungen* and these are concerned with the general Palearctic region and with Europe. Volume 2 is to treat of the literature referring to Palearctic Asia and Africa together with the Indian, Malayan region; Volume 3 with Ethiopia, Austral and Oceania and Volume 4 with America.

A specialized work of this kind should prove a valuable aid to the taxonomist and especially to students in the great museums. A survey of the two parts already published makes it evident that the "Führer" will simplify the task of searching the literature in any particular group of these insects inhabiting a specified country or region.

Einführung in die theoretische Physik

Von Prof. Dr. Clemens Schaefer. Band 3, Teil 1 Quantentheorie. Pp. vii+510. (Berlin und Leipzig: Walter de Gruyter und Co., 1937.) 26 gold marks

THIS substantial volume forms one part of a comprehensive "Introduction to Theoretical Physics" written by Dr. Schaefer of Breslau, and concerned with quantum theory, treated mainly from a mathematical point of view. About one half of the book relates to the theory of Bohr, for the author considers that this is historically correct and also represents the best approach to wave mechanics. The final chapter deals with Dirac's theory of the electron and positron.

Plastics and Some Recent Applications

By H. V. Potter

CONSIDERABLE progress has been made in the practical application of plastics in every where since the author's review which appeared in *NATURE* of March 9, 1935. Moulded radio cabinets were then just being introduced, and these were regarded as a great step forward since they represented by far the largest mouldings which had at that time ever been made. The advent of these large mouldings meant far more than capturing the radio cabinet market. Their introduction entailed the installation of larger and more powerful presses in moulding works, and more presses of this type had been purchased. Efforts were made to find uses for them, and larger mouldings followed as a natural corollary.

Probably the largest mouldings ever made are the standard-sized coffins or caskets which are now in experimental production. These require a press of approximately 4,000 tons capacity, and each casket uses nearly 95 lb. of moulding material in its production. Although the consistent increase in size of mouldings is an indication of progress, improvement is primarily noticeable in the materials from which the mouldings are produced.

It is proposed to confine attention in this review to those synthetic resinous plastics which have already attained an important position in industry. A brief perusal of the patent literature will disclose that hundreds of new plastics have been proposed in recent years, most of which will progress no farther than publication of the patent. From the industrial point of view, the two most important synthetic resins are the phenol-formaldehyde and urea formaldehyde types, both of which are thermo-setting. From each of these, moulded materials and laminated materials are produced, while they are also employed in paints and varnishes in place of natural resin.

A brief outline of the manufacture of phenol products—better known, perhaps, as 'Bakelite' materials—may assist those who are not familiar with the process. Basically, the production of urea materials, once the resinoid has been made, is similar to the methods adopted for manufacturing phenolic moulding powders and laminated sheet.

By mixing phenol and formaldehyde in a heated reaction vessel together with a suitable catalyst, a reaction occurs which results in the formation of a heavy viscous mass at the bottom of the vessel with a layer of water above it. When the upper

layer has been removed by evaporation, the remaining material is tapped off and allowed to cool. It is then a brittle, amber-like solid which can be softened by heating. Continued application of heat, however, causes this 'resinoid', as it is termed, to become permanently hard and insoluble. Moulding powders are made by pulverizing the initial resinoid and mixing with it various fillers, pigments, mould lubricants, plasticizers, etc. The ultimate result of this processing is a powder from which the moulder produces the finished moulding by charging pre-determined quantities into heated steel moulds which are then closed under pressure. The properties of the mouldings can be varied by changes in the resinoid formula and by differing types and proportions of filler. In this manner the moulding material manufacturer can ensure, within limits, that any desired characteristic shall be present in the finished moulding. Good dielectric properties, low power losses at very high frequencies, resistance to heat, water or chemicals are typical examples of the many grades of material which have been developed to meet some specific requirement.

In a similar manner, the properties of laminated materials can be varied, but within much narrower limits, since the manufacturer is restricted in his choice of fillers. These laminated materials are built up by impregnating sheets of paper or fabric with resinoid and forming many such sheets into a solid board under heat and pressure. The material is produced ranging from a few thousandths of an inch in thickness for some types of electrical insulation up to a maximum thickness of 4 inches for gears. Yet another grade of laminated material is employed for decorative purposes. Veneers and wall panels are now in regular production and are used for the surfacing of walls and furniture in the home, hospitals, offices, hotels, restaurants and all types of public buildings. A surprisingly wide range of beautiful colours—pastel shades, black, white, mottles and wood grain patterns—is available, and the materials also embody unusual and valuable properties. They are unaffected by steam or moisture and are resistant to heat, fruit-juices and alcohol. Their surface does not corrode and, being non-hygroscopic, is hygienic and easily kept clean.

The range of present-day uses of plastics is so wide and so important that it is impossible fully to describe their applications in the space of this

article. Since engineering uses are now very much to the fore, some of the more interesting developments in this sphere will be outlined. The aircraft industry finds many uses for plastics. Phenol plastics are mechanically strong and their weight is only half that of aluminium. This fact, combined with the ease with which moulded parts can be produced, provides a tempting prospect for the aircraft engineer, and it is reasonably certain that moulded fuselages, wings, etc., will be pressed out of plastic material in the not too distant future. The size of mouldings has hitherto been a drawback but, as mentioned earlier, moulded coffins have been made and moulded sheets of laminated paper and wood have been manufactured up to 20-ft. in length. For large structures, such as an aeroplane fuselage, wood reinforced with synthetic resins has an important future. The latest developments here follow closely along the lines of laminated

material practice, that is, veneers of wood are treated with 'Bakelite' resins, built up into boards of required size and consolidated under heat and pressure. Another recent development is the moulded airscrew blade shown in the photograph opposite. This is probably the largest moulding yet made in which continuous lengths of fabric have been used. The threads at the root end forming the flange are unbroken throughout the whole

length of the blade except where necessitated by the gradually decreasing cross-section. A core accurately located in the centre of the blade and around this the reinforced material is moulded and compressed. A high-frequency furnace employed to melt the core metal without damaging the blade.

An organic glass, obtained from methyl methacrylate, which is one of the thermoplastic resins, is replacing ordinary glass for wind shield observation turrets, etc., in aircraft. It is light in weight, has a good refractive index and will not splinter on impact.

Many small components in aircraft construction are produced from plastics, including barrel supports for variable pitch airscrews, shims, chafing rings, etc. There is no doubt, too, that if a synthetic resin having much greater physical strength and elastic properties could be developed, the field of application for plastic

would be far wider. Research is continually proceeding in an endeavour to attain this object and it must eventually be achieved. The limit has almost been reached for increasing the mechanical strength of plastic materials by differing types of filler. Synthetic resins have made possible a great improvement in plywood, which is of particular importance for aircraft work. Phenolic resin incorporated on paper are employed as the



APPLICATION OF PLASTICS IN DECORATIONS. THE WALLS AS WELL AS THE DESK ARE SURFACED WITH 'BAKELITE' VENEERS.

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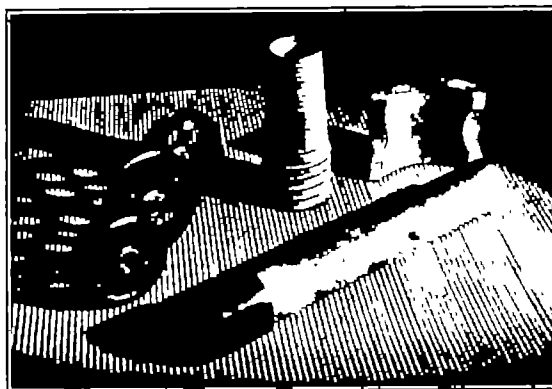
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hesive for the various plies of a plywood board. The paper is of tissue thickness and is merely a vehicle for providing a resin film in convenient form. The plies with the impregnated paper interlaved between them are formed into a solid board in a hot press, the heat causing the resin film to flow, penetrating the wood and finally polymerizing. In contrast to ordinary plywood sheets, the strength of the synthetic resin bond is actually increased by immersion in water. This remarkable water resistance, and the fact that the adhesive is impervious to insects and fungus, greatly enhances the prospects of plywood for aero construction.

Two important applications of phenolic laminated materials in engineering are for the production of gears and bearings. The material is easily machined by standard workshop methods, and gears transmitting up to 300 h.p. are now made from it. One or more of these plastics gears in a gear train results in a considerable reduction of noise and they have other advantages due to their chemical resistance. Wherever bearings of phosphor bronze, white metal or lignum vitae have been used previously, consideration may advantageously be given to the synthetic resin bearing. A longer life is frequently obtained and the sole lubricant required is water. The material is not, of



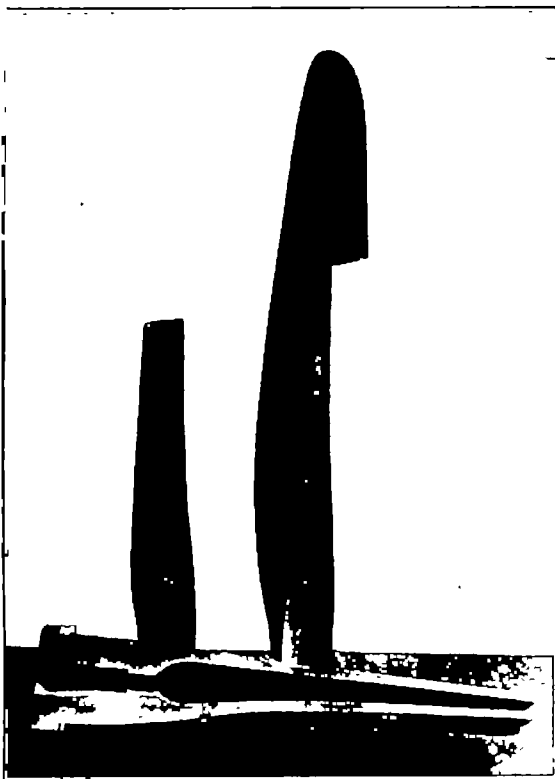
CONTROL PULLEYS, BARREL SUPPORT AND UNDER-CARRIAGE PISTON USED IN MODERN AIRCRAFT, MACHINED FROM PHENOLIC LAMINATED MATERIAL.

course, suitable for use for components in high-speed engines.

The applications of plastics to-day are extraordinarily diverse. Thousands of mouldings are made daily and are used in almost every industry. More than seven million insulating components punched from laminated material may be used in a single telephone exchange. Matrices for printing stereotypes are made from a phenolic material, dentures are made from the pure resinoid, and, in the form of lacquers, varnishes and cements, synthetic resins are assisting industry in many ways. Yet despite the progress which has been made in the past four years, it is not too optimistic to forecast that progress in the next four years will be even more rapid.

The resins more recently developed, such as vinyl and polystyrene, are slowly making headway for uses to which they are better suited than the earlier resins. These materials can be moulded by the injection process, that is, forcing the resinoid (which has previously been plasticized by heat) through an orifice into a closed mould, in place of the older method of using the resinoid in powdered form. The vinyl and polystyrene resins have valuable properties some of which are not possessed by the other resinoids. They have a water-white transparency, good electrical properties and excellent water resistance. They are, however, thermoplastic and can, therefore, be softened repeatedly by heat while, as already noted, the phenolic and urea resinoids are permanently hardened by heating.

There has been a good deal of development in connexion with the equipment for injection moulding, and machines are now available which work almost automatically except for switching on the electric current and keeping the feeding hopper filled with the resinoid. Further important advances in the mechanization of press operations will undoubtedly be seen in the future.



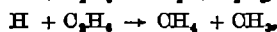
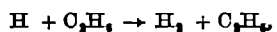
A HOLLOW MOULDED BLADE FOR A VARIABLE PITCH AIR-SCREW, 6 FT. FROM CENTRE TO TIP.

Hydrocarbons in Industry

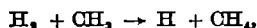
SINCE the structures and classical methods of synthesis of the aliphatic hydrocarbons serve as an admirable introduction to systematic organic chemistry, it is perhaps natural that these early chapters should be soon ignored and then forgotten. In those countries, however, fortunately endowed with natural sources of liquid hydrocarbons, their chemistry has become a subject of vital technical and national importance, whilst countries which have to rely on imported or synthetic products are even more dependent on methods by which cheapness of production and economy in utilization of fuels of high octane number or of lubricants can be achieved.

A general discussion was held by the Faraday Society on April 17-19 at the Imperial College of Science and Technology, London, under the title "Hydrocarbon Chemistry", with the object of ascertaining how far present scientific inquiry into the reactions of the hydrocarbons could serve in interpreting the somewhat complex processes already operating in industry. The discussion divided itself naturally into four sections: homogeneous thermal reactions, catalytic reactions, synthetic hydrocarbon production and, finally, olefine polymerization.

It is admitted that the mechanism of the thermal cracking process is a complicated one, but that it involves chain mechanisms at some stage, a hypothesis first advanced by Prof. R. O. Rhee and now generally accepted. There is, however, no unanimity of opinion as to the actual chain processes involved in the reactions. Hydrocarbon free radicals can be prepared by a variety of methods and their properties have been described. It has also been shown that they can initiate chains of reaction when admitted to the saturated hydrocarbons at suitably elevated temperatures. Much of the discussion centred around the questions as to how the reaction centres originate, what were the relative rates of such reactions as



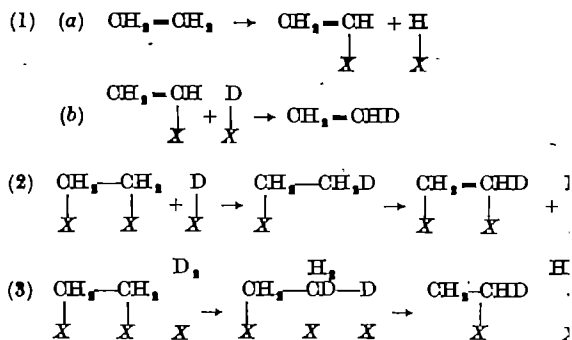
and



and by what mechanisms admission of nitric oxide cuts down the velocity of decomposition.

From the technical point of view, the problems to be solved in connexion with the synthesis of fuels such as iso-octane or aromatic hydrocarbons are how to utilize two straight-chain hydrocarbon

fractions, one from C_6-C_8 and the other from C_1-C_4 . It appears clear that owing to the high temperatures involved in thermal cracking, which leads to loss of control, the method of attack is thermal decomposition of the C_6-C_8 fraction. C_6-C_8 and re-synthesis of isoparaffins is not in favour, and alternative methods are being sought. Three avenues of attack on this problem are being explored, each involving catalytic reactions. The most direct involves catalytic cracking to C_6-C_8 fraction followed by re-synthesis of isoparaffins, the second catalytic ring closure, or the third attempts to bring about directly catalytic isomerism to isoparaffins as has already been found possible in the shorter members of the series. The discussion made it clear that the *modus operandi* of any one of these processes is by no means clear. This is exemplified by the fact that in one of the simplest reactions, namely, the exchange reaction of deuterium with an unsaturated hydrocarbon, such as ethylene, or a saturated one, such as ethane, three different mechanisms have been advanced. These may be depicted as follows:

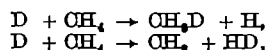


A similar diversity of opinion was noted when the mechanism of ring closure was discussed.

When heptane is passed over a dehydrogenation catalyst either of the oxide or metal type to produce toluene, a mono-olefine is found to be present. The third mechanism described above for the exchange reaction is likewise applicable to the process of olefine formation, but we note that the half hydrogenated state is an intermediary in the reaction. The answer to the question whether the cyclization proceeds through the olefine or through the half hydrogenated state awaits further experiment. It is also interesting to observe that both (2) and (3) provide us with mechanisms by which the double bond in a olefine can travel towards the end of the chain, a

at cyclization may result. Cyclization in the gas phase involves a large change in entropy, since the difference in the internal mobilities of the straight chain and ring is so pronounced; it is clearly important to devise some method by which the position of the molecule adsorbed on the catalytic surface at the temperature of ring closure may be examined.

On the synthesis side, discussion was devoted to the interesting reaction which occurs between saturated tertiary hydrocarbon and an olefine in the presence of a variety of catalytic agents, especially sulphuric acid. Whilst considerable progress has been made in elucidating the structure and energies of reactions involving conjugated double bonds, it would be very desirable if calculations on reactions of the type



are made. In the technical synthesis of liquid fuel, it is clear that processes of coal hydrogenation are extremely complex and that the identification and examination of the various reactions involved would be a matter of great

difficulty. Whilst very complex products can be made by the Fischer-Tropsch process, the initial reactions which the carbon monoxide and hydrogen undergo in building up the complex hydrocarbons are much simpler, and some success has already been achieved in identifying and examining the successive reactions which are involved. It was clear from the discussion that it may be possible to synthesize many other products in addition to the straight-chain hydrocarbons by means of this elegant reaction.

The last section of the discussion was devoted to the polymerization of the olefines. Here dimerization of short-chain olefines to produce fuels, and polymerization to produce long-chain macromolecules suitable for plastics, are at present the two important technical objectives. No less than nine papers were devoted to this aspect of hydrocarbon chemistry.

The Faraday Society always attempts to emphasize the international character of its discussions on scientific subjects, and it is worthy of comment that this meeting was a truly representative one in spite of the present political situation.

ERIC K. RIDGAL.

Growth of Induced Plant Tumours

By László J. Havas, Institute of Pathological Anatomy, Brussels

A COMPARISON between the malignant tumours of animals and the plant tumours, commonly called 'crown gall', is beyond the scope of the present article*. It may be pointed out, however, that characteristic histological and cytological differences can be observed—obviously enough—between these two pathological structures, such differences being inherent in the two types of host organisms themselves. It may be added further that the analogies of response of plants and animals, to be described, were obtained *in spite of* their structural differences.

Inspired, no doubt, by the experimental induction of tar tumours in animals, discovered by Yamagata and Ichikawa, Komuro¹ exposed the root tips of *Vicia Faba* and *Pisum sativum* to suspensions of coal tar. He obtained by this method well-characterized neoplastic structures termed by him 'phyto-tartumours'. Most of the cellular abnormalities described by Komuro in these swellings, such as giant and multinucleate cells, hypernucleolated, lobed, vacuolized and fragmented

nuclei, amitotic divisions, chromosome aberrations, etc., were also observed by Mottram, Picon, Levine and Bergmann² and others, in onion and bean roots treated with coal tar and also with Scharlach Red. Such effects, as the systematic investigations of Levine^{3,4} and Chargaff⁵ have shown, were not limited to the particularly sensitive root tips, for swellings macroscopically comparable to crown gall, and presenting similar cytological abnormalities, were also produced by them on the stems of the most heterogeneous annuals, and even woody plants, subjected to local treatments (painting) with the above and a variety of other chemicals.

The discovery of the active factors in coal tar responsible for tumour production in animals (Bloch and Widmer), and the isolation and synthesis of these and other highly carcinogenic hydrocarbons (Kennaway; Clar; Cook *et al.*⁶, Fieser, and others), gave an added impetus to the study of the etiology and of the experimental induction of chemical cancers in animals. One of these compounds, 1:2:5:6:dibenzanthracene, was tested by Levine⁷, and was shown

* See for reference on this subject the excellent review of A. J. Baker and T. O. Berge, *Amer. J. Cancer*, 26, No. 2, 310-356.

to produce marked overgrowths when applied locally (painting) on the stems of a great variety of plants. A similar application of benzpyrene and of methylcholanthrene provoked, however, only an unlocalized thickening and bending of the stems of roses and tomatoes (Havas), although the carcinogenic potency of these compounds is known to be far superior in animals to that of dibenzanthracene. On the other hand, a definite increase in the size of the neoplasms was observed by Havas⁷ when crown gall tumours of the tomato were painted with benzpyrene at an early stage of their development. Such divergencies are natural, as the degree of sensitivity of different plants, and even of individuals within the species, varies in a great measure^{8,9}.

But the faculty of inducing neoplasms in plants is not limited to the above-mentioned polycyclic hydrocarbons. Thus, Auler¹⁰ was able to demonstrate that lactic acid also has such properties, while the role of this substance in the carcinogenic sensitization of animals was shown by Parventjev¹¹ and others. The influence of the different amino-acids on the development of the tar tumours and the spontaneous tumours of rodents has been studied by a great number of workers (Vles¹², Coulon, Suzuki¹³, etc.). While some of these acids seem to inhibit cancerous growth, L-cystine and glutamic acid are generally regarded as carcinogenic sensitizers¹⁴ in animals. An analogous effect of these two chemicals is reported by Levine¹⁵, who induced by their local application neoplasms in plants. Similar parallelisms of action were obtained by such widely different organic and inorganic substances as copper, alcohol, ethylene, etc.¹⁶.

While in the preceding examples the method of the experimental approach to the problem consisted in the attempted *induction* of tumours in normal plants, the experiments to be reported now were designed to test the effects of the various carcinogenic and carcinolytic sensitizers of animals on the incremental *growth* of plant tumours already induced by inoculating the plants with *Bacterium tumefaciens*, the causal agent of 'crown gall'. The technique applied in these experiments was also different, the substances having been introduced (unless otherwise mentioned) directly through a cut in the stem or through a petiolar stump, using the negative pressure in the water stream to pull up the solutes in the plants¹⁷.

The carcinogenic power of the oestrogenic hormones seems to be now rather convincingly established in animal experiments (Leo Loeb¹⁸, Lacasseagne, Fodor *et al.*¹⁹, Gardner, McEuen, and others). Comparable effects of the follicular hormone were shown by Havas¹⁸ on the incremental growth of the crown gall of the tomato, an increase in the weight of the tumours, amounting to 70–80

per cent, having been obtained as a result of treatment. The stimulating effect of this hormone on the tumours of the tomato was also observed by Stapp²⁰; but on *Bacillus*, and using a different mode of administration, Verona²¹ was unable to confirm such an action. Although apparently less active than the follicular hormone, an increase in the weight (23 per cent) of the above phytoecanoma could also be recorded by treatments with the hormone of the anterior lobe of the pituitary (Havas).

The experimental evidence furnished by the majority of workers (Fodor¹⁹, Hayaashi²², Engel-Reiss *et al.*²³, Jones, and others) seems to confirm the similarity of action of this endocrine product in animals. The role of the active principle of the thyroid gland in the carcinogenic sensitization of animals is still under discussion (Suzuki, Engel¹³, Forsell, Jones, and others). It may be mentioned, however, that a definite increase (10 per cent) in the weight of the above neoplasms of the tomato was obtained under the influence of thyroid extracts²⁴. Effects to the contrary, namely a 20 per cent reduction in the weight of the tumours, were also observed by Havas¹⁸ on plants treated with the hormone of the thymus gland which according to Engel²⁵, Arzt, Fichera, and others increases the cancer resistance of animals.

In spite of the many contradictory views expressed by cancerologists as regards the influence of the different vitamins on malignant growth (Gordonoff and Ludwig²⁶, Caspari, Biseglie, Geré, Fodor and Kunes²⁷, and others) there is now fairly general agreement that an excess in the vitamins C and D increases the receptivity of animals to cancer. Vitamin C was tested by Havas²⁸ on tomato plants, inoculated as above, and it was found that the weight of the tumours exceeded by 29 per cent that of the controls. Still more striking were the results obtained with the vitamins A and D tests on a variety of *Opuntia*, which, after several hundred inoculations, had proved to be highly immune to *B. tumefaciens*, as only about 1.5 per cent of the inoculations have taken. When, however, the site of the inoculations was painted with solutions of vitamin A or D, 80 per cent of the inoculations yielded large intumescences^{29,30}.

Colchicine, which has come recently to the fore, thanks to the important investigations of A. P. Dustin³¹, was shown to have encouraging carcinolytic properties by Dustin and Amorós Peyron³² claims even a "complete sterilization" of the experimental and spontaneous tumours of different animals. A parallel action of this alkaloid was described by Havas³³ on the growth of the crown gall of the tomato, the weight of the neoplasms of the treated plants having been reduced to half that of the controls.

Finally, an example may be given when the recovery of a carcinolytic substance of plants has exceeded the experimental evidence of the similarity of its action in animals. This agent is the p of the mistletoe (*Viscum album*) which, according to the mode of its extraction and administration, produced tumour resolutions ranging from 66 to 1000 per cent on tomato and *Ricinus* plants (Havas¹). But no clear-cut results were obtained by the author in animal experiments. Thanks to an apparently more adequate preparation of the *viscum* sap, Koeh² could report, however, a surprisingly high percentage of amelioration and complete healing of the Ehrlich tumours of the mice.

In conclusion, it seems desirable to emphasize that, in spite of the suggestive analogies of response ascribed, the *specificity* of action of the agents responsible for such reactions is by no means suggested. The diversity of the chemical structure of the substances used and the fact that similar parallelisms of response can be obtained by purely physical intervention speak for themselves against

such a concept. The connecting link between the phenomena observed is, therefore, more likely to be found in analogous endogenous factors present in both the animal and plant protoplasm.

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- ¹⁸ Hugel, H., *Z. Krebsforsch.*, (1923): *Med. Klin.*, 2, 120 (1930).
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Obituary Notices

Prof. W. Cramp

THE sudden death of Dr. William Cramp, at Llandudno on April 20, at sixty-three years of age, will be a severe blow to his many friends and especially to his old students at the University of Birmingham. He had a great gift of sympathy with his students. He readily understood their difficulties, took great pains to clear them up and so endeared himself to them all.

Cramp was educated at King Henry VIII Grammar School, Coventry, and at the University of Manchester. From 1892 until 1897 he served his apprenticeship with Rotherham and Sons, Coventry, and from 1897 until 1901 was an engineer with Arranti, Ltd., Hollingwood. At the age of twenty-five he was appointed lecturer in electrical design at the Central Technical College, South Kensington, under Prof. Ayrton. He then set up in practice as a consulting engineer in London and Manchester, giving, at the same time, lectures to his old University. In 1908 he was transferred to full membership of the Institution of Electrical Engineers; he communicated many papers to it and was awarded several premiums for them. During the Great War he was twice commissioned to do special work for the Board of Trade in Italy. In 1919 he was appointed professor of electrical engineering at the University of Birmingham, where he did much valuable research work. He always enjoyed showing his friends the original work that is being done in the laboratories under his direction. Cramp took an active part in the meetings of the

British Association. In his presidential address to Section G at Blackpool on "The Engineer and the Nation", he took a sombre view of the world as a whole and of the little recognition given to the work done by the engineering profession. He controverted the popular criticism of the use made of scientific discoveries for war purposes. He stood as a devotee of pure science that had no moral obligations and no ethics. If the engineer were left undisturbed by the politician, he visualized the power he might exert to make war impossible. A few months later, Prof. Cramp lectured before the Royal Institution on the future of power supply, and he pointed out some of the difficulties that would have to be overcome before the 'grid' system of supply could be regarded as ideal. In 1931 Prof. Cramp gave the Faraday Lecture to the Institution of Electrical Engineers at London and at several of the local centres, the subject chosen being "Faraday and his Contemporaries".

Several treatises which have proved useful to students of engineering were written by Prof. Cramp; in particular, his books on "Armature Windings", "Continuous Current Machine Design", and, in conjunction with O. F. Smith, "Vectors and Vector Diagrams". He also contributed many scientific papers to various journals.

He was the inventor of the 'Cramp single-phase motor', a self-exciting alternator, apparatus for the production of nitric acid from the air, and a new system of coal-face lighting. It was only a few weeks

ago since his special knowledge of the use of electricity of mines was recognized by his appointment to the chairmanship of the committee set up by the Secretary of Mines to consider what amendments are required to the general regulations governing the use of electricity in mines under the Coal Mines Act, 1911.

Cramp took an active part in the activities of the British Broadcasting Corporation. He was largely responsible for founding the Engineering Club in Manchester in 1913 and the 'Children's Concert Society' in Manchester in 1914. His interests were very wide and he had been looking forward to many plans for the future when the end came. He was a widower and leaves two daughters, to whom the sympathy of his many friends will be extended.

Prof. F. J. Cheshire, C.B.E.

THE death of Prof. Frederic John Cheshire, on March 24, at seventy-eight years of age, removes one who had a very considerable influence on the development of the optical instrument industry in Great Britain, more especially during the War of 1914-18 and in the following years. His main interests lay in the fields of experimental science, and his true vocation was to the life of a teacher.

Cheshire was born on June 8, 1860, being the son of the late Mr. George Cheshire of Leeds. He was educated at Birkbeck College, and at the Royal School of Mines. After some early training in engineering at the works of Messrs. Greenwood and Batley, Leeds, he entered the Customs and Excise Service in 1880, and thence went to the Government Laboratory as a chemist. In 1885 he secured an appointment by open competition on the examining staff of the newly instituted Patent Office, where he served until 1915, when he was transferred to the Ministry of Munitions and became deputy director-general of the Optical Department. On the formation of the Optical Engineering Department at the Imperial College in 1917, he accepted the post of director, and held this position until his retirement in 1925. He was awarded the C.B.E. in 1918. Even this busy career had not exhausted his abundant energies, and he afterwards acted as consultant to various commercial firms.

In the course of his early teaching work, Cheshire became well known for the interesting experiments with which his lectures were illustrated. He had a great desire to give practical assistance to students from industrial firms, and on one occasion had been invited to give a course of lectures on sound under the auspices of the London County Council for the benefit of workers in piano factories. At the beginning of the course he was asked, "What do you know about making pianos, Mr. Cheshire?" "Nothing at all," he replied, "but I do know some things which every maker of pianos should know."

With this outlook, it is natural that Cheshire's main publications were concerned with the improvement of apparatus for teaching and lecture demonstration. Early papers described optical projection apparatus of an improved description including a

polariscope. He also took much interest in the design of microscopes, especially petrological type and apertometers. His papers appeared generally in the *Transactions of the Optical Society* and the *Journal of the Royal Microscopical Society* between 1907 and 1923. In 1917, it was difficult to purchase teaching apparatus, and he designed various ingenious optical benches and similar apparatus which could be constructed in the College workshop, in addition to sundry pieces of apparatus of an original character including 'focimeters' and 'squaring-on eyepieces' for the equipment of the laboratories.

Cheshire insisted that technical optics was essentially a branch of engineering, and changed the name of the section to the "Optical Engineering Department". He considered that the mechanical design of instruments needed attention, and the provision of instructional courses, equally with purely optical design. His experience at the Patent Office and contacts with the staff of Messrs. C. Zeiss had, however, shown him the importance of thorough-going computational work in optical design and the appointments made to his teaching staff reflected these ideas.

Cheshire was a man of charm, and had a natural capacity for leadership. From 1916 until 1920 he was president of the Optical Society, and in 1922-1923 president of the Royal Microscopical Society. He was a founder fellow of the Institute of Physics. He was a sportsman of parts, and designed a well-known golf-club. In 1886 he married Mary, daughter of the late Mr. George Richardson of Huddersfield, and had a son and a daughter.

PROF. FRANTIŠEK NAČHTIKAL, a distinguished Czech physicist, died in Prague on April 12 at the age of sixty-five years. He was the author of several monographs on electrotechnics and applied physics. He served on the Czechoslovak patents council and was an authority on wireless transmission technology.

WE regret to announce the following deaths:

H. Coote-Lake, treasurer of the Royal Anthropological Institute, on April 22, aged sixty years.

Dr. Marguerite Kettle, assistant editor of the *Lancet*, widow of Prof. E. H. Kettle, F.R.S., on May 5, aged fifty-one years.

Mr. Henry Marsh, C.I.E., known for his engineering work, especially in connexion with irrigation in India and South America, on April 25, aged eighty-eight years.

Engineer Vice-Admiral Sir Henry Oram, K.C.I. F.R.S., formerly engineer-in-chief of the Fleet, and president of the Junior Institution of Engineers and of the Institute of Metals, on May 5, aged eighty years.

Prof. C. S. Plumb, emeritus professor of animal husbandry in the Ohio State University, on March 10, aged eighty-eight years.

Mr. Daya Ram Sahni, C.I.E., formerly director-general of the Archaeological Survey of India, aged sixty years.

NATURE

SUPPLEMENT

Vol. 143

SATURDAY, MAY 13, 1939

No. 3628

LETTERS TO THE EDITOR

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR AT P. 811.

NUCLEAR PHYSICS

Control of the Chain Reaction involved in Fission of the Uranium Nucleus

It has recently been shown that the number¹ of neutrons liberated² in the nuclear fission of a uranium nucleus is sufficiently high to make the realization of a self-perpetuating reaction chain seem possible. The danger that a system containing uranium in high concentration might explode, once the chain is started, is considerable. It is therefore useful to point out a mechanism which gives the possibility of controlling the development of such a chain.

We form an expression which is characteristic for the behaviour of the chain:

$$v'' = \frac{A_f}{A} v (1 - \alpha), \quad (1)$$

A_f being the product of the cross-section for nuclear fission for a thermal neutron of the uranium nucleus with the concentration of the uranium; A_i the product of the absorption cross-section for thermal neutrons of the nucleus of kind i multiplied with its concentration; A the sum of all A_i 's, which is to be taken over all kinds of nuclei present in the solution; v is the average number of neutrons liberated in one fission, α the average probability for a neutron to diffuse out of the system before being absorbed.

The energy liberated by the chain will be

$$E = NF, \quad (2)$$

F being the energy liberated in one fission and N the number of fissions produced by the chain. We have

$$N = v' + v'^2 + v'^3 + \dots \quad (3)$$

The chain gives thus a quantity of energy, which is increasing rapidly with time, if v' is greater than 1. Let us consider the case of a chain which is due to fission produced by thermal neutrons; that is, a chain propagating itself in a system containing sufficient hydrogen for the slowing down of the neutrons.

If the cross-sections for capture or fission of all nuclei present follow the $1/v$ law, v'' will not depend on the velocity of the neutrons and therefore not on

the temperature of the system (since α will in practice be small and since it depends in the first place on the distance necessary for slowing down the neutron; the temperature has, of course, an effect, although it will be very small).

Let us, however, introduce an absorbent, such as cadmium, the cross-section of which does not depend on the neutron energy in the thermal region. We will have, instead of (1),

$$v'' = v \frac{A_f}{A' + A_0} (1 - \alpha), \quad (4)$$

where A' is the sum of all A_i 's following the $1/v$ law and A_0 is a constant, the term due to the newly added absorbent. v'' will now decrease with increasing temperature. At a temperature, which will be characteristic for the composition and the geometrical constants of the system, v'' will become smaller than unity and the system will stabilize itself somewhere near this temperature; the equilibrium being determined by the fact that the amount of energy given out per unit of time by the system (in the form of heat and nuclear radiation) is equal to the energy produced by the system. Similar questions have been discussed by F. Perrin³.

Added in proof: In the case of a chain propagating itself by thermal neutrons, the time necessary for the slowing down and for the absorption of a neutron, that is, its mean life, is of the order of 10^{-4} sec. If one makes v'' as small as 1007, it needs 100 times the mean life of a neutron or about 10^{-2} sec. to double the number of neutrons, and with that the energy liberated per unit of time. It is therefore possible to control the development of the chain by a periodical interaction of absorbers which break up the chains by entering the system.

F. ADLER.

H. VON HALBAN, JUN.

Laboratoire de Chimie Nucléaire,
Collège de France, Paris.

¹ von Halban, Jun., H., Joliot, F., and Kowarski, L., *NATURE*, 143, 470 (1939).

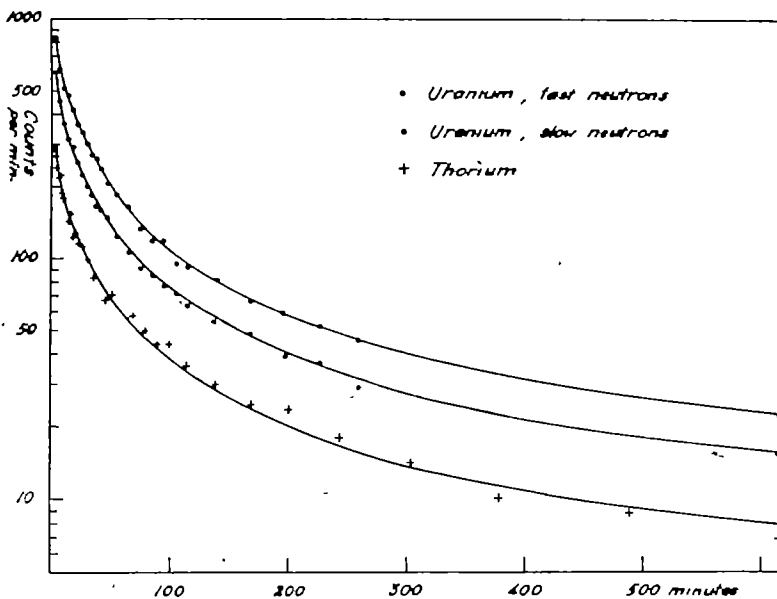
² von Halban, Jun., H., Joliot, F., and Kowarski, L., *NATURE*, 143, 480 (1939). Roberts, R., Meyer, R., and Wang, P., *Phys. Rev.*, 55, 510 (1939). Haenny, O., and Rosenberg, A., *C.R.* 208, 893 (1939). Szilard and Tamm (private communication). Huber and Bolding (private communication).

³ Perrin, F., *C.R.*, in the Press.

Decay Curves of Uranium and Thorium Fission Products

It has been suggested by Bohr¹ that the rare isotope ^{235}U is responsible for the fission produced in uranium by slow neutrons, while the fission produced by fast neutrons is to be ascribed to the abundant isotope ^{238}U . In this connexion it is of interest to see whether any differences can be detected between the shapes of the resulting decay curves for the fission products of uranium bombarded with fast

obtained with 100 minutes exposure; each curve represents two series of measurements. The shape of the curve is the same for fast and for slow neutrons. This was also the case in the experiments with 3 minutes exposure and 20 seconds exposure, where several series of measurements were taken and the decay was followed for 30 minutes and 5 minutes respectively. In no case did the ratio of the activity for fast and slow neutrons change during the decay a change of 10 per cent would have been noticed.



DECAY CURVES FOR THE DISINTEGRATION OF URANIUM BY FAST AND SLOW NEUTRONS, AND FOR THE DISINTEGRATION OF THORIUM

and slow neutrons, and also to compare these curves with those obtained with thorium. Some experiments by F. Joliot² indicated that slow neutrons were relatively more effective in producing the longer period activities than the shorter.

We have made similar experiments using neutrons from a lithium target bombarded with 50 microamperes of 750 kilovolt deuterons. The fission products were collected by recoil on a collector plate placed 1 mm. below a glass plate painted with uranium or thorium oxide. In the fast neutron experiments, these plates were surrounded with cadmium sheets and placed immediately below the lithium target. In the slow neutron experiments a 4 cm. slab of paraffin wax was interposed between the target and the plates, which were resting on another block of paraffin wax, 8 cm. thick. In the latter case 75 per cent of the activity obtained was due to slow neutrons (only 25 per cent remaining when the plates were shielded with cadmium).

In three series of experiments, uranium was bombarded for 20 seconds, 3 minutes and 100 minutes, respectively, care being taken to keep the neutron intensity constant during the irradiation. In the first two cases the collector was of lead, while in the 100-minute experiment paper was used. Afterwards the activity of the collector plates was measured with a Geiger counter connected through a Neher-Harper circuit to a 'scale of eight', which had been tested for linear counting up to 5,000 particles per minute. The accompanying graph shows the decay curves

As regards the thorium fission products, the shape of the decay curve is again indistinguishable from that of the uranium fission product for the same time of exposure. In order to avoid contamination with the active deposit from thorium emanation, the thorium oxide layer was sealed up behind a celluloid foil of 0.4 mm. air equivalent. In the case of the 100 minutes exposure this was, however, not sufficient and only when the emanation was continuously blown away during the exposure was this contamination avoided.

From the measurements just reported, it thus seems impossible to decide whether different uranium isotopes are responsible for the fission produced by slow and fast neutrons. Although some of the periods for the fission products from different nuclei must be different, the abundance of periods of any duration seems to be so great that these differences are smoothed out in the resulting decay curve.

We wish to thank Prof. Niels Bohr for suggesting the problem, and Prof. L. Meitner and Dr. O. R. Frisch for help and advice.

T. BJERGE.
K. J. BROSTRÖM.
J. KOCH.

Institute of Theoretical Physics,
University of Copenhagen.
May 2.

¹ Bohr, N., *Phys. Rev.*, **55**, 418 (1939).

² Joliot, F., *J. Phys.*, **10**, 159 (1939)

Tracks on Photographic Plates of the Recoil Nuclei of Disintegration of Uranium

UNDER the bombardment of uranium by neutrons, recoil nuclei of great mass and high ionizing power are produced. According to the measurements of Frisch¹, the ionization which they produce along their tracks attains 70 Mev. Their range in air, measured by Joliot², is nearly 3 cm.

For these reasons, it was to be expected that the tracks of such recoil atoms would be observed on photographic plates with a thick coat of emulsion. Our first experiments³ suggested this assumption. On a plate, 2 cm. x 3 cm., some thick and short tracks were obtained, which can be attributed to the uranium recoil nuclei. A preparation of radiothorium plus beryllium being taken as a source of neutrons, besides the recoil tracks a considerable background of γ -rays was also observed on the plates.

In order to avoid the background in further experiments, irradiation was effected by the neutrons obtained from a cyclotron by means of the reaction $n + D \rightarrow n + D$. The experiment itself was carried out in the following manner: a photographic plate was placed above a thick coat of metallic uranium powder at the distance of 2–3 mm. The plate was turned with the nucleus coat toward the uranium. The irradiation lasted 10 minutes. As a result, we obtained on the plate tracks of uranium α -particles and other tracks almost identical with them in range, but thicker and more continuous, which we believe to belong to the uranium recoil nuclei. The character of these tracks is shown on the accompanying figure, which shows a photograph of two tracks in the emulsion especially prepared for these experiments.

One of these tracks, continuous and thick, with a range corresponding to 1.6 cm. of air, belongs to a recoil nucleus. Another track, 5 cm. long, belongs to an α -particle of uranium. In the second track, separate grains can be discerned, and it can also be seen that its track is thinner. Although the composition of the emulsion was especially chosen in order to facilitate discrimination between recoil nuclei tracks and α -particle tracks, in many cases it is very difficult to do this, chiefly because many of the tracks are directed most perpendicularly into the emulsion and therefore they cannot be examined in detail with the microscope. Moreover, the greater number of tracks come from the anterior layers of the uranium and have therefore small ranges.

If the counting is limited only to the tracks of range 5 cm. and more in air, then the plate of area 6 cm.² receives nearly six hundred recoil nuclei in a minute.

Although in our experiments the source of neutrons is nearly thirty times as powerful as that used by Risch, our results agree fairly well with his data (5 particles in 1 minute from 300 mc.). Our data differ, however, greatly from the results of Roberts, Meyer and Hafstad⁴ (30 particles in 1 minute from a source equivalent to 10 curies). It is possible that this contradiction may be explained by the fact that Roberts and co-workers counted only the impulses of energy 75–150 Mev.; however, according to our experiments, the action of the uranium recoil nuclei on the photographic plate is not expected to differ much from the action of α -particles. This would accord with the assumption of Joliot⁵, who believes that the average energy of the recoil nuclei is only 5–35 Mev., and not 75–150 Mev. as Meyer and co-workers thought.

In conclusion, it is to be noted that after irradiation for three hours of bismuth, gold and platinum with neutrons from a cyclotron, no recoil nuclei were observed.

Radium Institute, L. MYSSOWSKY.
Academy of Sciences U.S.S.R., A. JDANOFF.
Leningrad. March 19.

¹Risch, O. R., NATURE, 142, 276 (1939).

²Joliot, F., C.R., 208, 341 (1939).

³Jdanoff, A., and Myssowsky, L., U.R. Acad. Sci. U.R.S.S., in the Press.

⁴Roberts, B. B., Meyer, B. O., and Hafstad, L. R., Phys. Rev., 55, 417 (1939).

⁵Joliot, F., C.R., 208, 647 (1939).

Short-Range α -Particles from Oxygen, Nitrogen and Fluorine Bombarded with Protons

THE bombardment of fluorine by protons leads to the emission of a strong γ -radiation, for which the excitation curve shows well-defined resonances¹. In a letter by Dee, Curran and Strothers², in which the nature of this γ -radiation is discussed, strong reasons are given for expecting the emission of a short-range α -particle group in the same transmutation, and it is pointed out that this group should show the same resonance excitation as is found for the γ -radiation. Assuming the γ -ray energy³ to be 5.8 Mev., the calculated mean range of the α -particle group is 1.1 cm.

In some earlier work⁴ on the transmutation of fluorine a search was made for this group, but no evidence of its presence could be obtained, although with a bombarding voltage of 450 kv. the measurements were extended to a range of 1 cm. Recent unpublished work in this laboratory on the energy of the γ -radiation has, however, shown that the figure of 5.8 Mev. is probably too low, and the calculated range of 1.1 cm. for the α -particles is thus too high. In order to investigate ranges of less than 1 cm., the bombarding voltage must be reduced to less than 450 kv. in order to prevent scattered protons from entering the ionization chamber.

Experiments at these low voltages have recently been carried out, and the emission of a group of α -particles of mean range 0.8 cm. from a thin barium fluoride target bombarded with 330 kv. protons has been established. (We understand that these short-range α -particles from fluorine bombarded with protons have also been discovered at Pasadena by McLean and Becker, using a cloud chamber.) A rough excitation curve for the production of these particles is given in Fig. 1 (curve A), and shows that they follow approximately the same resonance curve as that obtained for the γ -rays (curve B). The



RECOIL NUCLEI. $\times 410$.

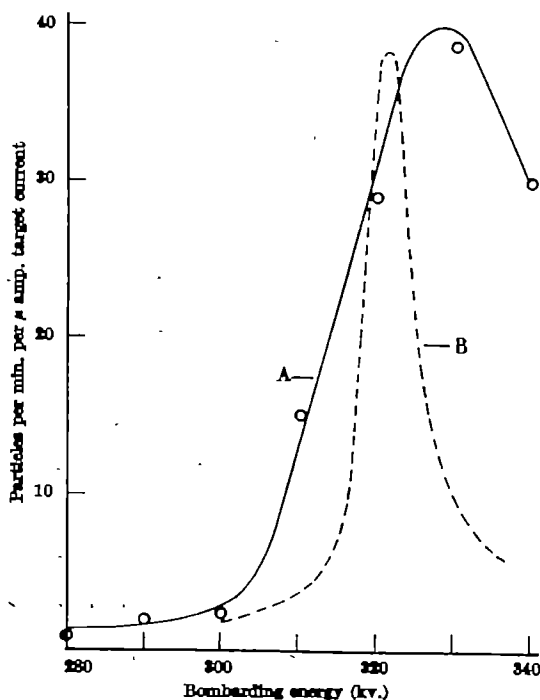


FIG. 1.

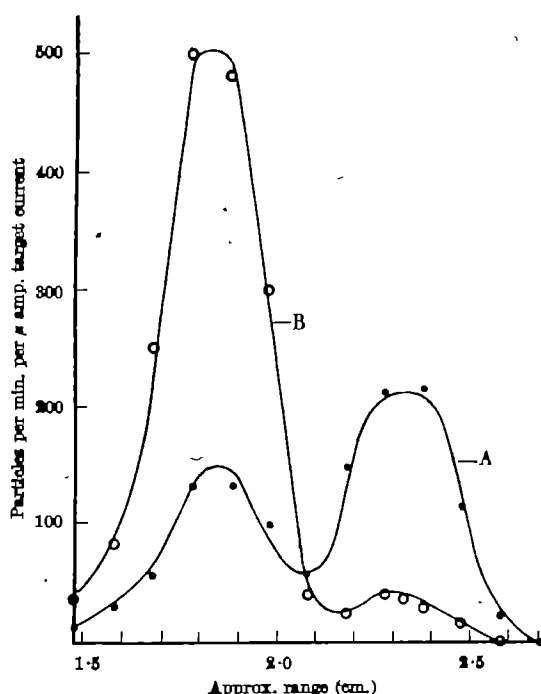
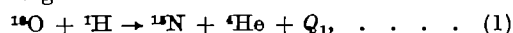


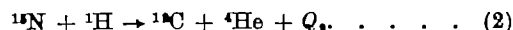
FIG. 2.

resonance character of the group makes its observation difficult, as it does not appear at bombarding energies below 300 kv. and is obscured by scattered protons above 400 kv. There is, however, a definite γ -ray resonance between these two voltages, and the occurrence of this peak in the α -particle excitation function indicates that these particles must be associated with the γ -radiation. A further discussion of the interpretation of the γ -ray process has already appeared².

In the course of this work, the emission of groups of α -particles of mean ranges 2.07 ± 0.05 cm. and 2.57 ± 0.05 cm. at 500 kv. bombarding energy was also observed from fluoride targets. These groups were also obtained from a carbon target, and it was suspected that they were due to nitrogen and oxygen contamination. Confirmation of this view was obtained by passing the proton beam from the accelerating tube through a thin aluminium window into a mixture of nitrogen and oxygen. The range distribution of the disintegration particles was investigated with a shallow ionization chamber. Curve A of Fig. 2 shows the α -particle groups obtained from air, and curve B those from a mixture of 20 per cent nitrogen and 80 per cent oxygen. The intensity ratio changes in the manner expected assuming the 2.07 cm. group to be due to the transmutation of oxygen and the 2.57 cm. group to that of nitrogen. These groups have therefore been interpreted as due to the disintegration of the rare isotopes of oxygen and nitrogen in accordance with the reactions



and

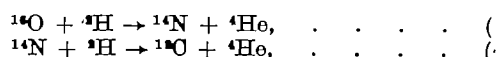


The observed energy releases are $Q_1 = 3.96 \pm 0.15$ Mv. and $Q_2 = 5.00 \pm 0.15$ Mv.

The mass of ^{15}N has been determined by Bainbridge and Jordan³ from the mass-spectrograph doublet $^{15}\text{N}^1\text{H} \rightarrow ^{15}\text{N}$ and is given as 15.0050 ± 0.0003 ,

assuming that the mass of ^1H is 1.0076 ± 0.0001 . This value of ^{15}N agrees with that obtained from disintegration data⁴, and combining it with the observed value of Q_1 , we obtain a value of 18.0050 ± 0.0004 for the mass of ^{16}O . The mass of this isotope has been given by Aston⁵ as 18.0057 ± 0.0002 and by Mattauch⁶ as 18.00376 ± 0.0002 , and the present determination thus tends to support an intermediate value.

There is considerable discrepancy between the various values which have been obtained for the mass of ^{16}O ; Aston gives 12.00355 ± 0.0001 , Bainbridge gives 12.00402 ± 0.00017 and from disintegration data given by Cockcroft and Lewis⁷ for the reactions:



a value of 12.0043 is obtained using Aston's value for the masses of ^4He and ^1H . From the observed Q_2 we calculate that the mass of ^{16}O is 12.0038 ± 0.0004 , assuming Bainbridge's mass of ^{15}N . Our value for the mass of ^{16}O is thus based ultimately on Bainbridge's mass of ^{15}N , which is in agreement with the value obtained from reaction (3). The energy release found by Cockcroft and Lewis for reaction (2) enables the mass of ^{16}O to be calculated directly from that of ^{17}N , and this gives a value of 12.004 in good agreement with our value.

W. E. BURCHAM.
C. L. SMITH.

Cavendish Laboratory,
Cambridge.
April 22.

- ¹ Curran, Dee and Petrillka, *Proc. Roy. Soc., A*, **180**, 269 (1938).
² NATURE, **143** (759) (1939).
³ Halpern and Crane, *Phys. Rev.*, **55**, 290 (1939).
⁴ Burcham and Smith, *Proc. Roy. Soc., A*, **168**, 176 (1938).
⁵ Bainbridge and Jordan, *Phys. Rev.*, **51**, 384 (1937).
⁶ Cockcroft and Lewis, *Proc. Roy. Soc., A*, **154**, 246 (1936).
⁷ Aston, *Proc. Roy. Soc., A*, **168**, 403 (1937).
⁸ Mattauch, *Phys. Rev.*, **50**, 617 and 1089 (1935).

The Meson and its Transformation into Heavy Particle

THE meson or mesotron was first introduced by Yukawa to serve as the connecting link between β -ray disintegration and the forces responsible for nuclear binding. Subsequent work has identified it with the penetrating component of the cosmic rays but the meson has not so far been observed in nuclear reactions (apart from cosmic rays), for the necessary energy of about 100 Mev. has not been available except in the recent experiments on the fission of the uranium nucleus, which, however, have not so far been investigated in sufficient detail to make a definite conclusion possible.

Following Yukawa, the meson is assumed to obey the Bose statistics. This is necessary if the neutron-proton interaction is brought about through the meson only; but if the existence of neutral particles called neutretos¹, be also postulated, then the proton-neutron interaction will be brought about through the exchange of a meson and a neutretto, and will lead to two alternatives for the statistics obeyed by the intermediate particles: (1) both the meson and the neutretto obey Bose statistics; or (2) both obey Fermi statistics. Case (1) corresponds to that studied in detail by Bhabha, Heitler, Kemmer and others but possibility (2) has not been fully explored, and therefore, the statement that the meson obeys Bose

statistics can at the present stage be regarded only as an assumption.

The spontaneous transformation of a meson into an ordinary electron and neutrino has been discussed theoretically¹, and the 'decay period' has been found to be in reasonable accord with observations on the meson absorption anomaly for cosmic rays. We have considered the possibility of a meson being transformed into two heavy particles, a proton and a neutron. The initial energy of the meson must of course exceed about $2Mc^2 \sim 2 \times 10^6$ ev., M being the proton mass, to provide the proton and neutron rest-masses. The transformation probability is proportional to g^2 , where g is the usual constant (dimension, electric charge) characterizing the strength

of the nuclear field surrounding a neutron or a proton. This probability comes out to be very high, and it seems that the protons and neutrons found in cosmic rays are possibly due to the spontaneous transformation of mesons of very high energies.

R. C. MAJUMDAR.

Bose Research Institute,
Calcutta.

D. S. KOTHARI.

University of Delhi,
Delhi. Feb. 14.

¹ Arley and Heitler, *NATURE*, **142**, 168 (1938). These authors assume the neutrinos to follow Bose statistics.

² Baker, H., and Heisenberg, W., *Hydrog. exalt. Neutrons*, **17**, 27 (1938).

PHYSICS AND CHEMISTRY

Preliminary Report on the Masses of ^{12}C and ^{14}N

WITH a newly constructed mass-spectrograph of Bainbridge and Jordan type¹, we measured the mass differences of $^{12}\text{CH}_4 - ^{16}\text{O}$ and of $^{12}\text{CH}_4 - ^{14}\text{N}$. These ions were produced by electric discharge through a mixture of methane, carbon dioxide and air in a cylindrical discharge tube of the usual type. In addition to these doublets, lines of NH_3 , NH_4^+ , CH_3 , H_2O , H_2O^+ were also simultaneously obtained on the same plate. Photographic plates employed in this work were prepared from the commercial process plates by Schumannization, 10–20 seconds being sufficient for photographing spectral lines on these plates.

By measuring every interval of these lines with $\lambda = 1.008$, a dispersion coefficient at every point on the plate was determined empirically as accurately as we wanted.

Since difference in dispersion coefficient at various parts of the plate was found to be very slight, and moreover no systematic error took place during the measurement, the determination of dispersion coefficient with our method can be quite justified, and the following results were obtained:

Doublet	Number of doublets measured	Difference of mass
$^{12}\text{CH}_4 - ^{16}\text{O}$	16	0.03642 ± 0.00009
$^{12}\text{CH}_4 - ^{14}\text{N}$	88	0.01257 ± 0.00006

From these results and Aston's $^1\text{H} = 1.00812 \pm 0.00004$ ², isotopic masses of ^{12}C and ^{14}N can be calculated as follows:

$$^{12}\text{C} = 12.00394 \pm 0.00018.$$

$$^{14}\text{N} = 14.00761 \pm 0.00021.$$

A full account will be published elsewhere.

T. ASADA.
T. OKUDA.
K. OGATA.
S. YOSHIMOTO.

Department of Physics,
Osaka Imperial University,
Osaka.

March 23.

¹ Bainbridge and Jordan, *Phys. Rev.*, **50**, 282 (1936).
² Aston, *Proc. Roy. Soc., A*, **162**, 891 (1937).

Discrepancies in the Isotopic Weight of ^{12}C

OF some forty isotopic weights so far determined by the doublet method, more than half depend on that of ^{12}C as a substandard. As chairman of the International Committee on Atoms, I am anxious that some agreement should be reached on this isotopic weight to enable a satisfactory table to be adopted. Ill-health has prevented me making any further measurements for the past year, but Mattauch has recently published results¹ indicating that my value 12.00355 ± 0.00015 is too low. He gives as his own 12.003876 ± 0.000032 , closely agreeing with Bainbridge and Jordan's latest value, 12.00398 ± 0.00009 . Much as I regret being compelled to criticize the results of other workers, I feel it may be well to explain some of the reasons which prevent me accepting the high value with entire confidence.

My first criticism concerns the accuracy claimed. My own figure corresponds to an uncertainty of position of a line on the photographic plate of 0.0075 mm., Bainbridge's to 0.0045 mm.; Mattauch's, owing to the much smaller dispersion of his apparatus, to 0.0003 mm., which seems very small for photometric measurements. My second and more important criticism is the possibility of some systematic error in the instruments. The fundamental discrepancy in the doublet $\text{O}-\text{CH}_4$ could be explained by supposing that my apparatus gives the mass of the molecule too low relative to that of the atom, or that the other types give it too high. What evidence is there for either of these possibilities? Suspicious of the first, I checked the mass of ^{12}C by as many different methods as possible². One, the doublet $\text{CO}-\text{C}_2\text{H}_4$, only used molecules and others only used atoms; all gave results consistent with my low value, which was further supported by more measurements of the doublet $^{44}\text{A}-\text{C}_2\text{H}_4$ ³ and by work on ^{46}Ti ⁴.

The three doublets $\text{CO}-^{14}\text{N}$, $\text{C}-^{10}\text{BH}_3$, and $^{22}\text{Ne}-\text{CD}_4$ quoted by Mattauch to check his high value are neutral in their evidence, for it so happens that if my values for all the atoms concerned are put in, the agreements are equally good.

To use a loose optical analogy, Mattauch and Bainbridge's double focusing is related to my single focusing as a lens to a pin-hole. The lens gives greater sharpness, higher resolution and in most cases higher accuracy, but it may on the other hand

produce distortion not likely with a pin-hole. In connexion with such possible distortion, several points may be noted. The first is the asymmetry of the lines in the O—CH₃ doublet which caused Bainbridge to reduce his first estimate of 0.0369 ± 0.0002 for the difference in mass⁸ to 0.03649 ± 0.00008 , which was very nearly halfway to mine, 0.03601 ± 0.00016 . Then Mattauch⁹ states that in his measurements of the N—CH₃ doublet his plates were unaccountably inconsistent, some agreeing better with my value of this doublet than with Bainbridge's.

Two other cases are of interest. Mattauch⁹ measured the doublet ¹⁸O—¹⁸OH, obtaining a value for the mass of ¹⁸O of 18.0037 ± 0.0007 . My own measurements⁸ of this doublet indicate a higher value, 18.0057 ± 0.0002 , in much better agreement with the best optical determination of Babcock and Birge¹⁰ of 18.0065 ± 0.00018 .

In 1937 Mattauch, in collaboration with Hahn, demonstrated the formation of ⁸⁷Sr in rubidium material. In connexion with this piece of work, which I consider one of the most beautiful ever made in the application of mass-spectra to chemical problems, he measured¹² the doublet ⁸⁷Sr—⁸⁶SrF, and found a difference of packing fraction of 9.0 ± 0.5 . It is now known that the packing fraction of the comparison molecule is very exactly zero, but from Dempster's packing fraction curve¹¹ and the measured value for the isobare ⁸⁶Kr², which is -7.40 , or -7.13 if we use the high value of ¹³C, it seems reasonably certain that so large a negative value as -9.0 is inadmissible. It will be noted that both these discrepancies are of the same sign and suggest the same explanation.

Considerations such as these make me doubt the wisdom of adopting a value depending on measurements of one doublet only. I checked my value with the doublets CO—C₂H₄, ⁴⁴A—C₂H₄, ⁴⁴A—C, and ⁴⁴A++—OH₂. Measurements of these with a double focus mass-spectrograph would be of great help in the present uncertainty. In the meanwhile, it is a matter of some satisfaction that the whole difference remaining amounts to 27 parts in a million—only twice my estimated error.

F. W. ASTRON.

Cavendish Laboratory,
Cambridge.
April 29.

¹ *S. tech. Phys.*, **12**, 578 (1938).

² *NATURE*, **139**, 923 (1937).

³ *Proc. Roy. Soc., A*, **153**, 391 (1937).

⁴ *NATURE*, **141**, 1096 (1938).

⁵ *Phys. Rev.*, **40**, 883 (1936).

⁶ *Rev. Mod. Phys.*, **9**, 309 (1937).

⁷ *Nature*, **95**, 747 (1937).

⁸ *Phys. Rev.*, **50**, 617 (1936).

⁹ *Phys. Rev.*, **37**, 233 (1931).

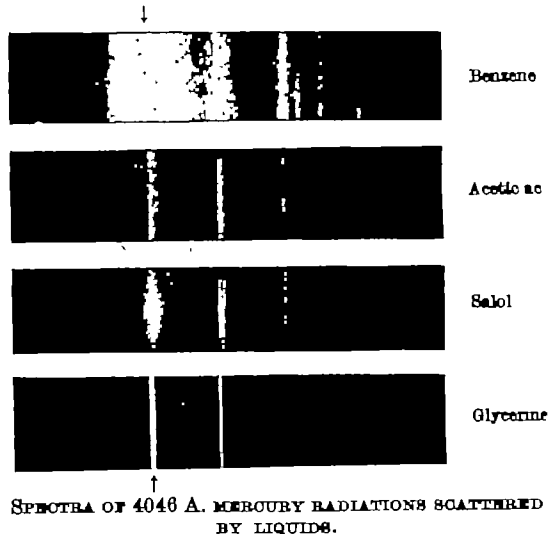
¹⁰ *Nature*, **95**, 170, 189 (1937).

¹¹ *Phys. Rev.*, **53**, 870 (1938).

Rigidity of Liquids

As was reported by us in a recent note¹, the monochromatic radiations of the zinc arc, namely, 4680, 4722, 4810 Å., diffused longitudinally by liquid glycerine at 26° C., revealed, on either side of the primary lines, the presence of sharply defined displaced components in the spectrum of the scattered light. The spectral shifts of these components is 0.52 cm.^{-1} , corresponding to a modulation frequency of $1.53 \times 10^{10} \text{ sec.}^{-1}$.

On the basis of the usual Brillouin formula, the velocity of the acoustic waves giving rise to the components comes out as 2500 metres per sec. This is considerably higher than the ultrasonic velocity of 1910 metres per sec. as determined for glycerine at the same temperature for longitudinal waves of frequency 10^7 sec.^{-1} , generated by the piezo-electric method. That sound waves of such high frequency as 1.53×10^{10} should be observable at all in liquid so highly viscous as glycerine is unintelligible on the classical hydrodynamics. It appears to me that Clerk Maxwell's concept² of fluid viscosity as fugitive elasticity resolves this difficulty and, in addition, offers a ready explanation for the observed great difference between the velocities for 'hypersonic' and 'supersonic' waves.



SPECTRA OF 4046 Å. MERCURY RADIATIONS SCATTERED BY LIQUIDS.

It is clear that if a liquid possesses rigidity, the velocity of propagation of the longitudinal wave of sufficiently high frequencies would be $\sqrt{\frac{k + 4/3}{\rho}}$

instead of $\sqrt{\frac{k}{\rho}}$, k and n being the bulk modulus and

rigidity modulus respectively of the liquid. Taking these two expressions as giving the velocities of sound in the hypersonic and ultrasonic ranges of frequency respectively, the bulk modulus comes out as 4.6×10^{10} and the rigidity modulus as 2.4×10^{10} , the former agreeing closely with the reciprocal of the directly observed adiabatic compressibility.

The foregoing explanation of our results finds strong support from the fact that the time of relaxation calculated from the viscosity and the rigidity of glycerine, by using the Maxwell formula $\eta = n \cdot \tau$, comes out as $3.5 \times 10^{-10} \text{ sec.}$, which is much larger than the actual value of the time period, $0.65 \times 10^{-10} \text{ sec.}$, of the observed Debye waves. Further, we have found that with rising temperature, the divergence between 'hypersonic' and 'ultrasonic' velocities of glycerine diminishes, as is to be expected from the rapidly falling viscosity and the consequent diminution of the relaxation time.

Our observations thus seem to establish, experimentally, the thesis that for mechanical disturbances of sufficiently high frequencies, a liquid behaves essentially as a solid. On the basis of this thesis, becomes easier to understand the general relation

between light-scattering and fluid viscosity, illustrated in the accompanying spectra of light scattered by four liquids of increasing viscosity, namely, benzene, acetic acid, salol, and glycerine, all of which depolarize light strongly. It will be noticed that in the spectrum of glycerine the rotational 'wings' accompanying the Rayleigh line, which are so prominent in feature with the more mobile liquids, are almost completely absent, thus indicating that, in respect of light-scattering, glycerine is practically indistinguishable from an amorphous solid.

O. V. RAMAN.

C. S. VENKATESWARAN.

Department of Physics,
Indian Institute of Science,
Bangalore.

April 1.

Raman, O. V., and Venkateswaran, C. S., *NATURE*, 142, 791 (1938).
Jack Maxwell, "Scientific Papers", Vol. 2, "Dynamical Theory of Gases", 31.

Anomalous Properties of some Anhydrous Salts of the Iron Group at Low Temperatures

It has been established in the Leyden Laboratory¹ that the susceptibility of nickel, cobalt, ferrous and chromium chlorides at the temperatures of liquid hydrogen depends on the intensity of the magnetic field.

It has been found in our laboratory² that all these substances show jumps in the specific heat similar in shape to those exhibited by ferromagnetics. These facts have led to the view that the anomalies observed, namely, dependence of the susceptibility on the field and the jumps of the specific heat, might be due to a transition of the salts from the paramagnetic to the ferromagnetic state. A detailed investigation of the temperature dependence of the susceptibility, carried out by us, showed that the ferrous and cobalt chlorides and cobalt iodide exhibit at the temperature of the specific heat jump a maximum of susceptibility the position and sharpness of which depends on the intensity of the magnetic field, and in such a manner that on increasing the field the maximum shifts to the lower temperatures. This fact does not fit in with the usual notions of ferromagnetism. The low value of the susceptibility and the absence of signs of saturation in these salts are likewise inconsistent with the hypothesis of ferromagnetism.

It seems possible to explain the dependence of the susceptibility on the field, the anomaly of the specific heat and the temperature dependence of the susceptibility by the 'quenching' of the orbits of metallic ions in the electric field of the crystal, a concept introduced by Stoner. The dependence of the susceptibility on the field is then accounted for by the external magnetic field forcing out the orbits from their quenched states, that is, increasing the effective number of the carriers of magnetism. The temperature influences the quenched orbits in the same sense, namely, increase of the temperature diminishes the effectiveness of the crystalline field. The existence of the maximum of susceptibility is accounted for by the increase of the effectiveness of the electric field due to the lowering of the temperature, and its location is determined by the internal electric field, the temperature and the external magnetic field. As the latter two are disturbing factors with regard to the quenching of the orbits in the crystalline field, the increase of one of them,

say, of the magnetic field, diminishes the temperature of the maximum. The jump in the specific heat is due to the orientation of the orbital moments in the crystalline field.

Investigations of the magneto-caloric effect and the specific heat of ferrous and cobalt chlorides in magnetic field, carried out by G. Miljutin and S. Shalyt, show that at temperatures below that of the susceptibility maximum the magneto-caloric effect is negative, that is, the salt cools when the magnetic field is applied and vice versa. The position and magnitude of the specific heat jump depend on the intensity of the magnetic field. These new facts support the hypothesis of the quenching of the orbits and cannot be explained by the ordinary transition to the ferromagnetic state.

A detailed description of the results obtained will appear in the *Journal of Experimental and Theoretical Physics* (Russian).

S. SHALYT.

Ukrainian Physico-Technical Institute,
Kharkov.
March 21.

¹ *Loid Comm.*, 29 b; 173 b; 173 c; 201 a.

² *Sov. Phys.*, 7, 66 and 255 (1935); 9, 237 (1935).

Experiments on Pumping Liquid Helium to Low Temperatures

TEMPERATURES sensibly lower than those usually attained by pumping liquid helium are accessible now that the design of apparatus can take into account the known characteristics of the creeping film phenomenon¹ of liquid helium II. In a previous paper² it was shown that temperatures below 0.8° K. could be reached very simply by constricting the lower part of the pumping tube, to restrict the creeping of the helium II film. We suggested that still lower temperatures might be attained by using a membrane pierced by a small hole instead of the constriction tube. The advantage of this design is that it reduces the film flow while offering the minimum impedance to the flow of gas evaporating from the surface of the liquid owing to the normal heat influx.

Experiments in which the hole was 0.15 mm. in diameter have confirmed this suggestion: using an ordinary laboratory pump of speed 10 litres/sec., we obtained a temperature of 0.73° K. in a vessel of 4 c.c. capacity. The temperature was measured magnetically using chrome alum as thermometer, and calibrating its magnetization (corrected to that of a sphere³) against temperature between 4° K. and 1.5° K., as given by Keesom's 1932 vapour pressure curve⁴.

There is at present an uncertainty of some hundredths of a degree in the value of the temperature reached. If Keesom's 1937 vapour pressures⁵ are used in the calibration, the figure for the temperature becomes 0.76° K. Some of the values on the 1937 curve are probably in error, however, for application of the Clausius-Clapeyron equation leads to improbable thermal properties of helium gas. Also, careful measurements of vapour pressure against the susceptibility of paramagnetic salts (which form a more adequate thermometer in this region than can a gas thermometer) indicate that there is some inconsistency in both vapour pressure curves. (This question is being further investigated in the Clarendon Laboratory.) The same uncertainty, of course, applies

also to previous experiments⁴ on the lowest temperatures attained by pumping liquid helium (0.71° on the 1932 scale), so we can state that the region of temperature hitherto available only with the elaborate apparatus of these earlier experiments is now accessible with the simple means described.

As the pierced membrane used in the above experiment offers an appreciable resistance to gas flow, we are now engaged on experiments to determine the size of membrane hole best suited to different conditions of heat influx to the apparatus. For this purpose the normal heating (that is, by gas conduction and radiation) to vessels less well insulated is simulated by enclosing an electrical heating coil in the helium vessel. These experiments have shown that a hole of 0.15 mm. diameter is too small unless the heat influx can be reduced below 1 millical./min. For example, a heat influx of 3.5 millical./min., which is roughly that occurring in our ordinary 30 c.c. vessel for demagnetization experiments, gives a temperature of 1.06° K. with a 0.15 mm. hole, while with a bigger hole it is again possible to reach below 0.8° K.

A complete account of these experiments will be given later.

A. H. COOKE.

R. A. HULL.

Clarendon Laboratory,
Oxford. April 4.

¹ Bollin, B. V., and Simon, F., *Physica*, **6**, 219 (1939).

² Blaise, B. S., Cooke, A. H., and Hull, R. A., *Physica*, **6**, 231 (1939).

³ Kúrdi, H., and Simon, F., *Phil. Mag.*, **26**, 849 (1938).

⁴ Keesom, W. H., *Leiden Comm.*, Suppl. No. 71d (1933).

⁵ Schmidt, G., and Keesom, W. H., *Leiden Comm.*, No. 250c (1937).

⁶ Keesom, W. H., *Leiden Comm.*, No. 219a (1932).

Polymorphism of the Micas and Diffuse X-Ray Scattering of Layer Silicate Lattices

THE first significant work on the structures of the micas was that of Mauguin¹, who measured the units of structure and discussed types of isomorphous replacements. Pauling², on the basis of his co-ordination theory, proposed general structures that were shown by Jackson and West³ to be correct in some detail for muscovite. Mauguin noted that the lattice dimension along the *c* axis of a biotite crystal was apparently one half that of muscovite, and he further observed diffuse scattering of X-rays from several crystal zones.

Muscovite contains close-knit layers approximating $[(\text{Al}_2)\text{AlSi}_3\text{O}_{10}(\text{OH})_2]^+$ in composition that are joined across the cleavage plane by potassium atoms having twelve-fold co-ordination. The unit of structure chosen by Jackson and West is crossed by two such layers related by a glide reflection plane, the crystal symmetry being monoclinic holohedral. Phlogopite results from replacing (Al_2) with octahedral co-ordination by (Mg_2) , which completely fills the octahedral positions; in biotite, (Al_2) is replaced by magnesium and iron.

Examination of many micas now brings to light a great variety of structure. Biotite, phlogopite, lepidomelane, zinnwaldite and lepidolite often have a single layer structure, the crystal symmetry being monoclinic hemihedral. A pseudohexagonal three-layer structure is also frequently found for lepidolites and zinnwaldites. Two-layer structures, similar to but not identical with that of muscovite, have been found for four of the fifty biotite-like samples examined. Several biotite samples were found in which the unit of structure apparently was crossed by six,

eight and ten layers. In the last case, the lattice periodicity is more than 100 Å. in a direction normal to the unique monoclinic axis, which introduces some question about the extent of an element in the crystal mosaic. Twenty samples of muscovite including seven specimens associated with biotite (lepidolite (zoned crystals), all had a two-layer structure, and none showed diffuse reflections.

Many of the biotite-like samples give diffuse scattering of X-rays in $[h, k, l]$ zones for which the *l* index is not a multiple of three. This is a result of random combinations of the various structure. Thus if some elements of the three-layer arrangement are replaced by a two-layer structure, the periodicity along the *c* axis will be destroyed for those planes with the *l* index other than a multiple of three, and reflections from such planes will be broadened. Random elements in the single-layer structure give rise to diffuse scattering but do not prevent close agreement between observed and calculated intensities. In structures of higher layer multiplicity, few random elements make intensity calculation impossible by introducing an indeterminate phase shift, but do not necessarily lead to diffuse scattering as is shown by the layer minerals dickite, talc and pyrophyllite as well as by the micas.

The uniqueness of the muscovite structure is result of its departure from the ideal arrangement proposed by Jackson and West. This departure which is considerable, is shown by the relatively high intensities of reflections from (06 $\bar{l}$) with *l* odd, which should be absent for the ideal structure as they are for the biotites. Incomplete filling of the octahedral co-ordination positions in muscovite leads to distortion of the co-ordination and therefore of the layer. As a result, there is but one way in which the twelve fold co-ordination of potassium between layers can be obtained. In the biotites, complete filling of the octahedral positions gives a regular arrangement within a layer and thus permits various combination of layers. Even the two-layer biotite structures have (06 $\bar{l}$), *l* odd, reflections absent.

The distinction between muscovites and biotites from mineralogical data, has partially been recognized by Winchell⁴. Diffuse scattering of X-rays from the micas has features in common with the phenomenon described by Preston⁵ and Guinier⁶ for alloys. Considerable time will elapse before detailed analyses of the many structures observed can be published.

STERLING B. HENDRICKS.

U.S. Bureau of Chemistry and Soils,
Washington, D.C.

¹ Mauguin, O., *C.R.*, **125**, 228 (1927); **126**, 879, 1131 (1928).

² Pauling, L., *Proc. Nat. Acad. Sci.*, **16**, 123 (1930).

³ Jackson, W. W., and West, J., *Z. Krist.*, **78**, 211 (1930); **84**, 11 (1933).

⁴ Winchell, A. N., *Amer. J. Sci.*, **9**, 309, 415 (1925).

⁵ Preston, G. D., *Proc. Roy. Soc. (London)*, **A**, **166**, 872 (1938) *NATURE*, **142**, 570 (1938); *Phil. Mag.*, **26**, 855 (1938).

⁶ Guinier, A., *C.R.*, **206**, 1641, 1972 (1938); *NATURE*, **142**, 569 (1938).

Interrelation of Dissociation Energy, Internuclear Distance and Bond Order for Carbon-Carbon Linkage

Fox and Martin¹ have found that the heat of dissociation (*D* kgm.-cal.) for different carbon-carbon linkages (organic compounds, graphite, diamond) follows smooth curves when plotted against either the internuclear distance (*r*, angstroms) or bond order *x*. When the assigned values of any pair of the three magnitudes *D*, *r*, *x* are plotted against each other

logarithmically, approximately linear relations are obtained, from the slopes and intercepts on the axes of which it may be deduced that the following relations could hold very approximately:

$$Dr_s^2 = 282 \quad (1)$$

$$x^2/r_s^2 = 3.7 \quad (2)$$

Fox and Martin¹ have independently deduced the relation Dr_s^2 equals a constant, by a semi-empirical method, as consistent with a potential energy function of a simple form recently proposed by Sutherland, and with a modified Morse-Clark relation connecting bond constant k_s with r_s . It is of interest to note that the latter type of relation, originally devised for spectroscopic diatoms only, is found to have application to molecular linkages. This has also been shown by Thompson and Linnett².

In the last two columns of the table below, r_s is calculated from D , and x from r_s (calc.), using (1) and (2).

C—C link oethylene and spectrum	D	r_s	x	Dr_s^2	x^2/r_s^2	r_s (calc.)	x (calc.)
ethylene	161	1.204	2	281	3.03	1.205	3.07
ethylene	126.8*	1.208	2	284	3.55	1.305	2.15
ethylene	125.1	1.23	2	294	3.74	1.31	2.10
ethylene	105.3	1.40	1.02	289	3.78	1.39	1.02
graphite	100	1.42	1.45	286	3.67	1.41	1.50
diamond	76	1.54	1	274	3.65	1.55	0.98
hydrocarbons	71.8	1.56	1	270	3.76	1.58	0.91

* Approximate assignment for C_2 by Mulliken³ (5.5 volts).

It should be mentioned that the data involve the uncertain heat of sublimation of carbon (S kgm.-cal.). The D values above depend partly upon the estimate of Sidgwick and Bowen⁴, $S = 150$. If we follow Fox and Martin and take the true value to be $S = 150 + q$, where q is unknown, it is found that the slope and degree of linearity of the logarithmic Dr_s^2 lines are little affected by changes in q over a wide range from $q = -20$ to $+100$. The best exponents for r_s in (1) range from about 2.9 to 3.4 as q changes from -20 to $+40$, with corresponding changes in the constant term of (1). If we adopt Herzberg's⁵ value $S = 124$, the r_s exponent in (1) is 2.8, so that the form of the relation is practically unaffected. The value $S = 140$ makes Dr_s^2 as nearly constant as possible, and the constant in (1) takes the general form $282 + 2.13 q$. The relation (2) is independent of S .

Fox and Martin have obtained good additive relations for the heats of formation of various organic compounds on the basis of their assignments to individual linkages on the assumption that the C—C (and C—H) single bond energies are constant. The accurate work of Rossini⁶, however, indicates that even in paraffin hydrocarbons, C_nH_{2n+2} , these linkages differ slightly in D values, and that only for n greater than 5 is the increment in D for each CH_2 added constant. It is hoped that the present work may assist in the task of assignment of individual linkage contributions more accurately than is at present possible.

O. H. DOUGLAS CLARK.

Department of Inorganic Chemistry,

University, Leeds.

March 27.

¹ Fox, J. J., and Martin, H. A., *J. Chem. Soc.*, 2106 (1938).

² Privately communicated.

³ Thompson, H. W., and Linnett, J. W., *J. Chem. Soc.*, 1384 *et seq.* (1937).

⁴ Mulliken, R. S., *Rev. Mod. Phys.*, 4, 1 (1933).

⁵ Sidgwick, N. V., and Bowen, H. J., *Ann. Rep. Chem. Soc.*, 367 (1931).

⁶ Herzberg, G., *Chem. Rev.*, 30, 145 (1937).

⁷ Rossini, F. D., *Bureau Stand. J. Res.*, 18, 21 (1934).

Demonstration of Optical Interference Figures

It is not generally known that by using 'Polaroid' filters of sufficient size (1½ in. to 2 in. diameter), optical interference-figures afforded by crystals in convergent polarized light—most difficult subjects to project satisfactorily on a screen—are obtained in a simplified manner with results exceeding in clearness and brilliance those got by the older apparatus.

As shown in Fig. 1, the left-hand side consists of the usual source of light, L , either arc or coiled-filament lamp, W , a water-cell, Ab , an ordinary Abbe condenser and S , the stage. P is the polarizer,

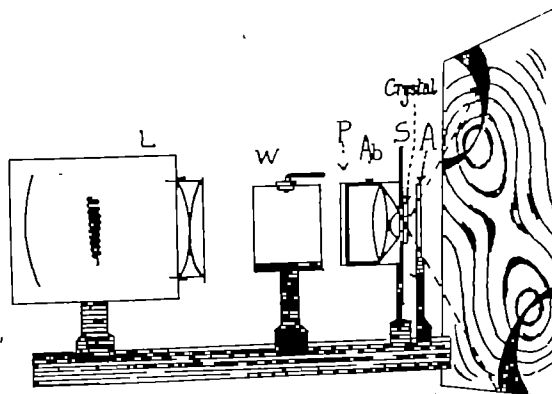


Fig. 1.

SKETCH OF PROJECTION APPARATUS USING 'POLAROID'. NOTE SIMPLIFICATION OF THE R.H.S.

large enough to give full scope to the width of the Abbe. This is standard practice, except that a 'Polaroid' filter may be used for P . The departure from the usual practice is in having no lenses whatever between crystal and screen, in fact, nothing but the largest available 'Polaroid', A . A large, even interference figure results, and if A is placed close to the specimen, the full aperture of the Abbe is made use of. Actually, the optic axes of Rochelle salt can just be brought in ($2E = 120^\circ$). For intermediate optic axial angles, for example, mica, sanidin, borax, etc., the results are excellent. With uniaxial figures, up to 36 rings have been counted, under optimum conditions. Figs. 2 and 3 are from actual photographs of the screen itself with the figure projected on it. The screen should not be more than a foot from the

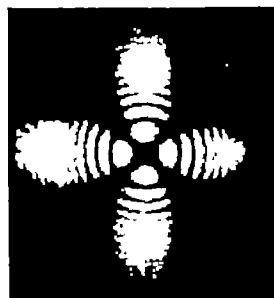


Fig. 2.

PHOTOGRAPH OF SCREEN WITH UNIAXIAL FIGURE FROM KH_2PO_4 PROJECTED ON IT.



Fig. 3.

PHOTOGRAPH OF SCREEN WITH BIAxIAL FIGURE FROM MICA CLEAVAGE.

analyser for large $2H$ values, but may be any distance for uniaxial crystals. A translucent screen, with the glass on the far side, is better for a 'front' view.

The apparatus used by me was a microprojector, supplied by Flatters and Garnett of Manchester, a 3-ft. circle being well illuminated with a 48-watt, low-voltage lamp. Cheaper grades of 'Polaroid' are also effective.

H. E. BUCKLEY.

Crystallography Department,
The University,
Manchester.

Measurement of the Amount of Steam Escaping from Areas of Volcanic or Solfataric Activity

ON the slopes of Mt. Tongariro in the Tongariro National Park, New Zealand, there is a remarkable area of solfataric activity called Ketetahi Hot Springs. One of the most noteworthy features is the column of steam arising from the vigorous fumaroles of this area. This column of steam has

cloud, and the velocity of ascent in calm weather or of sideways dispersion by wind, were determined in various ways. From the Ketetahi hut, about $\frac{1}{2}$ mile distant, the steam appears as two columns, which at about 80 per cent humidity are 100 metres and 50 metres in diameter respectively. The rougher measurement was that of the size of the cloud. I had to be assumed that the cloud was circular in cross-section. For vertical ascent the diameter was estimated, and in a strong wind the diameter of the horizontal cloud could be determined with the aid of an inclinometer. The velocity in calm weather could be found from the observation from the hut of the time for the cloud to rise to the height of the summit of Te Mari, and in a wind, from the time to blow over the face of Tongariro. Measurements were also made at the active area with an anemometer. Here, on the driest day, the size of the cloud from the individual fumaroles was estimated on the field and from a photograph. A final assumption was that the temperature in the cloud was the same



CRATER OF WHITE ISLAND.

[Photo by Dr. P. Marshall]

been noted by Hochstetter¹, who gave a drawing of the volcanic peaks from Ongarue, 36 miles away, and in this the column was clearly shown. Thomas² stated that it was visible for fifty miles, and although it has not been possible to check this, the statement is probably still correct in favourable circumstances.

In March 1935, I attempted, among other physical and chemical investigations at this area, to estimate the amount of steam escaping. The method was based on the fact that the actual amount of water in the droplets forming a cloud is small in comparison with the water present as vapour in saturated air. The droplets, however, define the extent of the air saturated with water vapour from the fumaroles. If the original humidity be known, and the cross-sectional area and velocity of the cloud be observed, it should be possible to calculate the output of the fumaroles. The water present as droplets is of importance only if the original humidity be high. In observations by Köhler³ on ordinary clouds, the amount ranged from 0.12 gm. to 0.96 gm. per cubic metre. As a mean, an addition of 0.5 gm. was made to allow for the visible droplets.

Observations were made at humidities from 60 to 96 per cent, determined by wet- and dry-bulb thermometers in an improvised screen. The size of the

as in the surrounding air. This should be approximately correct at a sufficient distance from the fumarole. In calm weather, the rise of the column is assumed to be due to the lower density of saturated air, and not to a difference of temperature. The results of various estimates ranged from 30 lb. to 120 lb. of steam per second. The best value was taken as 50 lb. per second or 180,000 lb. per hour, which is about the yield of a small steam well in Tuscany or California. For comparison, it may be mentioned that the steam required to heat the water in the hot stream flowing from the area was only 0.6 lb. per sec.

In November 1938, Dr. P. Marshall made arrangements for a visit to White Island, the active volcano in the Bay of Plenty, and invited me to assist him on the chemical side. To reach White Island, a launch trip of fifty miles on the open sea is necessary, and the bad landing made possible a stay of only $1\frac{1}{2}$ days. In this short time, with much other work to be done, only very rough observations could be made. Four main columns of steam, 120, 60, 30 and 20 metres in diameter were observed. From the humidity and the time to rise to the level of the crater rim, the output was estimated as 1,000 lb. per second. This would make the area twenty times as active as Ketetahi, a not unreasonable estimate.

In view of the great importance of water vapour in all volcanic phenomena, it was thought desirable to direct attention to this method of estimating the activity of solfataric and volcanic areas. With suitable instrumental aid, and more time for thorough observations than was available, the method might be used for comparing the activities at different localities and recording changes in the activity of areas under observation at intervals.

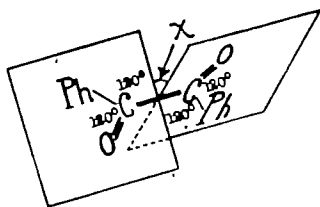
STUART H. WILSON.

Dominion Laboratory,
Department of Scientific and
Industrial Research,
Wellington, N.Z.

Hochstetter, "Reise der O. F. Novara", Geol. Teil, 1 (Wien, 1864).
Thomas, *Trans. N.Z. Inst.*, 20, 306 (1888).
Köhler, *Geophysikalische Publikationen*, 5, 1 (1930).

Benzil—a Skew Molecule?

THE values of the dipole moments of benzil and phenanthraquinone in various solvents, determined by us, and summarized below, suggest that the former molecule has a skew configuration in which the two $\text{C}_6\text{H}_5-\text{O}=\text{O}$ units lie in planes which are nearly mutually perpendicular (see figure).



Solvent	Benzil	Phenanthraquinone
n-Hexane	3.4 D.	—
Dioxan	5.7 D.	5.6 D.
Carbon tetrachloride	3.6 D.	—
Benzene	3.7 D.	5.5 D.
Carbon disulphide	3.4 D.	5.5 D.

This is seen if a certain structural similarity between benzil and phenanthraquinone be assumed, because then the moment of the latter can be taken as that of the completely *cis* form of the former, whence the component moments acting in the directions of the $>\text{C}=\text{O}$ links are each of 3.2 D. magnitude. Knowing this, the effective degree of departure of benzil from a co-planar model can be calculated, since, from symmetry, during rotation of the two benzoyl groups, only those resolved acting at right angles to the axis of rotation will contribute to the experimentally measured resultant; hence—if the two rotatable halves of the molecule are set in planes making an angle χ° with one another—this resultant is given approximately by $\mu = 3.2 \cdot \cos 30^\circ \sqrt{2(1 + \cos \chi)}$, from which values of χ between 90° and 100° are obtained by substitution of the results in the accompanying table.

If this conclusion is correct, benzil is the third molecule for which a 'skew' configuration seems to be necessary, the previous two¹ being hydrogen peroxide and hydrazine. We think that the reasons advanced by Penney and Sutherland¹ for the last cases, however, cannot apply to benzil, which is probably a molecule the shape of which is set by

the superposition of electrostatic and steric repulsive forces (tending to produce a *trans*-structure) and van der Waals' attractions (tending to produce a *cis*-structure). In connexion with this point, it is relevant to note that published data² show that diacetyl, for which the van der Waals' attractions must be weaker than for benzil, has a definitely greater χ angle (130° – 140°).

C. C. CALDWELL.

R. J. W. LE FEVRE.

University College,
London, W.C.1.
April 1.

¹ Penney and Sutherland, *Trans. Faraday Soc.*, 30, 806 (1934).
² Zahn, *Phys. Rev.*, 43, 231 (1932).

The Vector Map of the Cyclol C₃ Molecule

THE vector map of a projection of the cyclol structure O_3 , prepared by D. P. Riley and I. Fankuchen¹ provides elaborate illustrations of the rudiments of map theory. Particularly it is to be noticed that the weaker of the two peaks in the map is not the projection of a peak which could be observed in an equally coarse vector map of the skeleton in three dimensions. In this respect, the diagram illustrates a distinction between dominant features of a crude map and precise details of a complete map: in a complete map of a projection, every point against which there is an entry is necessarily the projection of some point in space against which there is an entry in the complete three-dimensional map.

If vector maps are to be utilized in science, care must be taken that the assurance proper to the realization that the nature of the relation between a point structure and its vector map is a problem in pure mathematics is not transferred to assertions which have no mathematical basis. When Riley and Fankuchen say that their projection "could reasonably be expected to bear some resemblance to that due to the whole molecule", I can only point out, by way of warning, that if the four triangular faces of the O_3 skeleton were omitted, much more than one third of the skeleton would remain, but the peaks of Riley and Fankuchen's own map would no longer emerge.

Again, there are no mathematical grounds for the statement by Riley and Fankuchen that side-chains roughly perpendicular to the plane of projection "cannot alter the fundamental pattern of the vector map". Even a few side-chains perpendicular to the plane can easily alter the intensity of every entry and therewith alter the shape of every contour and destroy or create recognizable peaks.

I am not, of course, presuming to suggest that Riley and Fankuchen's expectations may not be justifiable somehow for the particular case with which they are dealing, or to deny that when the structure of insulin is known the effect of the side-chains in the vector map may turn out to be as slight as the writers affirm. I am concerned only to protest, in view of the setting in which they have been displayed, that neither expectation nor affirmation can claim the support of general mathematical theory.

E. H. NEVILLE.

University of Reading.
April 15.

¹ NATURE, 143, 648 (1939).

BIOLOGY

Effects of Veiling Glare in Binocular Vision

T. Murray Martin and R. W. Pickford have reported an experiment on the effects of veiling glare on size perception in monocular vision^{1,2}. A differential veiling glare is often present in fog vision, when one object is seen through more fog than another. The present experiment, which was on binocular vision, dealt with size and distance perception when two similar objects were seen through a veiling glare greater over one object than over the other.

A box blackened inside was divided into two sections by a milk glass panel. Eyeholes in one wall and an opening opposite gave the subject an unbroken field of vision about one metre by two, at three metres distance. In the right-hand section were two 60-watt lamps. Light from either of these, passing the milk glass, produced a veiling glare in the subject's eyes, by reflection from a piece of plate glass set across the left-hand section at 45° to the line of vision. The lamps were set apart so that either produced a glare about twice as intense at one side of the visual field as at the other. The subject saw two white disks 11 cm. in diameter standing about 60 cm. apart on a blackened table, against a black background, lit by a 40-watt lamp above his head. He could vary the distance and apparent size of the disks by pulling strings. They varied slightly in relative height but not in apparent distance apart. Either disk could be used as a standard at 300-cm. distance. The greater glare could be on the right or left. The variable disk could be set initially too far away or too near. The eight possible combinations of conditions were used in turn and an equal number of readings taken for each.

Subjects 1 and 2 were instructed to move the variable until it seemed at the same distance as the standard. They often made a rather wide adjustment, were then dissatisfied and made a narrower adjustment. They said the wide difference represented apparent equality of distance, but left apparent inequality of size. If these attitudes to size and distance alternated unconsciously in fog vision in everyday life it might give rise to serious accidents. The remaining subjects were tested twice, first for distance and then for size perception. All agreed that equality for apparent distance left inequality of apparent size and vice versa.

Subject	Method	Mean reading cm.	Number	S.E. cm.	p.
3 m.	Distance	- 4.1	80	1.20	< 0.01
6 f.	"	+ 7.5	40	1.86	< 0.01
9 f.	"	+ 4.1	40	1.04	< 0.01
5 m.	Size	+ 2.4	24	1.06	0.05-0.02
8 f.	"	+ 0.2	24	2.16	< 0.01

For five of the nine subjects the differential veiling glare had a measurable effect. This is shown in the accompanying table, where the mean positions chosen for the disk under greater glare, measured from the other disk, are given for these subjects. The sexes of the subjects, numbers of readings, standard errors and probabilities of the means are shown. Subject 3 tended to see the veiled disk as if

farther away than the other (working by distance). Subjects 6 and 9 saw it nearer (by distance); subjects 5 and 8 saw it as if larger (by size).

Examination of the results by the analysis of variance enables us to draw the following conclusions: (a) The eight conditions, taken together, produced significant differences for all subjects but 4 and 7, working by distance. (b) The time order, indicating practice, produced no appreciable effect. (c) Change from variable-near to variable-far produced significant effects in subjects 3, 5 and 9, and doubtful in 7 and 8, working by distance; but only in 3 and 6 by size. (d) Change from variable under more to variable under less glare produced significant effects for subjects 3, 6 and 9 working by distance; but only for subject 8 by size. (e) Change from variable left to variable right produced significant effects for all but subject 7 (doubtful) working by distance; and for subjects 3, 6, 7 and 9 by size. (f) The smallness of variances due to interactions of conditions indicates that the factors mentioned above were effectively independent.

All subjects consistently over- or under-shot the mark when working for distance; by size all under-shot it but subject 9, who was inconsistent.

B. BABINGTON SMITH.

Psychology Department,
The University,
St. Andrews.

R. W. PICKFORD.

Psychology Department,
The University,
Glasgow.
April 3.

¹ NATURE, 141, 371 (1938).

² Brit. J. Psych., 30, 91 (1938).

Changes of Average Maternal Age

In a report in NATURE of March 18 of an address delivered by Dr. L. S. Penrose to the Industrial Section of the British Psychological Society on February 8, the following sentence occurs: "When the birth-rate is falling, the average maternal age [average age at child-birth] will probably become greater". In support of this view it is stated that Dr. Penrose estimates the average maternal age in England at the present time at 29 years, whilst, in Japan (with a much higher birth-rate), it is said to be 26 years.

In the case of England and Wales, on account of defectiveness of birth registration prior to the passing of the new Population (Statistics) Act last year, it is unfortunately impossible to estimate accurately the average maternal age for any past period, except perhaps 1921 and 1931, for which certain approximate figures derived from census data are available. For certain European countries, however, the average maternal age at various periods may be readily calculated from published data. The following estimates are derived from figures found in Kucynski's "The Measurement of Population Growth".

It will be seen that, contrary to Dr. Penrose's conjecture, the average maternal age falls along with the birth-rate. Reverting to Great Britain, it happens

TABLE 1. AVERAGE MATERNAL AGE.

Period	Average maternal age	Birth-rate (approximate)
Sweden		
1871-75	32.23	30.7
1891-95	31.78	27.4
1911-15	30.38	23.5
1926-30	29.67	15.9
Denmark		
1878-84	30.84	32.2
1901-05	29.93	29.0
1911-15	29.55	26.1
1926-30	28.93	18.6
France		
1892-97	29.08	22.5
1908-13	28.58	19.5
1928-31	28.10	17.9

That in the year 1855, the first year of compulsory birth registration in Scotland, the information required was relatively complete, and included age of mother. It is, therefore, possible to compute average maternal age for that year. Recently we have made an estimate of specific total fertility rates for Scotland for 1931 (based on the specific legitimate fertility rates published by the Registrar-General for Scotland in the Report for the year 1937) from which the average maternal age for 1931 may be obtained. The resulting figures are shown in Table 2, which also includes figures for England and Wales, 1921 and 1931, based on estimates published by the Registrar-General in the Statistical Review for 1932.

TABLE 2. APPROXIMATE AVERAGE MATERNAL AGE.

Period	Approx. average maternal age	Birth-rate
Scotland		
1855	30.2	31.3
1931	29.3	19.0
England		
1921	30.1	22.4
1931	29.6	15.8

These results show the same trend as the more accurate figures for Sweden, Denmark and France already quoted. There would seem, then, to be little doubt that in England and Wales and in Scotland, as in other European countries, the fall in the birth-rate has been accompanied by a fall, and not a rise, in the average maternal age. Closer examination shows that, in general, the fall in fertility first affects the older married women, and gradually spreads, usually in a remarkably regular fashion, to the younger age groups¹. The effect of this in lowering average maternal age is evidently more than sufficient to balance any rise in the average age of marriage which may have occurred.

It follows that the remarks of Dr. Penrose relating to mongolian idiocy have a significance exactly opposite to that suggested in the article. With the fall in the birth-rate we should expect not an increase, but a fall in the incidence of this congenital abnormality.

R. S. BARCLAY.
W. O. KERMAK.

Royal College of Physicians Laboratory,
Edinburgh.
March 29.

¹ Cf. Barclay and Kermack, *Proc. Roy. Soc. Edin.*, 58, 55-72 (1938).

Variations in Follicle Population Density in the Merino Skin

DURING research on fleece density in the merino, I was impressed with the urgent need for some form of direct observation of the skin structure in studying the follicle and fibre population. Consequently I have in the main adopted histological techniques. However, the suggestion made by Duerden¹ regarding the possible value of observations on the 'grain' surface of leather appealed to me as an even more rapid and direct approach. Through the courtesy of the Wool Industries Research Association, I was able to secure the tanned skin of a South African Cape merino which Duerden had used in his comparative zoological studies of fibre and follicle arrangement in the Ovidæ.



Fig. 1

After preliminary studies to establish the optimum unit area for counting, the order of accuracy of sample counts and a system of sampling, the whole skin was examined at 584 points. From this data the accompanying chart (Fig. 1) was prepared. The intensity of the colour tone is directly proportional to the follicle population density. Regional variations are defined by grouping values per unit area into four arbitrary class intervals (A, B, C and D). The chart is an accurate reduction of the original skin shape and represents rather more than 90 per cent of the fleece area in the living animal. The photomicrographs (Fig. 2) correspond numerically to the points indicated on the chart, the magnification ($\times$ about 6) being uniform. It will be noted that not only is there a progressive reduction in follicle population per unit area in a dorso-ventral direction but also that, corresponding with this reduction, changes

occur in the arrangement of follicles. The dense and more or less uniformly distributed population of the dorsal regions assumes an increasingly distinct linear arrangement ventrally (Sites 1-6). Passing across the margins of the well-defined inguinal and axillary regions (Sites 7-9) these rows become dispersed into isolated groups and single follicles. It is in such regions that the most obvious trace of the primitive trio grouping can be observed. With reduction in density an increase in mean follicle size occurs. It would seem that the values for density of follicle population are arranged with marked bilateral symmetry about the dorsal longitudinal median line. The main gradient appears to be dorso-ventral, though a fairly well-defined antero-posterior gradient may usually be observed. The inguinal and axillary regions constitute minor gradient fields within the

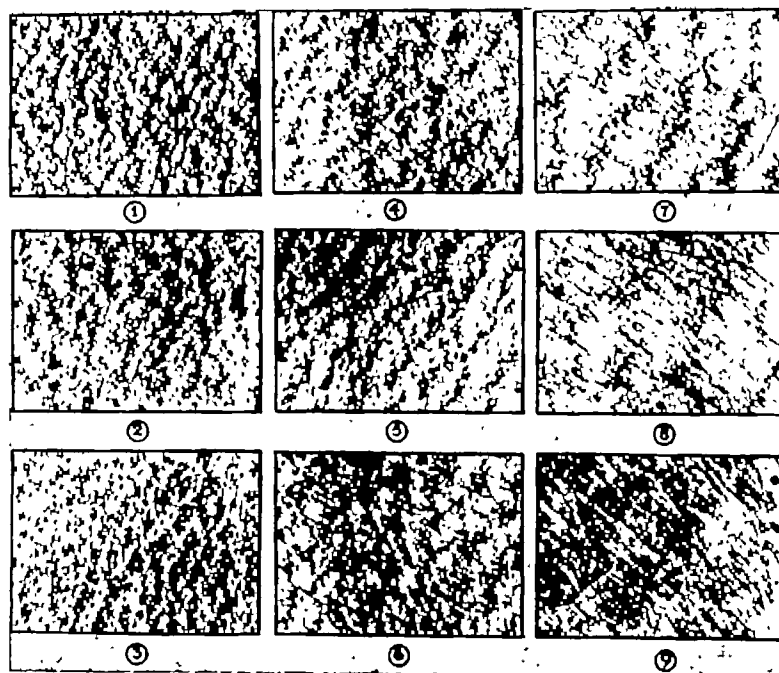


Fig. 2

main system but do not belong to the fleece area of economic interest. The gradient systems noted here are confirmed in histological studies.

These observations support those of Wildman³ and, considered in relation to embryological and histological studies, may have considerable significance in the development of reliable methods of fleece analysis, especially in regard to the problem of sampling. Further studies on this class of material are suggested in view of the encouraging results so far obtained.

This work was done during my tenure of the Walter and Eliza Hall fellowship in veterinary science at this University.

H. B. CARTER.

F. D. McMaster Animal Health Laboratory,
University of Sydney.
March 28.

¹ Duerden, J. B., *Bull. Wool Ind. Res. Assoc.*, 5, 2, 24 (1936).

³ Wildman, A. B., *NATURE*, 139, 236 (1937).

'Frequency Discrimination' in Insects: a New Theory

It has long been known that some at any rate of those insects which possess tympanic organs are able to discriminate between sounds which differ by a factor other than intensity. Regen¹, for example, showed that a long-horn grasshopper, *Thamnocris apterus*, could distinguish the stridulation of its owl from that of related species, and either from various artificial noises. No insect has any peripheral mechanism which would permit harmonic analysis after the manner of the mammalian cochlea. The only alternative basis for discrimination is that different sound qualities shall be represented in their auditory nerves by different temporal patterns of afferent nervous impulses. But here a limit is imposed by the refractory period of the nerve fibres, and frequency discrimination on this basis would only be expected to be possible for frequencies up to a few hundred cycles per second.

It has been shown^{2,3} that the tympanic organs of insects do not respond at all to such low frequencies, nor is it to be expected that they would, except at enormous intensities, for the area of the tympanic membrane is very small. Maximum sensitivity is found to occur for frequencies of 5000-20,000 c.p.s., and at any frequency the nervous response to a pure tone (if it can be obtained at all) is asynchronous, that is, the nervous activity in the auditory nerve is random and no temporal pattern can be detected. There is here an apparent paradox that the neural mechanism of discrimination seems to be suited to sound frequencies which the insect, by reason of its small size, can neither radiate nor detect.

Our experiments indicate that the way out of this impasse which has been adopted by these insects is closely analogous to the device

which has rendered wireless telephony possible. The high frequencies emitted by a stridulating insect act as a carrier for a low-frequency modulation, and it is the latter which probably characterizes the sound to an insect auditor.

We connected a surviving preparation of the tympanic organ and auditory nerve of a locust to an amplifier and oscillograph so that the nature of the nervous response could be observed. The preparation was exposed to a sound source which would yield pure tones of any desired frequency up to 10,000 c.p.s. These pure tones could be modulated sinusoidally in amplitude at a second chosen frequency. Modulation from 0 per cent to more than 90 per cent could be obtained without serious deformation of the modulation envelope, using a device which has been described in detail elsewhere⁴. As was to be expected⁵ the preparation was completely insensitive to pure tones at low frequencies (50-300 c.p.s.), and, though very sensitive to a pure tone of 8000 c.p.s., the latter elicited a completely random response. But in

response to an 8000 c.p.s. tone modulated at any frequency up to 300 p.s. the nervous discharge consisted of bursts of activity at the modulation frequency. The very characteristic pattern of impulses was found to be quite unaltered by large changes in the carrier frequency, and it is reasonable, therefore, to conclude that such high frequencies have in themselves no significance for the insect. Their function is only to carry the modulation precisely as audio-frequency modulation is carried in wireless telephony by high-frequency electromagnetic waves. In both cases, the radiation and reception of low audio frequencies is impracticable and for analogous reasons.

It is of interest to note the sharp contrast with human hearing. The human ear is about as sensitive as that of this insect at 8000 c.p.s., and deep modulation of such a tone may impart to it a perceptibly rill-like character. A human observer, however, though he readily perceives small changes in the carrier frequency, is quite insensitive to large variations in the modulation frequency provided that the latter is not so low that discrete beats are perceived.

On the hypothesis outlined above, the process of discrimination of the quality of a given sound by an insect with a tympanic organ is quite different in principle from frequency discrimination in the strict sense of human physiology. It is therefore possible to explain a number of puzzling observations which have been recorded. For example, Regen¹ showed that a virgin female cricket will regularly approach a telephone which is transmitting the chirruping of a male, even when the distortion is so gross that the sound is unrecognizable to the human ear. It is evident that distortion of the kind which would be introduced by a telephone, such as partial rectification, frequency discrimination and the introduction of odd harmonics will not alter the modulation frequency. Provided, therefore, that enough high-frequency carrier gets through the telephone to excite the female's tympanic organ at all, the pattern of nerve impulses corresponding to the modulation frequency will appear in her auditory nerve. Conversely, the ability of some insects to distinguish between sounds which are identical to human ears is also explicable if it can be shown that such sounds are differently modulated though the carrier frequency is the same.

A full account of the experiments will be published at a later date.

R. J. PUMPHREY.

(Beit Memorial Research Fellow)

A. F. RAWDON-SMITH.

(Senior Student of the Royal Commissioners for the Exhibition of 1851).

Department of Zoology,
Cambridge.

April 12.

¹ Regen, J., *Stitz. Abstr. Wiss.*, 185, 329 (1925).

² Pumphrey, R. J., and Rawdon-Smith, A. F., *Proc. Roy. Soc., B*, 181, 18 (1936).

³ Wever, H. G., and Bray, C. W., *J. Cell Comp. Physiol.*, 4, 79 (1933).

⁴ Rawdon-Smith, A. F., and Sturdy, B. S., *Brit. J. Psychol.* (in the Press).

⁵ Regen, J., *Physiol. Arch.*, 185 (1913).

Sponge Mortality in the Bahamas

A HEAVY mortality broke out among the commercial species of sponge (Wool, Velvet, Grass, Reef, Yellow and Hardhead) on the natural banks in the waters of the Bahama Islands early in December 1938. The mortality was recorded earliest among the

eastern islands of the Colony and spread rapidly westwards, until by the end of February 1939 there remained no sponge-bearing bank unaffected in the Colony. It is reported to have spread to the north coast of Cuba in February and Key West, Florida, in March. The mortality rate in most of the areas affected in the Bahamas is high (70-95 per cent).

The investigations, conducted jointly in the Bahamas by the United States Bureau of Fisheries and the Bahamas Sponge Fishery Investigations Department, were carried out along the following lines.

(1) Chemical and hydrographical observations carried out by Dr. C. Lealie Smith show on the sponge beds themselves (down to 8 metres) a wide salinity range (36.4-43.6 per mille), pH (8.15-8.35), phosphate (undetectable to about 5 mgm. P_2O_5 /m.³), silicate (undetectable to 220 mgm. SiO_2 /m.³), oxygen (90-110 per cent saturation), excess base (2.10-2.90 milli-equiv./litre), calcium (440-550 mgm. Ca/litre, and as much as 400 per cent saturation) and a temperature range of 22° - 28° C. These figures are consistent with results obtained regularly in this area over the last two years, and the main features (temperature-salinity correlation curve, thermocline and oxygen-poor layer) of a deep ocean channel between the islands remained unchanged down to 1,250 metres. As much as 60 mgm./m.³ ammonia nitrogen was observed as compared with the normal level of 20 mgm./m.³; but this is attributed to the large numbers of rotting sponges on the beds nearby. Dr. Galtsoff finds a relatively high copper content especially in inshore areas (between 2 and 8 mgm./m.³), but neither this nor any other observed hydrographical factor is regarded as responsible for the mortality.

(2) Examination of plankton collected by means of No. 20 silk net in the inshore areas of Andros Island and on the Little Bahama Bank disclosed the general paucity of microscopic life in the sea, typical for these waters, and is consistent with the observations over two years in the Bahamas of Dr. Walton Smith. This is correlated with the deficiency of the principal nutrient salts. Microplankton samples obtained by centrifuging small volumes of water also failed to reveal the presence of any minute forms, which might have been responsible for the destruction of sponges. With the exception of the inshore waters in close proximity to sponge kraals, the microplankton was extremely poor, comprising primarily bacteria, shown by Drew to be particularly abundant in this area¹.

(3) The records of a number of observers indicate that the sequence of infection was from east to west following the trend of water movements within the Colony.

At the same time the spread of the disease was recorded more closely from the research vessel, on the largest single sponge-bearing bank in the Bahamas. This bank lies to the west of Andros Island, and the sponge-bearing part of it measures 120 nautical miles from north to south, and between 45 and 70 miles east to west. Seven successive surveys show that the infection spread on this bank in an ever-widening area, from the north-west extremity of Andros. The infection followed the general trend of known wind-influenced water movements. The intensity of the infection on its advancing front suffered no diminution, such as might be expected from the dilution or dispersal of a chemical or physical factor. The spread was consistent with the possibility of transmission over the area of a water-borne biological agent.

(4) Biological investigations have been carried out by Dr. Paul S. Galtsoff and Dr. F. G. Walton Smith. Fungus-like filaments, first observed early in March by Dr. Galtsoff, have been found constantly in all diseased sponge tissues examined. The filaments have not been found in healthy sponge tissues, nor in the remains of sponges which have been long dead. They are particularly abundant in the marginal zone between the newly dead and living tissues of diseased sponges. The infection spreads gradually through the tissues, starting often from an origin inside. The symptoms contrast with those observed when death has ensued from other known factors observed during the previous two and a half years. The infection of the micro-organism and the mortality are confined only to a few species of sponge (including unfortunately all the six commercial species), and have not been observed to affect any other form of marine life.

It has been possible to infect Reef and Wool sponge with the filaments, by contact with fragments of infected sponges of the same species.

Attempts are being made to have the organism isolated and identified. A full account of this and further projected work will be published elsewhere.

PAUL S. GALTSOFF.

United States Bureau of Fisheries,
Washington, D.C.

HUBERT H. BROWN.

C. LESLIE SMITH.

F. G. WALTON SMITH.

Sponge Fishery Investigations,
Nassau, N.P., Bahamas.
April 1.

"Papers from the Tortugas Laboratory", 5, 7-45 (1914).

Growth of *Borrelia duttoni* in the Developing Chicken Embryo

THE value of the developing egg in the study of many viruses is now well established, and the chicken embryo method of passage has proved of great use in propagating these viruses, which, as a rule, can only be grown in tissue culture, and not in the ordinary bacteriological culture media. Many members of the spirochetal class of organism can only be grown, with great difficulty, in special media, and it was therefore decided to attempt the growth of a spirochete in the developing chicken embryo.

The organism chosen was that responsible for African relapsing fever, *Borrelia duttoni*, for this cannot readily be grown in culture, but is usually maintained by passage from mouse to mouse.

The method was simply the inoculation of a fertile hen's egg, which had been incubated for a certain period, usually eight to twelve days, at the temperature customary for such incubation, namely, 38.5° C. After this preliminary period, which was necessary to ensure that the embryo inside was at a suitable stage of development, the egg was inoculated with a small amount of mouse blood, the mouse having been infected a few days previously with the spirochete of relapsing fever. Having introduced the inoculum into the egg, the site of inoculation was sealed off with sterile paraffin, and the egg now incubated for a further interval of three to four days, at the ordinary bacteriological temperature, that is, 37.0° C. At the end of this time, the egg was opened and the contents examined by microscopical and other methods.

When such an egg was opened and the fluid inside inspected by the dark-ground illumination technique it was found that many actively motile, living spirochetes were present. These findings were easily confirmed by inoculation of the material into mice for on examining the mice forty-eight hours later, it was found that their blood contained large number of the organism.

A second batch of eggs, after preliminary incubation, was then inoculated with the material from the first eggs, and again, after three days further incubation, these were found to contain living spirochetes both by visual examination and by mouse inoculation.

The process of egg passage was then continued and a third sample of developing eggs, this time only seven days old, was infected with a small drop of the fluid from the second passage ones, and these on being inspected by the dark-field method, showed a very large number of spirochetes to be present particularly in the blood of the embryo, with a very much smaller number in the rest of the egg contents. Animal inoculation again proved that these spirochetes had not lost their pathogenicity towards mice.

A fourth passage experiment gave precisely similar results.

Further work is in progress, with the view of determining the effect of continued egg passage on the characters of the spirochete concerned.

It is interesting to note here the effect of the spirochete on the embryo. If viruses are grown in eggs, the usual action is either to kill the embryo or, alternatively, to produce local lesions on the chorio-allantoic membrane, with little or no effect on the embryo. *Borrelia duttoni*, however, has a different action, for in the four passages described above no naked-eye change could be observed in the membrane nor was the embryo killed. Examination of the constituent parts of several eggs appeared to show that the lesion produced took the form of a blood invasion. This finding is similar to the result produced in man and susceptible animals, for in them there is a definite infection of the blood stream, easily demonstrated, as a rule, by blood films.

Since writing the above, my attention has been directed to the work of Morrow and his colleagues¹, who have cultivated *Leptospira icterohæmorrhagiae* on the chorio-allantoic membrane.

R. KNIGHT OAG.

Department of Bacteriology,
University of Edinburgh.

April 11.

¹ *Science*, 53, 234 (1923).

Genetic and Cytological Interference

PAIRED meiotic chromosomes may have their four chromatids or strands involved in a variety of ways in two adjacent chiasmata. In most studies of chiasmata the materials have not been favourable enough to permit the tracing of all four strands through two or more chiasmata. We have recently been able to do this in forty-eight complete pollen mother cells of *Trillium erectum*, and have observed therein eight types of chiasma pairs. These are shown diagrammatically in Fig. 1 together with their frequencies and interstitial lengths (alternative one-plane representations of these three-dimensional configurations are here neglected).

Clear separation of chromatids and reduction of coiling at metaphase may be obtained in *Trillium*

y various treatments. An extreme example is shown in Fig. 2 (one of five photomicrographs taken at different optical levels in a single cell), in which the five pairs of chromosomes may each be seen to have four very widely separated chromatids. These can be traced throughout their length in the serial optical sections. The material from which the data in Fig. 1 were obtained was less drastically treated.

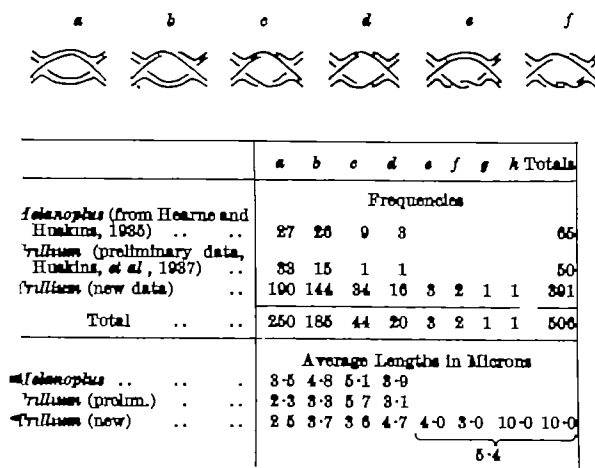


Fig. 1.

DIAGRAMMATIC REPRESENTATION OF THE EIGHT CYTOLOGICALLY DISTINGUISHABLE TYPES OF CHIASMATA PAIRS OBSERVED IN *Trillium erectum*.

Hearne and Huskins¹ found in *Melanophus femur-rubrum* 71 compensating pairs of chiasmata (those in which the paired strands separated by one chiasma were reunited by the second) and 35 non-compensating pairs. Sax² classified their figures into four types of chiasma pairs and showed that these did not occur in the proportions primarily expected on existing theories of crossing-over. A modification of the Wilson-Morgan theory which he proposed gave a better fit for these and other data than did Belling's or Darlington's theories of their simple interpretation.

Melanophus chiasmata are terminalized during the meiotic prophase and their position at metaphase

therefore gives little indication of their place of formation. *Trillium erectum*, having little or no terminalization, provides data on both chromatid relationships ('chromatid interference') and on the distances between chiasmata ('chiasma interference'). Fig. 1 shows that the least frequently occurring types of chiasma pairs are those having the greatest number of chromatid twists and the greatest interstitial length. Analysis of the more frequently occurring types in relation to theories of crossing-over involves assumptions which are the result of calculations too extensive to be entered into here. In brief, they also suggest an association between frequency, interstitial length, and complexity of chromatid relationships.

Our analyses of Lindgren and Lindgren's³ *Neurospora* data, and Beadle and Emerson's⁴ and Bonnier and Nordenskiöld's⁵ data from attached-X chromosomes in *Drosophila*, together with the observations of chiasmata in *Melanophus* and *Trillium*, seem to permit the following generalization: A chromatid is most likely to be involved in two adjacent cross-overs or chiasmata if the distance between these is short. In other words, chromatid interference occurs as well as chiasma interference, and it varies with distance. Further study has therefore confirmed and extended earlier conclusions from this laboratory^{1,6}. Details will be published shortly; they indicate certain new essentials for any hypothesis concerning crossing-over and suggest possible mechanisms, though it appears doubtful if sufficiently comprehensive data (particularly biophysical) yet exist for the inductive formulation of a general theory.

C. L. HUSKINS
H. B. NEWCOMBE.

McGill University,
Montreal.
March 29.

¹ Hearne, R. M., and Huskins, C. L., "Chromosome Pairing in *Melanophus femur rubrum*". *Cytologia*, 6, 125 (1935).

² Sax, K., "Chromosome Coiling in Relation to Meiosis and Crossing-Over". *Genetics*, 21, 324 (1936).

³ Lindgren, O. C., and Lindgren, G., "Non-Random Crossing-Over in *Neurospora*". *J. Hered.*, 28, 106 (1937).

⁴ Beadle, G. W., and Emerson, S., "Further Studies of Crossing-Over in Attached-X *Drosophila melanogaster*". *Genetics*, 20, 192 (1935).

⁵ Bonnier, G., and Nordenskiöld, M., "Studies in *Drosophila melanogaster* with Attached-X's". *Hereditas*, 23, 257 (1937).

⁶ Huskins, C. L., et al., "Chromonema and Chiasma Studies in Asynaptic, Desynaptic and Normal *Trillium erectum*". *Records of the Genetics Society of America* (1937).

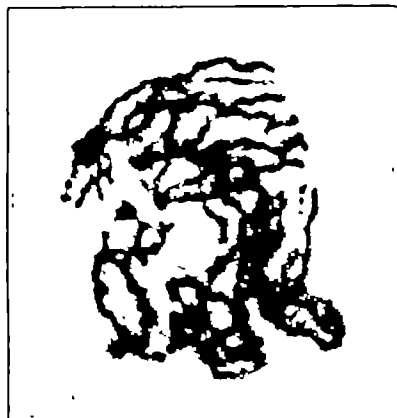


Fig. 2.

METAPHASE OF *Trillium erectum* SHOWING REDUCTION OF COILING AND EXTREME SEPARATION OF THE FOUR CHROMATIDS IN EACH OF THE FIVE BIVALENTS.

Influence of Colchicine on the Sexually Induced Colour Change of *Rhodospirillum rubrum*

In previous communications, I have given an account of some experimental evidence pointing to the intervention of hormonal influences in the action of colchicine in plants^{1,2,3}. I have also suggested⁴ that a similar mechanism of action may be, among others, responsible for the mitotic impetus described by A. P. Dustin and his school⁵ in the germinative zones of animals treated with this alkaloid. This view seemed to be further supported by the extraordinary number of mitoses observed by Allen, Smith and Gardner⁶, Bastenie and Zylberzack⁷, and many others, in the sexual organs of animals treated with sex hormones combined with colchicine. It seemed therefore worth investigating whether colchicine, hitherto regarded merely as a revealer of

these hormonally induced mitotic processes, can also exercise, either independently or synergetically with endocrine products, a hormonal action in animals.

Rhodeus amarus males are known to produce in the breeding season a characteristic colour change (*Hochzeitskleid*). This effect can also be obtained before or after the breeding period by the administration of sexual hormones¹. About ten-months old *Rhodeus* males weighing between 2 and 3 gm. were used about six weeks before their normal breeding period in Hungary. The fishes were divided into five groups and treated as follows:

The first group was placed in a large beaker containing a 0.075 per cent aqueous solution of colchicine. The second group was given intraperitoneal injections of 7.5 mgm. of testis hormone ('Oreutic' Choay) dissolved in 0.075 ml. of physiological serum, and was then placed in a beaker filled with tap water. The third group, similarly injected, was placed in a solution of colchicine of the above concentration. The fourth group received by intraperitoneal injections 0.075 ml. of tap water and was placed in tap water. The fifth group, untreated, served as control, and was placed in tap water, as above. Eighty-five minutes after the beginning of the treatments the animals were transferred into aquariums provided with running water.

Ten minutes after the beginning of the treatment, the animals of the first and second group showed already the first symptoms, consisting in a ruby red coloration of the iris. The animals of the third group manifested the effects of the combined treatment moreover by a carmine red coloration of the anal fin and continued to display, throughout the treatment, the successive stages of the colour change at a more accelerated rate than those of the first and second group. The full *Hochzeitskleid* of great intensity was produced by these animals within *ninety-five minutes*, calculated from the beginning of the treatment, whereas the fishes treated with either colchicine or the hormone alone did not display this full effect until about *twenty hours later*. It was also observed that the intermediary stages of the colour change were attained faster by the animals injected with the testis hormone alone than by those treated with colchicine alone. (This was to be expected as the pharmacological effects of colchicine are also produced after a prolonged period of incubation.) The full *Hochzeitskleid* of all the treated *Rhodeus* was maintained during about forty-eight hours and faded thereafter gradually, until it had practically disappeared about seven days after the beginning of the experiment. No colour change was observed throughout the experiment in any of the untreated or of the water-injected control animals.

These results demonstrated in consequence clearly that: (1) although displaying its effects somewhat more tardily than the hormone, colchicine produces effects of the same intensity; (2) colchicine acts in a high degree synergetically with the hormone.

A supplementary proof of the above gradation of the effects was furnished by an exactly corresponding gradation of the oxygen consumption of the treated and control animals, as measured by H. Mann².

It remained to test whether the above effects were not rather the manifestations of a direct response of the pigment cells, due to purely nervous stimulation, without necessarily involving the intermediary of a hormonal mechanism of action. For this purpose, other fishes (*Leuciscus rutilus* and *Perca fluviatilis*)

known to have lipochrome pigments similar to those of *Rhodeus*—but displaying no sexually induced colour change (*Hochzeitskleid*)—were treated with colchicine and sex hormones as above. No colour change was, however, observed in any of the treated animals. Although indirect, the value of this test was made even more plausible by the fact that the respiratory metabolism of these animals has shown according to the treatment given, an exactly analogous gradation to that previously observed in *Rhodeus*³.

LÁSZLÓ HAVAS.

Institute of Pathological Anatomy,
University, Brussels.
Hungarian Biological Research Institute,
Tihany.
March 20.

¹ HAVAS, L., NATURE, 140, 191 (1937).

² HAVAS, L., Bull. Assoc. Franc. du Cancer, 26, No. 6, 1-28 (1937).

³ HAVAS, L., Growth, 3, No. 3, 257-260 (1938).

⁴ DUSTIN, A. P., Le Sang, 13, No. 7, 678-697 (1938); Arch. f. exp. Zell., 23, 895 (1939).

⁵ ALLEN, SMITH and GARDNER, Anat. Rec., 87 (suppl. 1), 49 (1936).

⁶ BARTON and ZILBERMAN, Arch. intern. Med. expir., 13, 60-72 (1938).

⁷ BOUANE, A., Bull. Sci. pharmacol., 42, 193 (1935).

⁸ MANN, H., Biol. Zbl. (in the Press).

Alimentary Exudative Diathesis, a Consequence of E-avitaminosis

In a previous communication¹, we described a symptom which could be produced in chicks by feeding them an artificial diet in which the protein had been thoroughly extracted by alcohol. The symptom consists in large accumulations of blood plasma under the skin, originating from inflamed and hyperaemic capillaries in the connective tissue, notably the fat tissue. This condition was termed 'alimentary exudative diathesis', and it was shown to be a deficiency disease which could be prevented by alfalfa, and petrol-ether or alcohol extracts from alfalfa.

We have now studied the occurrence and nature of the anti-exudative factor. A relation with nutritional factors known to influence capillary permeability could be excluded with absolute certainty, and the same holds true for the possible relation to vitamin K. Wheat germ and dried hips were found to give protection against the disease when given in the proportion of 5 per cent of the diet and to be better sources than dried alfalfa. 0.15 per cent of the epiphasic fraction of an alcoholic extract of hips was found to afford a better protection than 2 per cent of wheat-germ oil.

A direct test of *d*, *L*- α -tocopherol uncombined or in the form of the acetate (supplied by F. Hoffmann, La Roche and Co., Basel) revealed the fact that vitamin E protects against the disease.

The production of alimentary exudative diathesis in other animals than chicks as well as the possible existence of related conditions in man is under investigation.

It is possible to estimate vitamin E by its anti-exudative activity. Exudative diathesis is inhibited by smaller quantities of vitamin E than encephalomalacia in chicks receiving a fat-rich diet, a disease which may also be used for the biological assay of vitamin E².

By the new method we have found that the lipid of hips is much richer in vitamin E than wheat-germ oil.

Experiments are being carried out in order to settle the question whether vitamin E is also identical with the light white casein factor of Coward *et al.*,³ a possibility which might be supported by the fact that an exhaustive treatment with alcohol is necessary for the complete removal of vitamin E from casein used in artificial diets.

HENRIK DAM.
JOHANNES GLAVIND.

Biochemical Institute,
University of Copenhagen.
March 24.

Dam and Glavind, *NATURE*, **148**, 1077 (1938).
Dam and Glavind, Benth and Hagena, *NATURE*, **148**, 1157 (1938).
Coward, Key and Morgan, *Biochem. J.*, **23**, 695 (1929).

Role of Manganese in the Biological Synthesis of Ascorbic Acid

Guha and Ghosh¹ found that rat liver incubated with mannose produced ascorbic acid, and followed it up by showing that parenteral administration of mannose also produced ascorbic acid in the rat tissue and notably in the liver. Euler *et al.*² were unable to confirm the *in vitro* results, which was explained as due to the absence of molecular oxygen.³ Euler's experiment was made in an atmosphere of nitrogen. However, Hawthorne and Harrison⁴ and Clodt⁵ also could not confirm Guha's results *in vitro* or *in vivo*.

It has now been found that manganese is a determining factor in the synthesis of ascorbic acid by rat tissue. The experiments of Hawthorne and Harrison (*loc. cit.*) were repeated with this modification, that the Ringer-Locke solution in which the

liver was incubated with mannose contained 0.02–0.001 per cent manganese as manganese chloride. The concentration of manganese in the incubated mixture thus ranged from 0.01 to 0.0005 per cent. In my series of experiments 0.001–0.0005 per cent of manganese in the incubated mixture has been found to be most favourable for the synthesis of ascorbic acid *in vitro*. It has also been found that galactose, like mannose and glucose to a less extent, may also act as precursors. In *in vivo* experiments, the mannose solution given intravenously contained 0.001 per cent manganese as the chloride. Typical results are given in the accompanying table.

<i>In vitro</i>			<i>In vivo</i>	
% Mn in R-L	Sugar	Mgm. ascorbic acid per gm. liver	Mgm. ascorbic acid per gm. liver	
			Control (N.B.)	Mannose + Mn
0.002	Mannose	0.22	0.25	0.32
0.002	Galactose	0.21	0.21	0.29
0.002	Glucose	0.19		
Nil	Mannose	0.16		
Nil	Nil	0.16		

Details are being published elsewhere.

M. N. RUDRA.

Dept. of Medical Chemistry,
Princes of Wales Medical College,
Patna.
April 15.

¹ *NATURE*, **134**, 730 (1934), **135**, 871 (1935).

² *Biochem. Z.*, **286**, 399 (1935).

³ *NATURE*, **133**, 844 (1934).

⁴ *Biochem. J.*, **31**, 1061 (1937).

⁵ *Arch. Exp. Path. Pharm.*, **180**, 157 (1938).

Points from Foregoing Letters

F. Adler and H. von Halban, jun., discuss the energy liberation of a nuclear reaction chain, consisting of successive fissions of the uranium nucleus by slow neutrons, and maintaining itself by the neutrons liberated in the fissions. The addition of a small quantity of cadmium to the system provides the possibility of controlling the energy liberation. The system will become stable at a temperature which is characteristic for the chemical composition and the dimensions of the system.

T. Bjerger, K. J. Broström and J. Koch have measured the decay curves of the fission products of uranium bombarded with fast and slow neutrons, and have carried out similar measurements on the fission of thorium. The decay curves with either fast or slow neutrons had the same shape, showing that the fission processes give rise to great numbers of different nuclei, the individual characters of which are smoothed out in the decay curves.

Tracks, on photographic plates with a thick coat of emulsion, of recoil nuclei produced by the action of neutrons from uranium have been recorded by L. Myssowsky and A. Jdanoff. Their range is very close to that of α -particles of uranium. The number of tracks of recoil nuclei having ranges greater than 1.5 cm. in air is equal to about one hundred nuclei per square centimetre per minute, in fair agreement with the results of Frisch.

The emission of short-range groups of α -particles from oxygen, nitrogen and fluorine under proton

bombardment has been discovered by W. E. Burcham and C. L. Smith. The group from fluorine follows a resonance excitation curve similar to that obtained for the γ -rays also produced by bombarding fluorine with protons. The groups from oxygen and nitrogen are interpreted as due to disintegrations of rare isotopes of these elements.

R. C. Majumdar and D. S. Kothari state that if the initial energy of a meson exceeds two thousand million electron volts (2Mc.) it could be transformed into two heavy particles, a proton and a neutron. It is possible that the protons and neutrons found in cosmic rays may arise in this manner.

A group of investigators from Osaka Imperial University have redetermined the isotopic masses of carbon and nitrogen by comparison of the doublets $\text{CH}_4\text{—O}$ and $\text{CH}_4\text{—N}$ and find the values 12.00384 and 14.00761 respectively.

F. W. Aston discusses the difference between his own value for the isotopic weight of ^{13}C and those obtained by other workers using double focusing mass-spectrographs. He points out that while the accuracy claimed is much greater than his own, there are results which suggest the possibility of systematic error. The discrepancy remaining is, however, very small.

Spectra of the 4046 radiation of mercury, scattered by benzene, acetic acid, salol and glycerine, are submitted by Sir C. V. Raman and C. S. Venkateswaran, showing that glycerine behaves in this respect like an

amorphous solid. These observations, and also the behaviour of ultra-sonic waves in viscous liquids, suggest that, for mechanical disturbances of sufficiently high frequencies, a liquid behaves essentially as a solid.

S. Shalyt states that nickel, cobalt, ferrous and chromium chlorides, the magnetic susceptibility of which at the temperature of liquid hydrogen depends on the intensity of the field, also show jumps in the specific heat and that these phenomena are related. They may be explained by the quenching of the orbits of metallic ions in the electric field of the crystal.

A. H. Cooke and R. A. Hull describe new experiments on pumping liquid helium to low temperatures. Using a pierced membrane to restrict the creeping of the helium II film, they reach by simple means temperatures previously only attainable with elaborate apparatus.

S. B. Hendricks states that aluminium silicate layers in the biotite-like micas are stacked in a variety of ways preserving twelve-fold co-ordination of interlayer potassium ions. Incomplete-filling of octahedral co-ordination positions within a layer of muscovite results in a distorted structure with a unique requirement on layer stacking. Diffuse scattering of X-rays by some biotites is a result of random combination of types of stacking. Variation in optic axial angles of micas is largely due to differences in structures.

C. H. Douglas Clark has deduced some simple relations between the heat of dissociation D , the internuclear distance r_e and the bond order α of carbon-carbon linkages. The relation between D and r_e was independently investigated by Fox and Martin by a different method, with the same conclusion. Satisfactory agreement with experiment is obtained.

Excellent optical interference figures of angular aperture up to 120° are obtained by H. E. Buckley by replacing the whole lens-system of the ordinary projector, between crystal and screen, by a single 'Polaroid' filter, of $1\frac{1}{2}$ in. to 2 in. diameter, close up to the crystal.

By observations on the clouds rising from active areas on Mt. Tongariro and White Island, N.Z., S. H. Wilson estimates the amounts of water vapour emitted to the atmosphere from fumaroles at these two localities.

It is suggested by C. C. Caldwell and R. J. W. Le Fèvre that the stable configuration of benzil (Ph.CO.CO.Ph) is one in which the two Ph.CO. units lie in planes, which are approximately at right angles to one another.

E. H. Neville submits that there is no basis in mathematics alone for certain comments made by D. P. Riley and I. Fankuchen on their recently constructed vector map of a cyclol skeleton.

In an experiment on binocular vision through a veiling glare comparable with illuminated fog, B. Babington Smith and R. W. Pickford found that the effect of differential veiling glare on the apparent relative distances or sizes of objects seen through it is very variable from subject to subject. It is much affected by conditions such as the rightward or leftward and near or far initial positions of the variable object, and by the presence of greater glare over the variable or standard—conditions which might be thought irrelevant.

R. S. Barclay and W. O. Kermack point out the contrary to certain opinions, the average maternity in various European countries for which figures are available has decreased while the birth-rate has been falling. The evidence indicates that a similar fall has occurred also in Scotland and in England and Wales during recent decades.

H. B. Carter reports a detailed study of regional variations in the density and arrangement of the follicle population observed on the 'grain' surface of the tanned merino skin. The results indicate the existence of an antero-posterior gradient in population density for which evidence had previously been presented by Dr. A. B. Wildman, but it is shown that in the present case this is subsidiary to the dorso-ventral gradient. This is illustrated by a chart and photomicrographs.

R. J. Pumphrey and A. F. Rawdon-Smith present evidence that the ability of certain insects to discriminate between different sounds is due to the rectifying action of the tympanic organ, which permits the activity in the auditory nerve to be synchronous with the amplitude modulation imposed on a carrier frequency lying within the insect's auditory spectrum. This difference from the mammalian method of frequency discrimination provides a satisfactory explanation of previously irreconcilable experimental observations.

The incidence and spread of a mortality among sponges in the waters of the Bahama Islands, reported by Paul S. Galtsoff, H. H. Brown, C. Leslie Smith and F. G. Walton Smith. Evidence is adduced which suggests that a fungus-like organism may be responsible for the mortality.

The spirochaete of African relapsing fever, *Borrelia duttoni*, has been successfully propagated by R. Knight Oag in the developing chicken embryo for four serial transfers, and a profuse growth of the organisms obtained. The spirochaetes do not kill the embryo or produce visible lesions in the chorio-allantoic membrane, but invade the blood-stream of the embryo. Throughout the series of egg passage the virulence of the organisms for mice has remained unaltered.

Eight types of chiasma pairs have been observed by C. L. Huskins and H. B. Newcombe in the pollen mother cells of *Trillium erectum*. They indicate that a chromatid is most likely to be involved in two adjacent cross-overs or chiasmata if the distance between these is short.

L. Havas reports that treatment with colchicine effects the sexually induced colour change (*Hochzeitskleid*) in *Rhododendron amarum* males, and this, in the same time (20 hours) as treatment with the testis hormone. A combined treatment with colchicine and testis hormone produces, however, the full *Hochzeitskleid* in ninety-five minutes. The oxygen consumption of the animals showed the same gradation of effects.

H. Dam and J. Glavind point out that the alimentary exudative diathesis in chicks can be prevented by synthetic *d*, *l*- α -tocopherol, and by natural sources of vitamin E.

M. N. Rudra has found that incubation of rat liver with mannose, galactose or glucose in Ringer-Locke solution and phosphate buffer containing manganese as chloride produced ascorbic acid in the liver. Intravenous injection of mannose in manganese solution also produced ascorbic acid in the liver.

News and Views

Prof. H. H. Dixon, F.R.S.

ON May 19, Prof. H. H. Dixon reaches his seventieth birthday, an occasion upon which all his friends would like to offer him their best wishes. In collaboration with his lifelong friend, the late Prof. J. Joly, Dixon developed the cohesion theory of the ascent of sap. This classical work, published in 1894, was the precursor of many physiological and morphological papers, which led to his election to the Royal Society in 1908, and to the award of the Boyle Medal of the Royal Dublin Society in 1917. In 1904, he was appointed to the University professorship of botany in Trinity College, Dublin, a position which he, happily, still continues to adorn. During his tenure of the chair, the new School of Botany (1907) and the new Herbarium (1912) were erected, both largely due to Prof. Dixon's enterprise and the late Lord Iveagh's generosity. His early morphological and cytological work enriched his laboratory with many beautiful slides of nuclear division, and, during the Great War, he published an exhaustive examination of the varieties of mahogany, many of which were used in aeroplane propellers. In 1937, he delivered the Croonian Lecture before the Royal Society in which he reviewed the theory of the ascent of sap. This lecture was illustrated with his distinctive experimental ingenuity. In recent years, among other subjects, he has investigated the alterations in the permeability of plant cells due to electrical stimuli and shown how closely they may be paralleled by the changes in resistance of certain emulsions. His pupils, including many medical men, scattered widely over the Empire, will long remember with affection the tutelary genii of the Botany Lab. T.C.D., "Botany Dick" and his "Mate" Mr. Joe Murray.

Dr. D. A. E. Garrod

THE appointment of Dr. Dorothy Annie Elizabeth Garrod as Disney professor of archaeology in the University of Cambridge in succession to Prof. E. H. Minns, who will retire on October 1 next, will be welcomed by all archaeologists as no more than the due recognition of a remarkable career of archaeological research and discovery. It is also the first appointment of a woman to a professorial chair at Cambridge. Miss Garrod, who is the daughter of the late Sir Archibald Garrod, Regius professor of medicine in the University of Oxford, was born in May 1892, and she is now director of studies in archaeology and anthropology (Section A) of Newnham College. In her prehistoric studies, Miss Garrod has been a faithful disciple of the Abbé Breuil, but her discipleship has in no way cramped her in the development of a strong and independent line of thought in archaeological theory, of which the germ is to be seen in her first important publication "The

Upper Palaeolithic Age in Britain" (1926), and came to full fruition in her remarkable analysis of palaeolithic culture in a reorientation, which formed the subject of her striking presidential address to the Prehistoric Society in 1937. To a wider public Miss Garrod is known as the director of a succession of successful archaeological excavations at Gibraltar (1925-26), in Southern Kurdistan (1928), in the caves of Mount Carmel, Palestine (1929-34), and Bulgaria (1938), which have produced among other results the discovery at Gibraltar of a second Neanderthal skull, and in Palestine have traced early man through successive phases of prehistoric culture back to Acheulean times, as well as added a new culture and race to the peoples of that region at the close of the palaeolithic period. Miss Garrod's success as an excavator is equalled by the skill and lucidity with which she has described her discoveries. In 1927 she was a member of the International Commission which reported adversely on the Glozel antiquities; and in 1936 she occupied the presidential chair of the Anthropological Section of the British Association.

Sir Clement Hindley, K.C.I.E.

SIR CLEMENT HINDLEY has been elected president of the Institution of Civil Engineers for 1939-40 and will take up his duties on November 7. Sir Clement joined the Engineering Department of the East Indian Railway in 1897 and his career as a railway engineer in India culminated in his appointment in 1922 as the first Chief Commissioner of Railways for India. On retirement from India in 1928, Sir Clement was appointed as the first chairman of the Racecourse Betting Control Board, and he has recently been lent temporarily by the Board to the Home Office to act as chairman of the Professional Advisory Committee (Shelters) in connexion with air raid precautions. The organization of scientific research is a matter in which Sir Clement has taken a great interest and he was a member of the Advisory Council for Scientific and Industrial Research during 1932-37. He has been chairman, since its inauguration in 1935, of the Institution of Civil Engineers Research Committee, which has been responsible for carrying out many important engineering researches in connexion with soil corrosion of metals and cement products, pile-driving, velocity formulae, special cements for large dams, fish-passes, steel structures, repeated stresses in structural elements, earthing to metal water pipes and mains, breathing apparatus for use in sewers, etc. His election as president of the Institution of Civil Engineers is both a fitting acknowledgment of his eminence as an engineer and a mark of recognition of the importance of research in engineering.

Conference on Air-raid Shelters

THE Government has now announced its decision on the subject of providing heavily protected shelters against air attack for large numbers of the civil population, and it has come to the conclusion that such a policy is impossible as well as undesirable. There is little doubt that the demand for deep tunnels and 'focal' shelters of the type advocated by the Finsbury Borough Council arose in consequence of statements made by superficial observers in Spain that such shelters were available for many of the inhabitants of Barcelona and other large cities, and that their provision was mainly responsible for the small number of casualties that had resulted from the more recent air raids in Spain. This, too, in spite of the fact that the statements were contradicted in January last by the person in the best position to know, namely, the chief air raid officer in Barcelona. That official was reported in *The Times* to have said that only about thirty thousand persons out of a total of nearly two millions in Barcelona had such shelters available, and that only about half the population had shelters of any sort, which consisted chiefly of cellars in private houses, and covered trenches. They had learnt from experience the necessity of evacuating the areas that were made special objects of attack, such as the docks, and of clearing the streets and of getting under cover of some sort.

THE public was, however, misinformed; and the demand for deep shelters became so insistent that, although the Lord Privy Seal has scarcely concealed his disbelief in the necessity for them, he convened a conference under the chairmanship of Lord Hailey to consider the whole matter. In its report (H.M. Stationery Office, 6d.) the Conference has examined the chief proposals put forward and has rejected all of them, giving half a dozen reasons for the conclusion reached, each one of which would have been sufficient to justify the verdict. The report concludes with a warning against a too ready acceptance of some of the estimates of cost put forward, and by expressing the belief that most British citizens would prefer to count upon less effective protection at their own homes, even if this made no pretence of warding off direct hits or near hits of bombs.

Emergency Preparations in the Event of War

THE Minister of Health has forwarded to all local authorities concerned in the Government's Evacuation Scheme in England and Wales a communication asking them to work out in detail their plans for the evacuation of school children and others who are to receive priority under the scheme (Ministry of Health Circular 1800. H.M. Stationery Office, 1d.). Enclosed with this communication is a memorandum (Memo. Evacuation No. 4, 3d.) indicating the general lines of the procedure that would be necessary in an emergency and the problems likely to arise, and discussing transport arrangements, arrangements at detaining stations and details of reception, and giving practical advice for householders and others. Authorities are

recommended to make full use of all voluntary agencies that might be useful, and it is stated that the Government does not intend that the operation of the scheme should result in any additional burden on the local rates. Another circular has been issued by the Ministry detailing the progress in organization and recruitment of first-aid posts in London. These schemes provide for 181 fixed aid posts, five cleansing stations and thirty-four mobile units. The estimated total of fixed posts required for the County of London is approximately two hundred.

Social Relations of Science

THE British Association announces a meeting of the new Division for the Social and International Relations of Science to be held at the Royal Institution at 4.30 on Thursday, May 25, by permission of the managers of the Institution. This will be the first public meeting of the Division to be held in London. Prof. Ernest Barker, professor of political science in the University of Cambridge, and Sir Daniel Hall, former chief scientific adviser to the Ministry of Agriculture, are to be the principal speakers, with Sir Richard Gregory, chairman of the Division, in the chair. The object of the meeting is to show how science and society are 'out of gear', and the nature of the task which the Division has undertaken in trying to assist in bringing about an adjustment. Prof. Barker is to speak on "The Impacts of Science on Society", showing the repercussions of scientific discovery and invention upon the social structure. Sir Daniel Hall is to deal with the failure to apply science properly by showing how the application of science to agriculture has been impeded. Sir Richard Gregory will deal with the work of the Division. Primarily, the meeting is intended for workers in every branch of science with the view of securing their interest and co-operation in the work of the Division. It will, however, be open to members of the public and to representatives of organizations interested in the work of the Division. Tickets may be had on application to the Secretary of the British Association, Burlington House, Piccadilly, London, W.1. Another important meeting of the Division is to be held at Manchester in June, when the effects of science upon certain industries will be discussed. Work of the Division at present in hand includes questions of nutrition, population, social psychology, the organization of science and the international relations of science. A committee has also been appointed to report on the world sources of raw materials.

Indirect Rule and the Anthropologist

As a principle of administration, indirect rule is essentially a system of local government, in theory functioning through local native tribal institutions. Admirable as this principle may be in intention—its object is at once to conduce to fairness and justice in the maintenance of law and order, while educating the native in a sense of civic and political responsibility, and at the same time affording him an opportunity of gradually adapting his institutions to

the conduct of public affairs on modern lines—yet when the searchlight of anthropological investigation is turned on to indirect rule as a working system, difficulties in giving it full effect and shortcomings in its practice begin to appear. In the earlier days of British administration in Africa, it was assumed, perhaps too readily and without intensive anthropological inquiry, that each local unit must be subordinated to a headman or chief, and ruled by him with or without a council of elders. In either event, it was assumed to be a system susceptible of individual representation. In default of a more penetrating examination, it was not realized that local sovereignty, to use an expressive, if not a fully applicable, term, was bound up with religious ritual, belief and organization, upon which the native was not only reticent, but also incapable of expounding the ramifications except in response to the patient inquiry of an experienced and trained observer. Hence the system of native courts composed of members, who have come to be called 'warrant chiefs', was by no means invariably in accord with native institutions, while the legitimate representative of native authority, according to tradition, was often relegated to the background, either through native reticence or the influence of a more forceful personality.

THE relation of the warrant chiefs to the real seat of native authority has been carefully analysed by Prof. O. Daryll Forde, who, as a Rockefeller Research Fellow of the International Institute of African Languages and Cultures, has made a special study from this point of view of the tribal customs of the large village centre of Umor in the Obubra Division of Southern Nigeria, with a population of more than 10,000 (*Africa*, 12, 2; 1939). Not only does he show how intricate an affair is native traditional machinery for the preservation of order and for local administration, but he also goes on to show how native custom and principles in local administration have been controverted by the appointments made, in the praiseworthy desire to secure the representation of native knowledge and opinion. At the time of Prof. Forde's investigation in 1935, reform of the composition of the native court was under consideration, and the moral of his report is clearly that any change should be made only after intensive inquiry into the details and essential character of native institutions. He himself has certain constructive suggestions to make; but at the same time he points out that it is now difficult to make that use of native institutions which at one time was open to the Government. The interest of the natives has been diverted from their own institutions to the form which has been imposed upon them by the white man, and among them discussion has tended to centre on the methods of appointing warrant chiefs rather than on any radical reform, which would allow for the incorporation of the traditional system in the administrative machinery, or its development in that direction. Further, the young men have formed a group now actively in opposition to traditional authority in

village affairs. It is evident that if native institutions are to be used and developed as a means to native education and civic training, some compromise will have to be effected. Otherwise native institutions and the stabilizing influence of tradition will go by the board.

International Standard for Chorionic Gonadotrophin

At the third International Conference on the Standardisation of Hormones, held at Geneva on August 11-13, 1938, it was decided that international standards should be established for certain hormones of the anterior lobe of the pituitary gland and analogous substances found in urine and serum, and that international units should be defined in terms of a weight of each standard. The final preparation of these standards, their dispensing in a form suitable and convenient for the use of the laboratory worker, their storage, preservation and subsequent distribution, was to be undertaken by the National Institute for Medical Research, Hampstead, London. The preparation of the international standard for the gonadotrophic substance of human urine of pregnancy (chorionic gonadotrophin) has now been completed. It has been prepared from substantial amounts of material generously provided by six firms in different countries. The individual samples having been approved by the Conference, a mixture was made and the standard has been finally dispensed in the form of 10 mgm. tablets. The international unit has been defined as the specific gonadotrophic activity of 0.1 mgm. of the standard preparation, an amount of activity similar to that required, under the conditions used by many workers, to cause cornification of the vaginal epithelium of the immature rat. Each tablet contains approximately 100 international units. As in the case of the international standards for other hormones, drugs and vitamins, the new international standard is held, on behalf of the Health Organisation of the League of Nations, at the National Institute for Medical Research, Hampstead, London, from which it can be obtained by national control centres established in other countries; workers in Great Britain should apply to the Department of Biological Standards, National Institute for Medical Research, Hampstead, London, N.W.3.

Preservation of the English Countryside

It may be remembered that at the Cambridge meeting of the British Association, Dr. Vaughan Cornish described his efforts to preserve the natural scenic beauty of the cliff regions near Sidmouth by ensuring that considerable tracts of land in his possession should be restricted entirely to agricultural purposes. *The Times* of April 26 announces that Dr. Cornish has decided to extend these restrictions to cover (during his lifetime) the lands of Thorn Farm, near Salcombe Regis. This is a place of considerable historic interest as well as of natural beauty, which takes its name from an old "Holy Thorn" tree used as a landmark from Saxon times, and replaced with

suitable ceremonial by another whenever it died. This decision has, also, its scientific aspect, on account of the proximity of the Norman Lockyer Observatory to Thorn Farm, where (but for the action of Dr. Cornish) it would have been possible to erect some six hundred houses under the local town planning scheme. It is well known that the work of Greenwich Observatory is badly hampered by smoke and glare from the surrounding district. The erection of six hundred houses in the vicinity of the Norman Lockyer Observatory might have been the first step towards a similar interference with the work of this observatory, and it is a matter of satisfaction that this annoyance has been at least postponed during the lifetime of Dr. Cornish.

Earliest Man

MR. J. REID MOIR, with an admirable sense of propriety, took as the text of his Huxley Memorial Lecture for 1939 before the Imperial College of Science and Technology on May 4 certain questions posed by T. H. Huxley in his famous book "Man's Place in Nature". There Huxley asked: "Where, then, must we look for primeval man? Was the oldest *Homo sapiens* Pliocene or Miocene, or yet more ancient?" Readers of Mr. Reid Moir's lecture in its published form ("The Earliest Men". By J. Reid Moir. London: Macmillan and Co., Ltd. Pp. 32. 1s. net) will appreciate the choice as lecturer on this occasion of an investigator of man's origins, who through his association with Edwin Ray Lankester is directly linked with Huxley, and also by his own researches has contributed so much of the material which must be taken into account by everyone who ponders the problems thus formulated by Huxley so long ago. The evidence of man's skeletal remains, as well as of his artefacts, which has been laboriously collected, pieced together and interpreted by numerous investigators since Huxley's day, ably summarized and surveyed by Mr. Reid Moir, may seem formidable enough in its detailed mass, but it is still far from offering a final solution of man's origins. Nevertheless it makes it possible to adumbrate a generalized formula, from which it may be that a concrete answer eventually will emerge. If in the meantime Mr. Reid Moir's technological and aesthetic arguments may seem a little overweighted in the period and degree of man's development they demand, and his credence in Miocene man a thought too readily conceded, none can deny that in his life work he has abundantly shown faith in that of which his powers of observation and reason have convinced him—the belief in the power of truth ultimately to prevail, which Huxley urged upon the youth of his time.

Verulamium Museum

THE new Verulamium Museum at St. Albans, which has been erected by the Corporation at a cost of £8,000, was declared open by the Earl of Harewood on May 8. The purpose of the Museum is to house the finds from the excavation by Dr. R. E. Mortimer Wheeler and the late Mrs. Wheeler between 1930 and 1934 of the Roman city of Verulamium and the pre-

Roman Belgic city in Prae Wood. A tablet in the entrance hall commemorates Mrs. Wheeler's part in the excavation. The museum building, of which Mr. F. Newton is the architect, and Mr. Philip Corden will act as curator, contains in addition to offices and laboratories, a museum hall 75 ft. long, in which are displayed a selection of the finest and most typical specimens from the two sites, grouped in an arrangement which will most readily convey their significance to the visitor. The large mass of material still under examination at the Institute of Archaeology in London will eventually be stored in the Verulamium Museum, and though not displayed, will be available for students' reference. Three of the finest of the mosaic pavements discovered at Verulamium, including the square pavement displaying the remarkable head of a sea god, and the striking semi-circular scallop-pattern pavement of about A.D. 180–190, are shown on the end-wall, facing the visitor on entering. On the left of the entrance are the wall-cases containing the Belgic pottery, both imported and home-made, from the pre-Roman site of Prae Wood, ranging in date from about A.D. 10–40. The remaining cases are given up to exhibits from Verulamium. The material culture of the inhabitants of the Roman site is exhibited in the long series of burial groups, among which not the least interesting relic is a denarius of Augustus, which was converted into a Mithraic token some two centuries after its issue. A large model of the important south-eastern, or London, gate is also shown.

Preservation of Fauna and Flora

IN an address entitled "The Dawn of a Geological Period" delivered at the London School of Hygiene and Tropical Medicine on May 4 for the University of London, under an arrangement for an exchange of lectures with the Universities of Belgium, Prof. V. van Straelen, director of the Royal Natural History Museum of Brussels, discussed the inroads made on the fauna of the world by the activities of man and especially by the exploitation of Central Africa. He pointed out the fact, which is usually entirely neglected if not always unrealized, that not only are the larger mammals threatened with extinction by the advance of settled areas in tropical Colonies, but also that the felling of rain forests, by exposing the soil to the direct attack of sunlight, renders it impossible to reforest such lands, and by completely altering all the micro climatic conditions, necessarily causes the destruction of all smaller plants and animals, whether they live above, upon or in the soil. In the light of his own great experience of such conditions, and of others the ultimate effects of which are similar, Prof. van Straelen showed that the changes of fauna and flora which are now occurring are in magnitude analogous to those which characterize the geological periods, and thus justified his title.

Cosmic Rays

PROF. P. M. S. BLACKBURN took "Cosmic Rays" as the subject of the thirtieth Kelvin Lecture which he delivered before the Institution of Electrical En-

engineers on Thursday, April 27. He gave a *résumé* of what had been done to discover the nature of these mysterious rays, from their properties. As a rule, engineers consider natural phenomena first of all to find out some possible utility for them. In addition, Prof. Blackett stimulated the imagination of his audience to consider all manner of possible consequences which might arise from the bombardment of the earth from outer space by some twenty particles per minute at astronomical values of electron volts. The effects of cosmic rays can be obtained, shown by experiment and recorded photographically without much difficulty and with quite simple apparatus, but calculation of these effects depends upon equations which, although easily written down, can only be approximately solved with great labour. The labour can be lightened by the use of calculating machines invented by engineers, but it is a lengthy operation. There is little exact knowledge about these rays and it is assumed that they are due to radiation from the extra-solar universe. Interesting accounts were given of the attempts that had been made on these rays by researches in the upper atmosphere, by investigations on the surface of the earth and by experiments below its crust. He said that, in the last case, the necessary apparatus had been installed in one of the underground platforms of the Holborn station of the London Passenger Transport Board, but it was found that the symmetry of the readings was effected by the presence overhead of the tunnel which carries the electric trams below Kingsway.

Photography in Science and Industry

DR. OLAF BLOCH, chief chemist of Messrs. Ilford Limited, delivered the twenty-ninth annual May Lecture before the Institute of Metals on May 10. Dr. Bloch pointed out that the photographic emulsion consists of a finely divided suspension of one or more of the halides of silver in gelatin. There are two broad theories of development, one of which suggests that the process consists in the deposition of silver upon the latent image from the developer which has first become supersaturated, whilst the second postulates increased adsorption at the points constituting the latent image with consequent increase of developer activity in these regions. As to the latent image, we are still without definite proof of its nature. Silver bromide crystals become much more sensitive by the inclusion in them of a small amount of iodide, but the great advance which has been made in emulsion-making technique is largely due to the employment of dye-sensitizers. The second part of the lecture dealt with the applications of photography to industry. By means of the photographic emulsion our powers of observation extend far beyond the limits originally set by the senses, and, further, the grains of the emulsion are rendered developable by the passage of the fast moving particles ejected from disintegrating atoms. Investigations into the nature of cosmic rays are also being actively carried on by the aid of the photographic emulsion. For this work special emulsions have to be prepared, but all are members of a large

emulsion family who serve mankind in the making of illustrations for books, in survey work, in photomicrography and photo-telegraphy, for ordinary picture making and record work, and in nearly every field of research.

Sound Transmission from London Television Station

It is well known that the use of ultra-short wavelengths for broadcasting purposes facilitates the attainment of a very high quality in the sound transmission on account of the extensive range of side-band frequencies which may be employed. At a meeting of the Wireless Section of the Institution of Electrical Engineers on May 3, Messrs. I. L. Turnbull and H. A. M. Clark read a paper on "The Marconi-E.M.I. Audio-Frequency Equipment at the London Television Station". This paper outlines the requirements of a high-quality sound equipment and describes the design and constructional features of the Alexandra Palace installation. The final section of the paper gives information on the overall performance of the apparatus and includes data on the frequency and harmonic distortion of the amplifier equipment. The overall frequency response from the microphones to the modulated radio frequency output to the transmitter is practically uniform from 40 cycles per second to more than 10,000 cycles per second; the second harmonic content varies up to a maximum of 0.5 per cent for full (that is, 100 per cent) modulation, while at the same modulation level the third harmonic content is about 0.1 per cent. The authors express the opinion that it is this low odd-harmonic distortion, quite as much as the extended frequency range, that is responsible for the satisfying and pleasing quality of the sound transmitted. The equipment has been in operation for a period of two years with complete satisfaction. It may be remarked in conclusion that, for some time past, it has been the practice of the British Broadcasting Corporation to transmit part of the ordinary National or Regional programme through the Alexandra Palace 'sound' transmitter, so that listeners having a television or other suitable ultra-short wave receiver may take advantage of this high-quality broadcasting station.

Maternal Mortality and Industrial Welfare

In the course of an address delivered to the Industrial Welfare Society on April 28, the Minister of Health, Mr. Walter Elliot, stated that the provisional maternal mortality figures for 1938 have just been received and that they show a further reduction from 3.13 per 1,000 births in 1937 to 2.97 in 1938, the lowest figure ever recorded in Great Britain. Although abnormally large sums have now to be found for defence, there has been no reduction in our social services. The Government's contribution to these services and to the cost of police, roads, etc., has grown by £186,000,000 since 1925, an expenditure that is proving an excellent investment. In addition to the new low record in maternal mortality, during the period 1927-37 the infantile mortality rate has fallen from 70 to 58, and the tuberculosis death

rate from 97 to 69. The toll of sickness upon industry remains, however, very great, for expenditure on benefits under National Health Insurance amounted in 1937 to £28,000,000, but hundreds of firms to-day are safeguarding the health of their staffs.

Earthquakes Registered at European Observatories

FOUR earthquakes of considerable severity have been registered by seismographs in Europe recently. The first, on April 28, was registered at De Bilt (Holland) at 0h. 38m. 15s. G.C.T. and may have been distant a little more than 24° . The second caused the needle on a seismograph in London to swing about $3/5$ in. It was recorded at De Bilt on April 30 at 3h. 12m. 0s. G.C.T., and at Uccle at 3h. 12m. 12s. Since the epicentral distance was greater than 100° , observations are awaited from more distant observatories before further computations are made. The third was on May 1, and this is discussed below, being the most important of the four. The fourth was recorded at Kew on May 2 at 13h. 27m. 12s. and may have been an aftershock of the one on the previous day, though a slightly nearer epicentre may be indicated.

Japanese Earthquake of May 1

RECORDS of this earthquake have been reported by the following observatories:

De Bilt	at 0h. 10m. 42s. G.C.T.
Strasbourg	at 0h. 10m. 47s. G.C.T.
Uccle	at 0h. 10m. 47s. G.C.T.
Kew	at 0h. 10m. 52s. G.C.T.
with an aftershock	at 0h. 12m. 32s. G.C.T.

The epicentre distance from all these stations was between 80° and 83° and the evidence points to an epicentre in the neighbourhood of the Oga Peninsula north-west of Akita, a town on the north-west coast of the main island of Japan. Possible epicentral co-ordinates are lat. 39.8° N., long. 139.9° E. The shock occurred at 2.59 p.m. local time and lasted 27 seconds. It caused strong vertical movement locally and there was a considerable amount of surface faulting. In the Oga Peninsula the faulting caused land to slide into the sea, and wrecked many houses. In Akita itself plate glass windows were shattered and shop fronts fell out. The reservoir at Funakawa is reported to have burst its banks and drowned three people. Altogether twenty-six people were killed and thirty-eight injured and many slept out in the open that night. Fortunately, the resulting fires were quickly extinguished by the fire brigades, though railway and telegraph communications were disturbed. Aftershocks were frequent locally for some time and some of these were of considerable severity as the Kew records indicate.

The Colonial Service: Recent Appointments

THE following appointments and promotions in the Colonial Service have recently been made: R. H. A. Marlen, veterinary officer, Gold Coast; E. Burt, junior entomologist, Sleeping Sickness Research Station, Tanganyika Territory; A. E. Pound, inspector of plants and produce, Gold Coast; G. H. Swynnerton, game ranger, Tanganyika Territory; R. B. Warner, inspector of produce, Nigeria; G. J. L.

Burton (senior plant breeder and experimentalist) chief research officer, Agricultural Department Kenya; G. Griffith (assistant agricultural chemist Uganda), chemist (soils), Malaya; G. R. Spurrell (inspector of plants and produce), agriculture superintendent, Gold Coast; Dr. G. J. William (assistant geologist, Tanganyika Territory), geologist Gold Coast; R. G. Newberry (schoolmaster), agricultural education officer, Agricultural Department Nigeria; W. H. Reeve (late assistant field geologist Tanganyika Territory), geologist, Nyasaland.

Announcements

SIR CHARLES VERNON BOYS has been awarded the Elliot Cresson Gold Medal of the Franklin Institute in recognition of his scientific achievements, "which have furnished scientists with new and remarkably precise methods for making measurements in gravitation, in sound, in heat, in radiation, in current and static electricity, so refined as to render possible the weighing of the earth, the determination of the radiant energy coming to us from the stars, the photography of the speeding bullet and the immobilization, even, of the lightning flash itself". The medal will be presented on May 17.

THE Chalmers Gold Medal of the Royal Society of Tropical Medicine and Hygiene has been awarded to Dr. Max Theiler of the International Health Division of the Rockefeller Foundation, New York. The medal has been awarded to Dr. Theiler in recognition of research of outstanding merit in tropical medicine or tropical hygiene particularly in reference to yellow fever, and the possibility of producing the vaccine by the use of attenuated virus.

THE twenty-fifth French Congress of Social Hygiene will be held at the Bordeaux Faculty of Medicine under the presidency of Dr. George Rislar on May 19-21. Further information can be obtained from L'Alliance d'Hygiène Sociale, 5 rue Las Cases, Paris.

AN International Meeting on Physics is being arranged during September 4-16 by the Federal Institute of Technology and the Physical Society of Zurich in connexion with the Swiss National Exhibition which was opened by the President of the Swiss Confederation on May 6. The meeting will be divided into five sections, dealing with nuclear physics, physics of the solid body, technical physics, television and high-frequency studies, respectively. Leading scientific workers in these subjects from all parts of the world are taking part. Further particulars can be obtained from the Secretary, International Meeting on Physics, 41 Gloriastrasse, Zurich 7.

THE English Universities Press, Ltd., Little Paul's House, Warwick Square, London, E.C.4, is organizing a competition for schools in the form of question papers on three of its recently published books: "Man against Microbe", "Physical Science in Modern Life" and "Ascaris: the Biologist's Story of Life". The age limit is nineteen years and the competition closes on July 31. Particulars can be obtained from the English Universities Press, Ltd.

Research Items

Petroglyphs of North Central New Mexico

IN the eleventh report of the Archaeological Survey Series of the University of Denver, Colorado ("Petroglyphs of North Central New Mexico", Anthropological Department, University of Denver. Pp. 58 with plates), Prof. E. B. Renaud gives the results of exploratory investigation of the rock carvings, engravings and paintings to be found in the region centring on Santa Fé, which was initiated in 1932, carried on in succeeding seasons, and finally reviewed in an expedition of 1938. The region to the north and south of Santa Fé, here under survey, is divided into three areas, north, west and south-eastern, mainly on geographical grounds. The petroglyphs found in these divisions do not differ materially in character. The whole region is bisected from north-east to south-west by the great Rio Grande valley. Certain general conclusions are drawn from the detailed descriptions of the sites. All sites, with a single exception, have anthropomorphic representations, whether realistic or schematic, isolated or in groups. Among occupations noted are dancers, flute-players, hunters, and warriors. Several dancers wear headdresses—horns or feathers. There were a few instances of men on horseback. The presence of phallic figures, frequently ithyphallic, is unusually marked. Simple or stylized human figures are present on all sites. Hands are seen at fairly numerous sites, though never many together. Zoomorphic figures are abundant, though not to be identified with certainty, excepting deer. Eight sites display birds, one type being the spread-eagle or 'thunder-bird'. The serpent is omnipresent. Phylomorphs are rare, and skeuomorphs not numerous. There is a vast class of geometric figures, signs, and symbols. Though no chronology is attempted, the majority of the figures belong to the prehistoric period of the south-west, which in Mexico ends about A.D. 1540, when the horse first became known to the Indians.

Iron Age Settlement in Wiltshire

THE excavations of the smaller of two prehistoric sites at Woodbury, near Salisbury, Wiltshire, now being carried on by Dr. Gerhard Bersu on behalf of the Prehistoric Society in pursuance of its recently instituted policy of systematic research in the field, have thrown considerable light on social conditions in the Early Iron Age in Britain. The report on the first season's excavation (*Proc. Prehist. Soc.*, N.S., 4; 1939) states that in the period from June 12 to September 18 about one fifth of the total area of the settlement of about 15,000 sq. metres, was uncovered down to the chalk. The settlement belongs exclusively to Early Iron Age A, and was of long duration. A ditch planned during the existence of the settlement was never completed; but it is evident from analogous sites in the area that some threat, at present of unknown character, forced the inhabitants to defend their open settlements by banks and ditches. This was at a time when hill-forts also were being planned. At one period, a simple palisade surrounded the site; but whether before or later than the construction of the ditch awaits elucidation. The main features of the site are the provision by pits and over-

ground structures for the storage of grain after partial roasting, hollows in which it is suggested the harvested grain was prepared for roasting and storage, and two circular structures for habitation—the first of their kind to be found in Early Iron Age A in Britain—of which the larger with the longer structural history, and situated in the middle of the enclosure, is clearly the principal building and the residence of the proprietor of the settlement. This settlement was neither a cattle kraal, as had been suggested, nor a village, but a farm in the nature of the subsequent Roman villa.

Revival After Electric Shock

W. T. McNIFF has reported (*J. Elec. Workers and Operators*, 36, 145; 1937) that he is able to revive small animals, which have been apparently killed by electric shock, by the application of a 'counter-shock' of 60 cycle A.C. As Wiggers has shown, the heart in fibrillation can be made to beat normally by the passage of an electric current through it, and this, apparently, is the mode of action of the 'counter-shock'. If the lethal shock is applied through electrodes on the head and tail, revival is not possible, since the central nervous system is destroyed. It follows, therefore, that this method cannot be employed to revive those subjected to legal electrocution. For the method to be effective, the lethal shock must not pass through the head, and the counter-shock must be applied through electrodes on chest and back within four minutes of the patient having received the apparently lethal shock.

Action of Quinine on Skeletal Muscle

A. M. HARVEY (*J. Physiol.*, 95, 45; 1939) has studied the actions of quinine on skeletal muscle, on the motor end-plate, and on the responses of the muscle to various other drugs in frogs, domestic fowls and cats with the following results. Quinine caused an increase in the tension response to a single maximal stimulus in normal, curarized and denervated muscle. This mechanical potentiation was accompanied by an increase in the amplitude and duration of the muscle action potential. The ability of the muscle to respond to a tetanus was diminished owing to an increase in the refractory period of the muscle fibres. The excitability at the motor end-plate was lowered by quinine, and the ability of a tetanus to facilitate conduction at the end-plate was weakened or abolished. Eserine and veratrine were no longer able to evoke repetitive response to a single stimulus in a muscle treated with quinine. The response of the normal mammalian muscle to injected acetylcholine was abolished by quinine. This phenomenon was largely due to the curariform action of the drug, the otherwise similar response to injection of a potassium salt being little affected.

Optical Isomerism and Growth

J. R. TOTTER and C. P. BERG (*J. Biol. Chem.*, 127, 375; 1939) have prepared the optical isomers of natural tryptophane, histidine and lysine, and given them to mice in diets deficient only in the corresponding natural form and under conditions analogous to

those previously employed in similar studies on rats. The growth promoted by the unnatural isomers of tryptophane and histidine was found to be slower than that induced by the modifications which occurred naturally in proteins. The response was quantitatively but not qualitatively at variance with that observed in rats. Unnatural lysine in the mouse as in the rat failed to promote growth when added to diet deficient in natural lysine.

Mammals of Tennessee

A USEFUL account of the mammals of this State has been based upon the special survey made by the U.S. National Museum in 1937, supplemented by all the relevant material in the collections of the Museum and of the Biological Survey (Remington Kellogg, *Proc. U.S. Nat. Mus.*, 86, 245; 1939). The author does not draw any conclusions from his list, but it is apparent that this is a fair sample of the mammals of the eastern States, its notable feature being perhaps the degree to which man has changed the aspect of the original fauna by his interference. The tale is largely one of reduced numbers and extermination. There is scarcely a creature, valued even in small degree for its pelt, which is not reported to be decreasing; even the opossum and raccoon are fewer, mink and skunk are becoming rare, fisher and otter and perhaps beaver are extinct. So with the larger beasts of prey, the grey wolf, black bear and others having been exterminated in many sections. Bison and elk disappeared in the early years of the nineteenth century; even the Virginian deer seems to be on its last legs, though in 1789 where troops were stationed good venison was accepted in lieu of taxes at a value of 9d. a pound. On the other hand, there have been additions to the fauna: fifteen wild swine from northern Germany were enclosed in 1912 and multiplied; about 100 broke through the fence in 1920 and now their progeny ranges over an area of 50 square miles. Coyotes have also been introduced recently, "for the purpose of training hounds" it is said; and of course those invariable camp followers of civilisation, the house-mouse, black rat, Alexandrine rat and brown rat have long been successfully established.

Distribution of Crop Productivity

It has been found that an area which produces high yields of one crop, for example, wheat, will as a rule also produce yields above the average of other crops, for example, barley, hay or potatoes. A statistical analysis of the geographical distribution of crop productivity in England (*J. Roy. Statistical Soc.*, 102, 21; 1939) has been made by M. G. Kendall, head of the Statistical Branch of the Ministry of Agriculture. The economic importance of the results is obvious, but from a wider point of view perhaps the most interesting aspect of the analysis is the application to agricultural economics of methods devised for psychological tests of intelligence. The prevalence of positive correlations between yields of different crops is a phenomenon similar to the prevalence of positive correlations of the results of mental tests. It is natural to ask if there is a coefficient of general productivity analogous to Spearman's ρ , the much-disputed general factor in intelligence. Mr. Kendall offers no fewer than four such coefficients. The first two, the 'productivity' and 'ranking' coefficients, are based on psychological methods.

These two coefficients give nearly the same results; the first is preferable theoretically, but the second is much easier to calculate. The third and fourth, the 'money-value' and 'energy' indexes, are spatial index numbers, agreeing fairly well with each other, but not so well with the previous pair. Finally, an attempt is made to estimate the validity of the conclusions reached by psychologists by seeing how far the same arguments hold when applied to crop productivity.

Potato Metabolism and the Blight Fungus

AN interesting paper upon the rates of growth of potato foliage and tubers in relation to attack by the blight fungus, *Phytophthora infestans*, by the late P. A. Murphy, has recently been published (*Sci. Proc. Roy. Dub. Soc.*, 22, N.S. No. 7, 69-82, February 1939). It has proved relatively easy to eliminate blight, but more difficult to avoid injury to the foliage. The first effect of spraying is usually to check the production of foliage and tubers, and benefits of the fungicidal wash only become apparent later, when the parasite is eradicated. Complete control of the disease without appreciable injury to the plant was effected by weekly applications of dilute solutions of cuprous oxide, with about half the quantity of copper usually given per acre with Burgundy mixture. Maximum production of tubers reached 1½ tons per week during the month of July, after which it fell off, until in September it was not much above ½ a ton per week. The period of maximum tuber production corresponded with that of maximum foliage. Benefits of spraying depend upon the interval between the arrest of production caused by the blight fungus, and the time of normal cessation of growth in September.

Sexual Isolation

ALTHOUGH it has been known for some considerable time that preference in mating was a powerful means of isolating one species or race from another there has been little experimental evidence available. T. Dobzhansky and P. C. Koller (*Biol. Zentralb.*, 58, 589; 1938) have analysed preferential mating between *Drosophila miranda* and *D. pseudo-obscura* and between *D. aestiva* and *D. athabasca*. It was found that in mixed cultures of these species homogametic mating was greatly preferred. Degrees of preference were, however, exhibited when different races of *D. pseudo-obscura* and *D. miranda* were used. Within *D. miranda* two races (Olympio and Whitney) exhibited a small degree of preferential homogametic mating. Although these species have approximately similar distributions in the wild they remain isolated from one another. There are indications that mating preference is genetical in origin and dependent on genes on the autosomes.

Earthquakes of the Pacific Coast of U.S.A. (1769-1928)

THE whole of vol. 29, No. 1 (Jan. 1929), of the *Bulletin of the Seismological Society of America* is taken up with this descriptive catalogue compiled by Sidney D. Townley and the late Maxwell W. Allen. It occupies 297 pages, earthquakes in California taking 232 pages whilst those of Oregon, Washington, Idaho, Nevada, Utah and Arizona take 44 pages in all, the remainder of the volume being concerned with the introductory remarks. The material used in the catalogue has been largely taken from the Holden

(1769-1897) and McAdie (1897-1906) catalogues, and since 1906 from notes by U.S. Weather Bureau observers, newspapers, magazines and the records of individuals and societies interested, all of which are acknowledged by the authors, and all of which have been carefully checked. The catalogue stops at 1928, since after that date the records have been kept and published by the U.S. Coast and Geodetic Survey annually. There are no figures or maps, and indeed it would be difficult to put all the matter accurately on a map unless it were drawn to an abnormally large scale, but it is hoped that in the near future Mr. Townley will arrange that this valuable information be arranged in geographical latitude and longitude order somewhat after the manner of Miss Bellamy's Catalogue, with cross references to the present work, as this would make it much more valuable from both the statistical and the ready reference points of view.

Detection of Nitrous Fumes

THE detection of nitrous fumes, which are encountered in many industrial operations and are dangerous poisons, is described in Leaflet No. 5, "Methods for the Detection of Toxic Gases in Industry, Nitrous Fumes" (H.M. Stationery Office. 3d. net) issued by the Department of Scientific and Industrial Research. The test depends on the Griess-Isolvy reaction. The atmosphere under test is drawn by a hand pump through a tube containing the reagent until a rose-pink colour of standard depth is reached, and from the number of strokes of the pump the concentration may be found from a table given in the leaflet.

Distribution of Carbon Isotopes

A SYSTEMATIC study of the relative abundance of the carbon isotopes ^{12}C and ^{13}C in various groups of materials has been made by A. O. Nier and E. A. Gulbransen (*J. Amer. Chem. Soc.*, 61, 697; 1939) with a mass spectrometer of high sensitivity and high resolving power. The compounds studied were arranged in four groups: (1) igneous carbon (graphite, meteorite and diamond); (2) limestones; (3) plant sources; (4) various (dry ice, air, flesh, coal, etc.). The $^{13}\text{C}/^{12}\text{C}$ ratio found appears to depend upon the classification of the material. In general, the heavy isotope seems more abundant in limestones and the light isotope in plant forms. The maximum variation in the ratio was about 5 per cent. More data would probably provide a method of determining the origin of carbon compounds in Nature. If the $^{13}\text{C}/^{12}\text{C}$ ratio in air is assumed to be 90 ± 2 , the atomic weight 12.012 is calculated for carbon, with the isotopic weights 12.0041 and 13.0079, and a conversion factor of 1.000275 in going from the physical to the chemical scale.

Structure of Triborine Triamine

TRIBORINE triamine, $\text{B}_3\text{N}_3\text{H}_6$, is iso-electronic with benzene. Fuller implications of this are brought out very elegantly by B. L. Crawford and J. T. Edsall (*J. Chem. Physics*, 7, 223; 1939) from a study of the long-wave spectroscopy of $\text{B}_3\text{N}_3\text{H}_6$. They have examined the Raman spectrum of liquid $\text{B}_3\text{N}_3\text{H}_6$, and the infra-red spectrum of gaseous $\text{B}_3\text{N}_3\text{H}_6$. The symmetry of the molecule is D_{3h} , and it should therefore have twenty distinct internal vibrations. Of these, seven should appear in the Raman spectrum only (four should be polarized), three should appear

in the infra-red spectrum only, seven should be common to both spectra, and three should be inactive in both spectra. These theoretical predictions have been substantially verified by the ascertained spectra, but the number of coincident frequencies is less than the predicted seven. However, by means of a normal co-ordinate treatment of the molecule, it has been possible not only to calculate the force constants of the various bonds but also to calculate all the fundamental frequencies, both active and inactive. This permits the assigning of all observed frequencies. One instance of an isotopic effect, due to molecules containing the isotope of boron of mass 10 has been noted and thermodynamic properties of $\text{B}_3\text{N}_3\text{H}_6$ have been calculated. The interesting comparison of the spectra and force constants of $\text{B}_3\text{N}_3\text{H}_6$ and C_6H_6 , which is made leads the authors to favour the assignment of the benzene frequencies made by Lord and Andrews in preference to the assignment of Angus, Bailey, Ingold, and co-workers.

American Meter-testing Methods

IN Mr. Shotter's recent paper to the Institution of Electrical Engineers on April 14, several useful and novel methods of testing electric meters are described which deserve to be better known in Great Britain. He was struck by the fact that Americans have to a large extent eliminated the use of stop-watches in their electrical laboratories, the timing being effected by impulses from a standard clock. This is achieved by the aid of a photo-electric cell. The method consists of keeping a constant load on the rotating substandard electric meters, which are kept under test for a definite time period with the potential circuit of these instruments controlled from the standard clock. A method which appears to be becoming popular is the use of a rotating standard fitted with a stroboscopic attachment, one meter at a time being tested. With the types of meter the Westinghouse Co. is producing the method appears to be very satisfactory. Mr. Shotter saw also a chemical method for cleaning badly corroded and tarnished clockworks and other types of mechanism. The method employed consists in the use of a rotating cleaner containing one or more solutions in which the clockwork is immersed for a short time. Similar apparatus for cleaning watches and clocks has been on the market in the United States for some years. The method appears to have considerable possibilities. Microscopic examination of pivots and jewels was employed in all the servicing laboratories which the author saw.

Measuring Focal Lengths of Zones of a Mirror

W. H. NEWMAN's paper entitled "A Method of Measuring the Focal Lengths of Zones of a Mirror for a Reflecting Telescope" (*J. Brit. Astro. Assoc.*, 49, 5; March 1939) will prove interesting to all makers of specula. Instead of using a complete Ronchi grating, two fine slits were employed, or, to be more correct, two lines were ruled with a needle on smoked glass, their distance apart being 0.02 in. The glass was smeared with paraffin first as this facilitates the ruling of straight lines, whereas smoking the glass without this paraffin coating may lead to ragged edges. This modification of the Hartmann method of testing was discussed by experts at the meeting of the Association, and some of them were a little dubious of its utility.

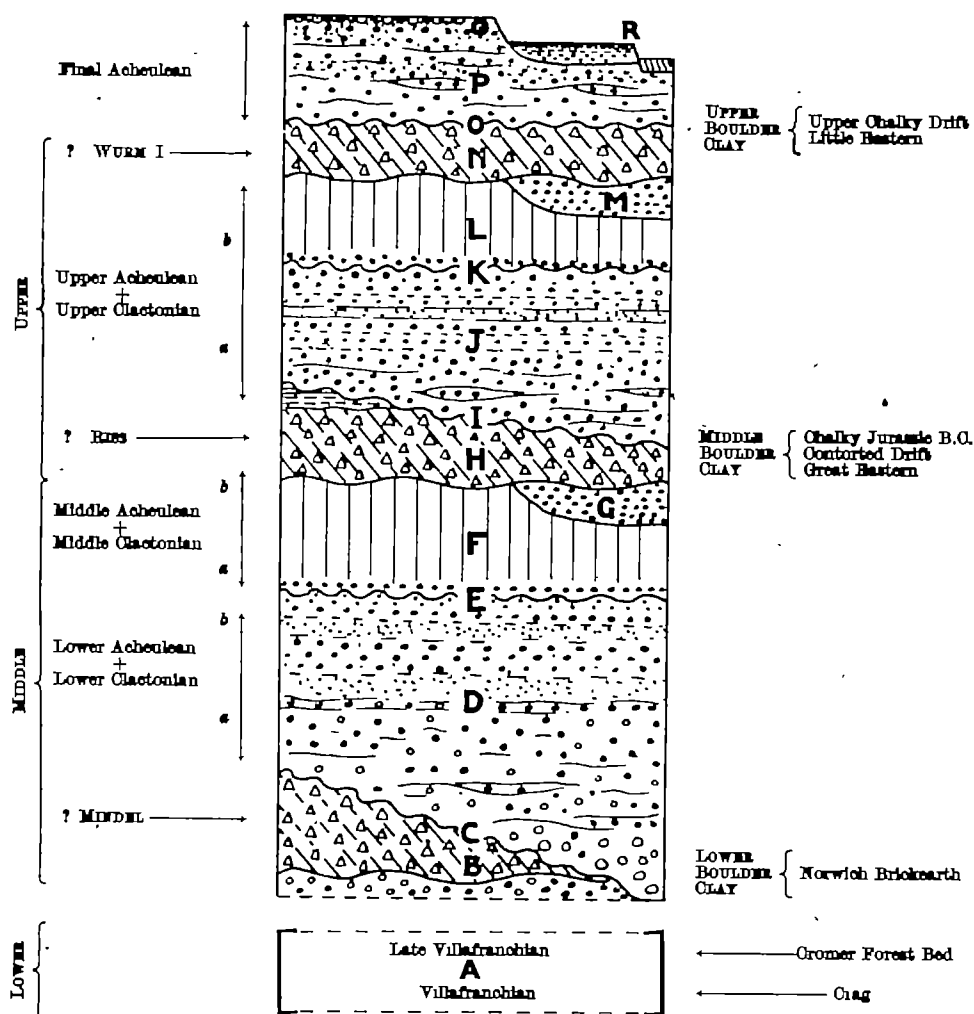
Pleistocene Stratigraphy of the Breckland

By T. T. Paterson, University Museum of Archaeology and Ethnology, Cambridge

AT the British Association meeting last year, during an excursion by the Geological Section to the Breckland, a sequence of the Pleistocene deposits there was demonstrated. Many requests for information have indicated that a short review of the stratigraphy and prehistory, prior to publication of a full memoir on that region, would be useful to geologists and prehistorians interested in the Pleistocene in England.

Moreover, they are coloured brownish by reason of loam and clay derived from an earlier interglacial deposit. The Middle and Upper have previously been confused and named the Upper Chalky Boulder Clay.

The Lower Boulder Clay (*B*) is only found on the slopes of shallow ancient valley forms and on higher ground, having been removed principally by a long period of erosion (*O*) which succeeded the ice advance and was related to a period of uplift. This must be



There are three boulder clays, called here the Lower, Middle and Upper. The Lower, hitherto called the Great Chalky Boulder Clay, is distinguished by its erratics from Scotland, Yorkshire and Scandinavia, as well as Jurassic and Kimmeridgian material; whereas the Middle and Upper are very much alike, carrying a great quantity of English, especially Triassic, erratics and none from very far parts.

been quite extensive since valleys several hundred feet deep were then cut out, and it is the period when the major features of the present landscape were decided. A great period of aggradation filled these valleys with gravels (*D*) up to about the level of our present river system. A warm fauna roamed the land surface so established. A period of increased rain deposition led to some slight erosion (*E*) and

subsequent formation of a loam (F). Another period of slight aggradation with a temperate fauna (G) was followed by advance of an English glacier (H), when the land was depressed some 150 feet.

The sequence of the first interglacial was repeated, but during a shorter second interglacial. Uplift was followed by erosion (I), valleys being excavated, generally along previously established drainage lines though some deflections occurred. Aggradation (J) was continued into a temperate period. A colder oscillation (K) was followed by temperate conditions, and deposition of a loam (L). A period of slight erosion (M) cut into the loam, and the Upper Boulder Clay was then deposited as a skin over the greater part of the Breckland, though not in the hills to the south.

This boulder clay and its associated gravels form an Upper Terrace dissected by an erosion phase (O) which cut out the present radial drainage of the Breckland. A Middle terrace was formed of well bedded gravels (P). Towards the upper part a cold fauna is succeeded by a bed (Q) showing the effects of sludging under severe cold conditions. A period of erosion and aggradation forms a late Low Terrace (R).

Because of its general lithological character and physiographic configuration the Lower Boulder Clay (the Great Chalky Boulder Clay of West Norfolk and Suffolk) is equated with the Norwich Brickearth. The Middle Boulder Clay is equated with the Great Chalky Boulder Clay (the Great Eastern Drift) of East Norfolk and Suffolk. The Upper Boulder Clay is equated with the 'Upper Chalky Boulder Clay and Little Eastern Drift'. A more widespread correlation is not possible here, but will appear in the full memoir, which, it is hoped, will be published later this year.

At several horizons palaeolithic industries have been discovered. The Acheulean is divisible into Lower *a* and *b*, Middle *a* and *b*, Upper *a* and *b*, and Final. The Clactonian can similarly be subdivided, into Lower *a* and *b*, Middle *a* and *b*, and Upper *a* and *b*. In general, it may be said that:

The Lower Acheul occurs during the early part of the Lower-Middle Interglacial prior to phase (E) and is characterized by free flaking, no controlled secondary work, no fine retouch, thickness, cortex remains, irregular outline and dominant pyriform shapes.

The Middle Acheul occurs during the later part of the Lower-Middle Interglacial and is characterized

by the presence of much controlled secondary working, some retouch (more in Middle *b*), and lingulate and ovate forms dominant. (In southern England the pseudo-Micoquian is dominant in Middle *b*.)

The Upper Acheul appears in the Middle-Upper Interglacial and is characterized by much controlled secondary working, fine retouch including controlled step retouch, thinness, no cortex, very fine and regular outlines (twisted forms common), small foliates, pointed ovates and straight-sided pyriform types dominant.

The Final Acheul appears in the post-Upper Boulder Clay aggradation gravels with the same general characters as the Upper Acheul, somewhat finer if anything, but the 'proto-celt' and the triangular forms appear.

The Lower Clacton occurs in the same period as Lower Acheul; with massive flakes, generally much cortex remaining, no controlled secondary retouch, no specifically prepared forms, and the cores coarsely biconvex and serrate, with no flat-bottomed forms.

The Middle Clacton occurs in the same period as the Middle Acheul and has thinner flakes, cortex wholly removed, controlled secondary working, some retouch, specifically prepared forms, points and such-like, proto-Levallois and Levallois cores, biconvex, serrate and flat-bottomed.

The Upper Clacton occurs in the same period as the Upper Acheul. Apparently the Upper Acheul has absorbed some northern Upper Clacton* elements and the only dominantly Clacton industry is of southern facies†, direct descendant of a Middle Clacton *b* of the Thames. The flakes are equally side- and end-types from biconvex and flat-bottomed cores, and of specific shapes. There are no pseudo- or proto-Levallois flakes or cores. The flakes are strong with median ridges instead of flake scars. There is no secondary working, but finely developed scaling retouch. Outlines are regular.

Faceted, possibly Levallois, flakes are occasionally found but no industry has so far been unearthed.

On broad palaeontological and stratigraphical grounds, the Pleistocene is divided into Lower, Middle and Upper. This division corresponds to three cycles of deposition, the first being less marked than the others. Both Middle and Upper begin with extensive land movement. The Lower is so named because of the Villafranchian and late Villafranchian character of the fauna.

* "Tayacian" stem of the Clacton.

† "Moustorian" stem of the Clacton.

British Empire Telegraph Communications

DURING the last ten years very rapid progress has been made in both telegraph and radio communication throughout the British Empire. In a paper by K. L. Wood recently read to the Institution of Electrical Engineers, the engineering aspect of the whole of this world-wide communication is considered. A short history of progress in cable telegraphy is given, but full explanations are given of novel technical methods. Methods of operating radio are also described, and reference is made to the effects of varying cosmic conditions on radio signals.

September 29, 1929, was a notable date in world communication, as on that date all the telegraph communications of the British Empire were, by Act of Parliament, placed in the hands of a single operating company. At the same time an Imperial Communications Advisory Committee was set up, the members of which were nominated by the British and Dominion Governments. A long list is given of the main companies taken over by the operating company. In addition, the ship and aircraft services were taken over as well as various small radio

circuits. In many parts of the world, the cable systems have been reorganized. The terminals of certain radio circuits in South Africa, India, Canada, Egypt and Australia are operated by local companies.

The Post Office also maintains a broadcast telegraph service on long and short wave-lengths. Radiotelephony in the United Kingdom is controlled and operated by the G.P.O., but the overseas terminals in the Dominions are controlled by the local companies or by the operating company. The operating company also handles abroad the shore end of various ship services, some of which are fitted with direction-finding apparatus. At Nairobi, Bermuda and Bahrain, Adcock direction-finding stations for air services are in operation. There are radio-phototelegraph services with New York, Buenos Aires, Melbourne and Tokio; also land telephony in Cyprus and Peru, and broadcasting in Kenya. The present telegraph system comprises 155,090 nautical miles of submarine cable, 125 wireless circuits, and 161 overseas branches. The tables given show that nearly all the Empire routes from the United Kingdom are served both by cable and by wireless. London stands out clearly as the focal point of the whole system.

During certain periods of the day, much of the traffic between distant parts of the Empire passes through London. For example, South Africa-India traffic may travel via the Cape Town-London beam and the London-Bombay, or via the cable chains over the same route. Many alternative routes to Australia are given. The choice as between wireless and cable is primarily dependent on the senders' instructions; but the particular route is regulated in part by the out-payments that have to be made on the various routes. These depend very largely on the time of traffic flow, and this, again, is largely dependent upon the business times in various parts of the world. During the night on a route which is served both by wireless and by cable, the cable circuit may carry the bulk of the traffic, since the majority of the cable chain stations may have to be kept

fully manual to serve other routes; methods have now been devised which largely overcome the effects of 'fading' and 'atmospherics'. Vardan working, while largely eliminating fades and atmospherics, fails when both these factors are present at the same time. Considerable experimental work is still being carried out, but only with limited success.

The author also considers the effect of cosmic conditions on wireless telegraph circuits, and explains how in practice large use is made of the effects of the solar cycle when predicting future conditions. The optimum wave-lengths of transmission for any given route are dependent upon the season and the time of the day and—this is an important factor—the degree of solar activity, which is found to follow approximately an 11½ years' cycle. The last sunspot maximum period was during 1928-29, and the minimum period during 1933-34. The years following the latter period have been accompanied by a marked increase in activity, which on a half-yearly basis exhibited a well-defined peak for January-June 1937. Records for the past hundred years reveal that, whilst the average length of cycle is 11.4 years, the change from minimum to maximum activity occurred over an average period of only 4.5 years; a study of wireless data for the year 1938 indicates that it is not improbable that the year 1937 may prove to have been the maximum peak of the present cycle. Unlike long-wave transmission, it is found that increased solar activity, with its increase in ionization, enhances the utility of the shorter wave-lengths.

At certain times and seasons, the attenuation of wireless signals is so low over both the major and minor arcs of the great circle embracing the two terminals that signals may arrive both by the forward and the backward route, and even encircle the globe some two or three times. Diagrams are given showing the reception at the P.O. station at Bridgewater of two consecutive dots transmitted from Cape Town together with a sequence of three 'echoes' of the main transmission, as the result of the rays encircling the globe three times.

The Gorge Dam, Hong Kong

THE problem of providing adequate water storage to meet the needs of the population of Hong Kong is a peculiarly difficult one by reason of the relatively large population living in a small mountainous area in which the rainfall is confined to the monsoon period of about six months. Although provided with twelve reservoirs with a gross capacity of 3,000 million gallons, there were only seven years since 1921 during which an unrestricted supply of water could be given. Faced with the necessity of obtaining further supplies, the director of public works, Mr. R. M. Henderson, came to the conclusion that the best solution lay in constructing a reservoir which should impound the waters of the Shing Mun—a river situated in an area on the mainland leased from the Chinese Government in 1898 for a period of ninety-nine years and known as the 'leased territory'.

The scheme, as finally developed, provided for the construction of a reservoir having a capacity equal to the combined capacities of the existing reservoirs,

thus doubling the provision for the Colony. To give effect to this plan it was necessary to build several dams and, of these, the largest—the Gorge Dam—presents both in its design and in its construction several features of especial interest. These were described in a paper read before the Institution of Civil Engineers by W. J. E. Binnie and H. J. F. Gourley on January 24.

The design selected as most suitable for the purpose and place was based on two principal considerations—economy in construction and the elimination of cracks such as would allow of the penetration of water and might arise from earth tremors or from volumetric changes due to the thermal phenomena exhibited in large masses of setting concrete.

The dam has a height of 275 ft. above the stream-bed and its length at the top is 690 ft. Its main structure, the 'thrust block', is not the actual dam but, in conjunction with the 'rock-fill' and the 'sand wedge', acts as a support for the 'diaphragm' or screen which forms the barrier to the water.

This thrust block transmits the water pressure to the rock-fill and presents to the diaphragm a row of buttresses faced with pre-cast concrete blocks. Against these blocks leans the diaphragm, which forms the main water face and is an articulated structure composed of vertical panels 25 ft. in width. Each panel was made in 'lifts' of 20 ft. at one operation and is reinforced with a 'grille' of steel rods $\frac{1}{4}$ in. in diameter.

Every precaution was taken to ensure water tightness, and when the reservoir was filled to top water-level there was no leakage whatever. The spaces between the buttresses, the centres of which are $2\frac{1}{2}$ ft. apart, and the function of which is to

support the diaphragm, constitute inspection pits whereby the diaphragm can be examined. Access is obtained to these pits by branch galleries connected with the main galleries, which are reached by steps from both ends of the dam. These pits would also, in emergency, act as interceptors of any water leaking from the reservoir and so prevent it entering and disturbing the sand wedge. It will be apparent that the design adopted has produced a structure possessing considerable flexibility so that disturbances might take place without giving rise to more than minor and controllable cracking. The details by which this result is obtained are described and illustrated in the paper.

River Physics in India

ONE of the major problems of India is that of the rivers, and it was with the object of inviting the attention of the central and provincial Governments to the urgency of making investigations on scientific lines that a symposium was organized by the National Institute of Sciences of India a little more than a year ago. The several papers presented have now been published (*Proc. Nat. Inst. Sci. India*, 4, No. 4) and show the profound interest that is being taken in the subject by a number of well-qualified workers. The presidential address by Prof. M. N. Saha pointed out the importance of the rivers to the agricultural life and as a means of the industrialization of India, and dealt with their influence on the level of cities on their banks, instancing the destruction of many ancient cities and the increasing difficulty now being experienced in the drainage of Calcutta by reason of this action (see also *NATURE*, 141, 797; 1938).

"The Post-Tertiary Hydrography of Northern India and the Changes in the Courses of the Rivers during the last Geological Epoch" were dealt with in a paper by D. M. Wadia, in which he traced the tectonic movements which have caused widespread and radical alterations in the whole system of drainage lines. The number, volume and direction of the units of this system bear evidence of changes which in some instances have amounted to the complete reversal of the flow of such a principal river as the Ganges. In a paper on the "Changes in the Drainage of India as evidenced by the Distribution of Fresh-water Fishes", Dr. S. L. Hora adduced evidence from various sources to show that there was a reversal of the drainage in the post-trappean period. From the nature of the valleys of the rivers and from certain other features of the physiography of the peninsula, it is concluded that the present-day lower portions of the rivers are of great antiquity, whereas the upper reaches are comparatively recent.

Coming more closely into touch with the nature of the problem of the present day, one of the difficulties facing the engineer is the construction of works in an alluvial boulder river bed, and the problems in respect of river training thereby presented have yet to be solved. Associated with these is the need for constructing irrigation canals transporting alluvium from the river on such lines as should ensure a condition of working stability and tend neither to silt

nor to scour. This aspect is dealt with in a paper, "Flow of Water in Alluvial Channels", by G. Leacey, in which he directs attention to those elementary principles which help to clarify issues and restrict generalization in river physics. He submits the view that despite the complexity of the problem presented by the great Indian rivers, the basic equations are of a simple nature and that it is on the foundation of the 'normal' or 'regime' channel flowing with constant discharge and silt charge that our ultimate knowledge of river physics must be based.

In his address on "The Use of Models for Elucidating Flow Problems based on Experience gained in carrying out Model Experiments at the Hydrodynamic Research Station, Poona", C. C. Inglis described several types of models and explained why some present little difficulty and yield results suitable for immediate application. Other types, especially those relating to alluvial rivers, present great practical difficulties, and in these cases, the data available are usually too meagre. In so many instances the problems presented are too urgent, requiring immediate steps to arrest the damage that is taking place. The magnitude of this class of problem is shown by the statement that during two years the cost of repairs to the Hardinge Bridge over the Ganges amounted to nearly a million pounds. Such questions require an intimate knowledge of the engineering side of the matter combined with a flair for diagnosis and a capacity to visualize a remedy.

It is the silt carried down by the floods which is at the root of much of the trouble. It has created the land, and made it habitable; it has also fertilized it and made it prosperous. But, as is shown in S. C. Majumdar's paper, "River Problems in Bengal", it has also, by damaging the river channels, caused their diversion through lower areas, leaving the other to become derelict. By raising the beds and consequently the flood level, the silt has created another set of problems, and it is the silt which has destroyed many of the tidal rivers in Central Bengal and is threatening also the cross channels so valuable to navigation. The concluding paper by Dr. N. K. Bose, entitled "River Physics Laboratories of Europe and America", deals briefly with what is being done on these lines elsewhere, but ultimately it must prove that the solution of the problems of India must be found by long and concentrated study of local conditions.

Science News a Century Ago

Exploration in North America and Abyssinia

AMONG the papers read at the meeting of the Royal Geographical Society on May 13 was an account of the recent arctic discoveries of Messrs. Dease and Simpson. This was communicated by the Governor and Committee of the Hudson Bay Company, and when thanking the Company the president announced that two gold medals had been awarded to the explorers. A map was displayed showing the discoveries of Franklin, Ross, Dease and Simpson in 1837-38 and from this it was shown that 150 miles had yet to be explored to connect the recent discoveries with those of James Ross in 1832 and Captain George Buck in 1834.

At the same meeting, Antoine Thompson d'Abbadie (1810-97) gave an account of his recent travels in Abyssinia with his brother Michel Arnaud d'Abbadie (1815-93). They started from Jeddah and visited Massawah, Adowah and also Gondar, from which place Michel endeavoured to penetrate to Enérea.

The Royal Society

At a meeting of the Royal Society on May 16, 1839, a paper entitled "On the Visibility of Certain Rays beyond the Ordinary Red Rays of the Solar Spectrum" was read by J. S. Cooper, who had sent it to Faraday. The author stated that he had observed an extension of the red portion of the solar spectrum, obtained in the ordinary way, beyond the space it occupies when seen by the naked eye, by viewing it through a piece of deep blue cobalt glass. He had found that the part of the spectrum thus rendered perceptible to the right was crossed by two or more very broad lines or bands; and he observed that the space occupied by the most powerful calorific rays coincided with the situation of the red rays thus rendered visible by transmission through a blue medium.

Ductile Thread from Rock Salt

In a communication printed in the *Athenaeum* of May 18, 1839, a foreign correspondent said: "M. Gaudin, one of the employés of the Observatory of Paris, has just submitted to the Academy of Sciences a process for converting Rock Salt into ductile thread. You must not shake your head at this, M. Gaudin is no quack. The Academy, at any rate, received his memoir with marked favour. Everybody knows that glass when in a state of fusion, may be drawn out into very slender threads; and M. Gaudin having succeeded in melting down rock salt, discovered that it was susceptible of the same modifications as vitreous substances—that it could be wound round a bobbin, or converted into a solid tissue at will. But of what use, you may say, is this discovery. According to M. Arago there are various ways of turning it to good account. The torsion balance (la balance de torsion) which in the hands of Coulomb has proved so useful is rendered *uncertain* by the variable elasticity of the wires which support the electric or magnetic needle. To remedy this defect, there can be no surer way than to substitute rock salt threads for the metallic wires now employed". There are other applications equally interesting.

Marc Antoine Augustin Gaudin was born April 5, 1804, and for a long time was a calculator for the Bureau des Longitudes. He devoted much time to researches in optics and in photography.

Societies and Academies

Paris*

Academy of Sciences (*C.R.*, 208, 953-1080, March 27, 1939).

R. FAIVRE and A. MICHEL: Chemical composition and crystalline structure of the product of slow oxidation of magnesium in a moist medium. The black compound formed seems to be brucite (a magnesium hydroxide) with additional magnesium atom inserted in the lattice.

O. BARON: Use of light metals in the composition of explosives with an ammonium nitrate base. Addition of powdered aluminium increases the power of the explosive by 10-12 per cent.

P. JACQUET and P. ROQUENT: Application of electrolytic polishing to the micrographic examination of iron and steels.

G. COSTANTU and P. RENAUD: Action of water on sodium, copper and mercury.

H. GUÉRIN: Arenates of calcium; study of the system $As_2O_3 - OCa - OH_2$ at 17°.

J.-M. DUNOYER: Reduction by hydrogen of allotropic varieties of manganese dioxide.

MILÉ, B. TOHOUBAR and O. SACKUB: Alkaline dehalogenation of chloro-1 cyclohexylmethyl-ketone and of chloro-1 cyclohexylphenyl-ketone; transposition in α -substituted cyclohexylformic acids.

D. BOUBOUX: Preparation of true acetylenic hydrocarbons.

L. DENTIVILLE: Butane diol-2, 3 and its esters.

M. TUOT: Carbonation of organo-magnesium compounds and the secondary reactions which accompany it in the aliphatic series.

R. PAUL: Reactivity of the two dianic systems of furyl ethylene.

A. MICHEL-LÉVY and J. WYART: Synthesis of anorthite by pneumatolysis with the help of an explosive (hexogene).

R. ABRARD and E. A. DE LA RÛN: Marine quaternary formations in the neighbourhood of Obock (French Somaliland).

G. DELAPINE: Extension and characteristics of the marine fauna of the oil basins of Djerada (Morocco) and Kenadza (Southern Oran).

H. BRUILL, L. AUFRÈRE and MME. A. BOWLER-KENLY: The *Hipphas meridionalis* alluvial deposits of the Carpentier quarry near Abbeville.

E. PHILIBIN: A water-sampling bottle. A metal tube of capacity about 2½ litres is used; the limit of depth is about 250 metres.

MILÉ, J. SALMON: Formation and structure of the sieve tubes in the hypocotyledonary axis of *Cucurbita pepo*.

A. BRUNEL and R. ROCHVIN: Assimilation of allantoin by the higher plants.

E. POZZI-ESCOOT: A case of xenia in the vine.

G. NICOLAS and MILÉ, B. AGGÉRY: Effects of the simultaneous presence of three parasitic fungi in *Senecio vulgaris* L.

MME. S. LALLERMAND: Action of colchicine on the chick embryo at different stages of development. The strophosomic reaction is only produced in embryos of 40-68 hours.

A. VANDER: Mode of distribution of the sexes of the terrestrial isopod, *Armadillidium vulgare* (Latr.). Proportions of the sexes are extraordinarily variable.

M. LECAMP: Regeneration of buccal pieces in phasmids.

(Continued from p. 774.)

N. FRETKE: Action of the salts of normal saturated fatty acids on phagocytosis *in vitro*.

J. LAVOILLAY and Mme. F. LABOREY: The lacto-avine produced by *Aspergillus niger* V. Tgh. is characteristic of culture media partially deprived of magnesium.

J. CUILLE and P.-L. CHELLI: Experimental transmission of 'trembling' in the goat. Virus from a sheep suffering from this disease produced 'trembling' in goats after a period of 25-26 months.

Cracow

Polish Academy of Sciences (March 6, 1939).

J. WYSSSENHOFF: Variations of the integrals of hypersurfaces under an invariant form.

A. BIELICKI, M. MATHISSON and J. WYSSSENHOFF: A theorem concerning a transformation of quadruple integrals into curvilinear integrals in Riemann space.

K. DJIEWOŚSKI, W. DYMEK and J. MOSIEW: New syntheses and transformations of compounds of the type of the 2-aryl-4-arylamino-quinolines (13).

K. KONIOR: Interglacial beds of Wilamowice.

Mme. H. WOJTUSIAK, R. J. WOJTUSIAK and A. TURBA: Quantitative researches on the fixed fauna and flora on the piles in Polish ports.

F. ROGOWSKI: (1) Transformation of chlorophyll in a neutralized chyme. (2) Chlorophyll in human digestion. Scarcely three per cent of ingested chlorophyll appears in the faeces, whereas in ruminants 2-22 per cent is eliminated.

Moscow

Academy of Sciences (C.R., 21, No. 3; 1938).

W. NIDMYTSKI: (1) Systems of curves filling a metric space. (2) Families of curves of the Bendixon type.

I. TAMM: Isotope shift of spectral lines and the interaction of neutrons with electrons.

M. BORISOV, V. P. BRAILOVSKI and A. I. LITVINSKI: Primary ionization with fast electrons in nitrogen.

G. A. BABSKI and J. B. ZILDOVICH: Heat transfer of gas to walls of a vessel by free convection.

P. A. CHERENKOV: Absolute output of radiation caused by electrons moving within a medium with super-light velocity.

V. VIKULOV, K. ALEKSEVA and N. REYNOV: Heavy electrons in cosmic rays.

W. I. VERNADSKY: Biochemical role of aluminium and silicon in soils.

F. LOWWINSON-LESSING: Some queries on classification and nomenclature of igneous rocks (2).

N. B. VASSONVICH: New data on the stratigraphy of Upper Jurassic and Neocomian of north-eastern Azerbaidjan.

N. T. KACHIDEN: Chromomere structure of wheat chromosomes.

A. S. AFANASSIEVA: Effect of comallarine upon seeds of summer wheat.

W. J. BUT: A quantitative dredge for investigating benthic population of plant communities in water.

C.R., 21, No. 4; 1938.

W. K. TURKIN: Normal divisors in the groups of odd order.

P. E. DUBUQU: Fundamental theorem of Frobenius.

W. K. TURKIN and P. E. DUBUQU: A criterion for non-simple groups.

N. D. MORGULIS and B. I. DIATLOVITSKAJA: Ionization of sodium atoms on the surface of thoriated tungsten.

G. FRANK-KAMENETSKIJ: Secondary radiation produced by the penetrating component of cosmic rays.

I. I. KORNILOV: Conversion velocity of super-saturated solid solutions of magnesium-aluminium.

O. E. ZVIAGINCHV and I. A. PAULSEN: Action of minerals on gold solutions.

B. N. SCHWANWITZ: Stereo-effect of cryptic colour patterns in Lepidoptera.

N. A. MAXIMOV: Increase of permeability of protoplasm in wilting plants.

N. A. MAXIMOV, M. M. GOCHOLASHVILI and V. I. TEKHOIDEH: Root-formation induced by heteroauxin in cuttings of subtropical plants difficult with regard to rooting.

A. P. SCHERBAKOV: Physiological role of elements indispensable for plants in minute amounts.

SHIGIUS LVOFF and E. L. LIMBERG: Effect of inorganic phosphates on the formation of citric, gluconic and oxalic acids in *Aspergillus niger*.

V. S. MURATOVA: Ecological and geographical classification and evolution of beans (*Viola Faba* L.).

A. A. WORTKOWITSCH: The influence of thyroidectomy on the development of ducklings.

S. YUDITSKAJA: Growth and differentiation of embryonic muscles in the extremities of a chicken.

L. F. BEREZKINA: Interrelation between the fibres existing in the tissue during explantation and those formed anew *in vitro*.

K. MARTINSON: Fossil sponge fauna of Tertiary deposits around Lake Baikal.

S. N. SEMIOHATOVA: Some results of investigation of the internal structure of Carboniferous brachiopods.

Tokyo

Imperial Academy (Proc., 15, No. 2, February 1939).

YASIO MUTO: Generalized circles in the conformally connected manifold.

KINJIRO KUNUGUI: On a theorem of Seidel and Reurling.

TATSUO KAWATA: Boundedness of the spectrum of a distribution function.

MISHIO ISHIMOTO: Characteristic of a seismic fault and its course.

JURO HORIBE and MASATUGU IKUSIMA: Mechanism of the hydrogen electrode process on platinum (2).

SIN'ITI KAWAI, TAKAO NAKAMURA and NOBORU SUGIYAMA: Researches upon ergonol (continued). A new general synthetic method for 2-phenyl-cumarone and its derivatives and the synthesis of ergonol.

SHIGEHICO SUGAWA and NOBIO SUGIMOTO: Oxidation of some β -phenylethylpyridinium- and -quinolinium salts.

SHIGEHICO SUGAWA and KITEIRO KAKEMI: Studies on the synthesis of dibenzopyridocoline derivatives. (2) Synthesis of 4', 5'-dimethoxy-4', 5'-methylenediomy-3, 4, 5, 6-tetrahydro-(1', 2': 1, 2; 1'': 2'', 8-dibenzopyridocholine) and the corresponding tetramethoxy derivative.

JUN SUZUKI: Age of the Sambagawa system.

NOBUHIKO OHARA: Studies on the nature of the sea-water and the bottom materials of Heda Bay, Izu Peninsula, Shizuoka Prefecture.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Monday, May 15

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Dr. E. B. Worthington: "Echo-Sounding of British Lakes".

Tuesday, May 16

ST. MARY'S HOSPITAL, LONDON, W.2, at 5.—Dr. A. S. Parkes, F.R.S.: "The Hormones of the Anterior Pituitary Body".

EUGENIUM SOCIETY (at Royal Society, Burlington House, W.1), at 5.15.—Prof. A. M. Carr-Saunders: "Some Problems of Population".*

CHADWICK PUBLIC LECTURE (at the Royal Institute of British Architects, 68, Portland Place, W.1), at 5.30.—G. H. Henderson: "Comparative Study of the Housing of the Working Classes, with Special Reference to Scotland".*

Wednesday, May 17

ROYAL MICROSCOPICAL SOCIETY (at B.M.A. House), at 5.30.—F. C. Bawden: "Some Properties of Plant Viruses".

Thursday, May 18

LONDON MATHEMATICAL SOCIETY (at the Royal Astronomical Society), at 5.—Prof. J. E. Lennard-Jones, F.R.S.: "Order and Disorder in Nature".

CHEMICAL SOCIETY (at the Institution of Mechanical Engineers), at 6.—Prof. C. N. Hinshelwood, F.R.S.: "Some Considerations on the Nature of Catalysis" (Laveridge Lecture).*

Friday, May 19

GEOGRAPHICAL DISCUSSION (at the Royal Astronomical Society), at 4.30.—"The Night Sky and Aurora" to be opened by Prof. S. Chapman, F.R.S.

ROYAL INSTITUTION, at 9.—Prof. J. D. Cockcroft, F.R.S.: "New Phenomena in Liquid Helium".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ASSISTANT (grade I) for the Research and Technical Publications Section of the Air Ministry.—The Under-Secretary of State, Air Ministry, Berkeley Square, London, W.1 (Ref. B 196. May 19).

CHIEF DESIGNER, ASSISTANT CHIEF DESIGNER AND ASSISTANT (grade II—chemical problems) at the Royal Aircraft Establishment, South Farnborough.—The Chief Superintendent (May 19).

SENIOR LECTURER IN PHYSICS in the Bradford Technical College.—The Principal (May 20).

ASSISTANT LECTURER AND DEMONSTRATOR IN GEOLOGY in University College, Cork.—The Registrar (May 27).

CHEMIST in the Admiralty Chemical Pool.—The Secretary of the Admiralty (O.B. Branch) (Ref. O.B. 5022/29. May 27).

ASSISTANT LECTURER IN ORGANIC CHEMISTRY in King's College, London.—The Secretary (May 30).

LECTURER IN PHYSIOLOGY in King's College, London.—The Secretary (May 30).

DEMONSTRATOR IN CHEMISTRY in King's College, London.—The Secretary (June 1).

ASSISTANT LECTURER (OR LECTURER) IN PHYSICS in University College, Southampton.—The Registrar (June 1).

ADVISER IN AGRICULTURAL CHEMISTRY AND HEAD OF THE DEPARTMENT OF AGRICULTURAL CHEMISTRY in University College, Aberystwyth.—The Principal (June 5).

PROFESSOR OF CHEMISTRY in Natal University College, Pietermaritzburg.—The Universities Bureau of the British Empire, 88A, Gower Street, London, W.C.1 (June 12).

SCIENTIFIC SUPERINTENDENT OF RESEARCH IN FOOT-AND-MOUTH DISEASE at the Experimental Research Station, Pirbright, Woking, Surrey.—The Secretary, Foot-and-Mouth Disease Research Committee, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1 (June 23).

ASSISTANT STATISTICIAN at Rothamsted Experimental Station, Harpenden.—The Secretary.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Imperial Bureau of Plant Breeding and Genetics. Bibliography of Baking Quality Tests, Supplement. Pp. 82. 1s. 6d. The Action and Use of Colchicine in the Production of Polyploid Plants. By J. L. Wyle. Pp. 11+10. 1s. (Cambridge: School of Agriculture.) [124]

Iron and Steel Institute. Special Report No. 24: Second Report of the Alloy Steels Research Committee. Pp. xx+390+22 plates. Special Report No. 25: Eighth Report on the Heterogeneity of Steel Ingots. Pp. xix+222+22 plates. (London: Iron and Steel Institute.) [124]

University of Sheffield. Report on Research Work carried out in the Departments of Mining and Fuel Technology during the Session 1937-38. Pp. 18. (Sheffield: The University.) [124]

Other Countries

U.S. Department of Agriculture. Leaflet No. 175: Irradiation of the Cultivated Black Currant in the White Pine Region. By J. R. Martin. Pp. 8. (Washington, D.C.: Government Printing Office.) 5 cents. [114]

University of Washington Publications in Anthropology. Vol. 7, No. 3: Talmshian Clan and Society. By Viola B. Garfield. Pp. 167-240+4 plates. (Seattle, Wash.: University of Washington.) [114]

Commonwealth of Australia: Department of Health. Recommendations for Protection against X-Rays, Radioactive Radiations and Ultra-violet Light. Pp. 17. (Canberra: Government Printer.) [114]

Ministry of Public Works, Egypt: Physical Department. The Nile Basin. By Dr. H. B. Hurst and Dr. P. Phillips. Vol. 5: The Hydrology of the Lake Plateau and Bahr el Jebel. (Physical Department Paper No. 85.) Pp. x+251+108 plates. (Cairo: Ministry of Finance.) P.T. 100; 20s. [124]

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The Rockefeller Foundation. A Review for 1938. By Raymond B. Foedok. Pp. 72. (New York: Rockefeller Foundation.) [124]

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University of Illinois: Engineering Experiment Station. Bulletin No. 307: An Investigation of Rigid Frame Bridges. Part 1: Tests of Reinforced Concrete Knee Frames and Balustrade Models. By Prof. Frank M. Richart, Prof. Thomas J. Dolan and Clifford A. Olson. Pp. 46. 50 cents. Bulletin No. 308: An Investigation of Rigid Frame Bridges. Part 2: Laboratory Tests of Reinforced Concrete Rigid Frame Bridges. By Prof. Wilbur M. Wilson, Ralph W. Klinge and John V. Oombe. Pp. 76. 85 cents. Bulletin No. 309: The Effects of Errors or Variations in the Arbitrary Constants of Simultaneous Equations. By George H. Deil. Pp. 52. 60 cents. Bulletin 310: Fatigue Tests of Butt Welds in Structural Steel Plates. By Prof. Wilbur M. Wilson and Prof. Arthur B. Wilder. Pp. 56. 65 cents. Circular No. 36: A Survey of Sulphur Dioxide Pollution in Chicago and Vicinity. By Alamfit D. Singh. Pp. 32. 40 cents. (Urbana, Ill.: University of Illinois.) [124]

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Smithsonian Institution: U.S. National Museum. Bulletin 172: Birds from Sumatra and the Malay Peninsula in the United States National Museum collected by Drs. Hugh M. Smith and William L. Abbott. By J. H. Riley. Pp. iv+622. (Washington, D.C.: Government Printing Office.) [124]

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Ideals in Africa*

ON March 9, 1938, H.M. the King appointed a Commission "to inquire and report whether any, and if so what, form of closer co-operation or association between Southern Rhodesia, Northern Rhodesia and Nyasaland is desirable and feasible". The Commissioners were five in number, of whom Viscount Bledisloe acted as chairman. After preliminary inquiry and the hearing of evidence in England, the Commission proceeded to Africa, arriving at Bulawayo on May 16. When evidence had been taken in Southern Rhodesia, the Commission visited Portuguese East Africa, passed on to Nyasaland and returned through Northern Rhodesia to Salisbury.

Taken together, the three territories which came under the purview of the Commission include an area of approximately 500,000 miles, with a total population estimated at roughly 3,300,000. Of these, approximately 68,000 are European, 8,000 are Asiatics and 'coloured' in the sense in which that term is used in southern Africa, namely, the offspring of union between non-native and native, and 4,230,000 are natives. The proportion of Europeans to natives in the combined territories is 1 to 62; but the ratio is more significant when the territories are distinguished: in Southern Rhodesia it is 1 to 22, in Northern Rhodesia 1 to 129 and in Nyasaland to 881. While both European and native populations have increased between 1926 and 1936, the rise among Europeans has been relatively more rapid owing to the development of the copper mines. It shows a decrease in the later return owing to the interruption of development work in the mines; but with the renewal of activity it is again increasing slowly.

* Rhodesia-Nyasaland Royal Commission. Report. (Cmd. 5949.) p. x+288. (London: H.M. Stationery Office, 1939.) 7s. 6d. net.

It is especially important to bear these figures and their inter-relations in mind, in view of the conditions which were imposed on the inquiry of the Commission and its findings. In the Royal Warrant, it was specifically laid down that in reporting on the desirability and feasibility of co-operation or association between the territories, due regard was to be had to "the interests of all the inhabitants, irrespective of race . . . and to the special responsibility of Our government in the United Kingdom of Great Britain and Northern Ireland for the interests of the native inhabitants". As will appear, the members of the Commission, collectively and individually, have given full weight to this instruction. The manner in which they have discharged their obligation raises issues in native policy of the gravest importance, not only as affecting the territories immediately concerned, but also as touching the interests of all natives throughout British colonial possessions in Africa. Indeed it may not be without repercussion elsewhere, in territories other than British, should certain suggestions which arise out of the report be given practical effect.

Broadly speaking, the recommendations of the Commission do not favour the proposal of an amalgamation of the three territories, at any rate in the near future. While there is a suggestion that they may look forward ultimately to becoming one great united territory, which might well aspire to dominion status, the time for such a development is far from being yet. Certain suggestions are put forward as practicable, with the view of securing greater uniformity in administration, especially in finance and education, as well as affecting labour, while certain measures in what may be termed the machinery of government are

adumbrated as likely to secure an even greater measure of association in organization and policy. On the whole, however, unless and until conditions change, the Commission is adverse from the close union, if not amalgamation, which for some time has been the subject of consideration and much discussion.

The report, in regard to its recommendations, is a document of singular interest. The main recommendation is, of course, unanimous; but in certain respects the report is exceptional. We are accustomed to reports of commissions in which the main recommendations are accompanied by a minority report; but a report in which each member of the commission, including the chairman with one other, makes what is virtually a minority report, is surely unusual. In fairness to the members, however, it must be stated that some of them add their individual statements with reluctance, and as a measure of self-protection lest silence should be misconstrued as complete acceptance.

The explanation of this remarkable position is that the circumstances with which the members of the Commission had to deal are of singular difficulty, even among matters of native policy in Africa. The crux of the situation is that of outlook in native policy. The difference between Southern Rhodesia and the two remaining territories of Northern Rhodesia and Nyasaland, which in this matter for practical purposes are at one, is so great, so fundamental, as to form an obstacle to amalgamation which in present circumstances is felt to be insuperable. In this the members of the Commission are agreed. Their differences lie in the degree to which they regard a measure of co-operation as immediately possible, and ultimate closer union as both practicable and desirable. At the same time, however, it is pointed out that native policy and the methods of native administration in all three territories are to a great extent still experimental; and it is by no means impossible that, as experience grows, modifications may be effected which will bring an outlook, at present diverse, into greater harmony.

In order to understand a situation which is regarded as of such gravity as to block a proposal which has much to recommend it in the many advantages, administrative, economic and financial, which would immediately accrue, especially to the less prosperous of the territories, it is perhaps necessary to recall that it is only within the last few years that certain important changes have

been made in the principles and methods of native government in all three territories. While, however, in Northern Rhodesia and Nyasaland the principle of indirect rule has been applied with all that involves in regard to the respect paid to native law and custom in matters affecting the natives—that is while, in the words of the White Paper which stands as a charter of the principles of British Colonial government, the interests of the natives are paramount—in Southern Rhodesia where the lead of policy in the Union of South Africa has been followed, the principle of segregation has been applied, and in the enthusiasm for reform, it must be admitted with some rigour. Not only is segregation physical—not only are native lands inaccessible to Europeans, but also native ownership or occupation of European land is forbidden—and the opportunities open to Europeans in the higher branches of education in certain occupations, and so forth are debarred to all natives. In short, a 'colour bar' no less strong and no less rigid than that which exists under the Union has been instituted in Southern Rhodesia. The problem raised by this difference in outlook to some extent is aggravated in Northern Rhodesia by the difficulties which arise from the poverty of the people and overcrowding, in itself a consequence of the poverty, alleged to be irremediable, of large parts of their lands, as well as the special problem, which has already arisen through the development of industry, of the urbanized native—a problem which will require but has still to receive, adequate special treatment.

A factor in the situation which should not be overlooked or underrated is the attitude of the natives themselves in both Rhodesia and Nyasaland. Their opposition is "unmistakable, pronounced and strikingly unanimous".

The position of Southern Rhodesia in following the lead of the Union, is, of course, one that is readily comprehensible, and to a great extent arises out of its history. Like the Union, its policy is based upon the ideal of a white civilization in a country that has been regarded as eminently suitable for remunerative and permanent white settlement with a white civilization as predominant while its main preoccupation in domestic economy has been the provision of an adequate and readily available supply of labour. With such an outlook Southern Rhodesia, being, as she would, the predominant partner in any amalgamation, manifest features in the present situation, which are not in the best interests of the natives of the other

two territories, might be rendered permanent, if not intensified. For example, much attention has been devoted to the question of the supply of labour, and the danger is stressed whereby it is feared that the native populations of these territories might become permanently no more than feeders of the labour supply.

The inquiries of the Commission have covered a wide field and the members have made full use of the labours of the numerous commissions and inquiries which have preceded them. They have taken a wide view of the departments of native life which they feel would be affected by the proposed changes in administration. They have, therefore, not hesitated to direct attention to matters affecting the development of the native in which they feel a progressive policy should now be applied, and in which rapid progress might be made by the measure of co-operation between the Rhodesias and Nyasaland which they recommend. Education, instruction in agriculture and technical training, instruction in the care of the soil and in hygiene and the principles of

nutrition, the fostering of the development of the peasant farmer class, are some only of the fields to which they point as urgently requiring development.

Fundamentally, however, the importance of this report lies in the stress laid, unostentatiously but nevertheless with unmistakable strength, on the difference in outlook of what may be termed the two schools of native policy, segregation and indirect rule, taking the latter in a broad sense. This antinomy prompts inquiry whether the white peoples in exercising their rule over Africa, and accepting their responsibilities for the welfare of the African as they profess to do, have any clear idea of the end to which they are directing him in assuming that responsibility for his development. Is indirect rule, which rests upon native custom, unless we do it no more than lip service, likely to lead either to stagnation, or a masked tribal disintegration, or is segregation, which sets the bounds of native development and that not beyond his presumed powers, the choice of the better part?

Prehistoric Crete

The Archaeology of Crete

An Introduction. By J. D. S. Pendlebury. (Methuen's Handbooks of Archaeology.) Pp. xxxii + 400 + 43 plates. (London: Methuen and Co., Ltd., 1939.) 30s. net.

IT was in 1894 that Sir Arthur Evans made his first journey in Crete, and in 1899 that his excavation of Knossos commenced. His own account of "The Palace of Minos" began to appear in 1921 and was completed in 1936. From time to time others have tried to summarize both the progress of discovery in Crete and the general bearings of it on the prehistoric archaeology of the Mediterranean. But Mr. Pendlebury's book is the first thorough and satisfactory account of the work of many travellers and excavators; his numerous maps show how vast an accumulation there has been of observations and finds, and the lists of sites appended to them how much he has himself contributed by persistent exploration, covering now every district of the island. As curator formerly of Knossos, where the Palace and its surroundings have been made over by Sir Arthur Evans to the British School of Archaeology at Athens, he has not only written an invaluable

"Handbook to the Palace", but has also himself examined and catalogued the stores of classified objects from every room and corridor, and from every stratum from the neolithic tell on which the Minoan settlements stand, to the sparse relics of classical antiquity, when the site had become a 'no-man's-land' in the outskirts of the Greek and Roman city. After directing excavations at Tell-el-Amarna, the Egyptian site most closely connected with Aegean peoples in the fourteenth century B.C., just after the fall of the 'Palace' regime, he has devoted himself to a series of small but most significant excavations in the Lasithi district of Crete itself, on sites ranging from the earliest human occupation to the turbulent age which intervenes between the latest Minoan and the earliest Hellenic periods. Here are, therefore, all the qualifications for an "Introduction", as the author modestly describes it, to the archaeology of Crete.

The greater part of the book is inevitably concerned with archaeological detail, most carefully selected, and clearly described; but it begins with a convenient retrospect of Cretan discoveries, and a presentation of the physical characteristics of Crete, and of the topography and routes,

ancient and modern, which show Mr. Pendlebury to be a worthy successor of Paahley, Spratt, and Raulin. Future travellers will value his personal estimates of distances, and of the practical utility of the more difficult tracks, especially in the western districts, which have been curiously neglected by travellers; though it has been left to Mr. Pendlebury to make it probable, by his closer examination, that there is not very much to find there; the reason, he thinks, being that, west of Mount Ida, the island was not only less well provided with cultivable lowlands, but also very densely forested.

Of the early inhabitants, it is here repeatedly insisted (pp. 61, 267) that they remained physically uniform throughout the Minoan age. This is, however, not in accord with the measurements of Duckworth, Hawes, and von Luschan, summarized by Sir Arthur Evans in the passage quoted by Mr. Pendlebury to support his contrary view; nor with his own derivation of early elements both of culture and of population from Anatolia (p. 53).

On more controversial points, Mr. Pendlebury presents fairly the evidence and arguments, and gives his own views cautiously; but where it is a matter of personal observation and long experience, he knows his own mind. On the disputed date of the 'Médallion Pithoi', he thinks they may have remained in vogue for long; and he emphasizes also on several occasions that objects that were durable as well as valuable, such as stone vessels, may well have endured for ages. On the relations between Crete and the Mainland, as to the building of cupola-tombs, he gives the Mainland priority; and his book was finished just too soon to note the newly discovered cupola-tomb of

earlier date at Knossos, which negatives that hypothesis.

Most accounts of Cretan archaeology stop short with the fall of Knossos about 1400 B.C., or treat what follows as an epilogue. Here, however, we have full and intimate description of the difficult and not very attractive sequel, when the natural resources of Crete attracted adventurers and eventually settlers from elsewhere, and therewith new elements of culture—iron, brooches, cremation—and a new æsthetic outlook, diverse expressions of which are the Idæan bronze-reliefs, and the fine geometrically painted pottery of Hellenic Knossos. Examples of both would have been welcome additions to the plates.

The general survey of Cretan prehistory, which follows the detailed account of successive periods, inevitably repeats many points; but it is very acceptable as a reasoned estimate of what was going on, in the arts and industries, and also in economic and social life. Mr. Pendlebury knows the Cretan countryside so well, that his reconstructions are often vivid and convincing: among revolutions in the superstructure, the fundamentals of Cretan life remaining essentially unaltered.

The fifty plates, from the author's own photographs, are extraordinarily good, and full of interest; and a word must be said in praise also of Mr. Pinion's distribution maps and the specimens of decorative design drawn by Miss Money Coutts. In a second edition—which there will surely be—would it be possible to include an orographic sketch map, with which to compare the distributions of sites and routes?

JOHN L. MYERS.

Cultivated Poplars

The Black Poplars and their Hybrids Cultivated in Britain

By G. S. Canadale and Members of the Staff of the Imperial Forestry Institute. Pp. 52+1 plate. (Oxford: Imperial Forestry Institute, 1938.) 3s. 6d.

IN common with many other groups of cultivated plants, the poplars include a number of hybrid forms, intergrading to such an extent in their morphological characters as to create considerable difficulties in the recognition of the different sorts. These difficulties are enhanced by the variation of the foliage borne on the several kinds of shoot normally found on a tree. Neverthe-

less, the necessity for careful selection of material intended for identification has often been overlooked. The author of the work under review wisely limits his attention to the vigorous long shoots and to the short shoots that carry the bulk of the foliage. The leaf and stem characters are studied, and those of critical value selected for use in the preparation of a key to the species and hybrids cultivated in Britain. With a genus such as *Populus*, flowering before the leaves appear, it is advantageous for a key to be based on vegetative characters only, providing ease and accuracy of identification are not impaired. In a few cases, the relative times of foliation and sex are introduced to distinguish closely related hybrids; but on the

whole the key is particularly clear and easy to use, and will be appreciated by all who have to deal with this critical group.

The short critical descriptions of the species and hybrids are excellent, and together with notes on various points of interest, they occupy about a third of the book. The same praise cannot be extended to the treatment of the nomenclature. Although much of the existing confusion has been cleared up, it is most unfortunate that the author has misinterpreted the International Rules of Botanical Nomenclature with respect to hybrids;

each segregate from the hybrid *Populus nigra* L. $\times$ *P. deltoides* Marshall is given a different binomial name. To comply with the rules, segregates of one hybrid should be given the status of varieties or forms under the oldest valid binomial applicable to the group. It is obvious that failure to observe this rule must result in the publication of numbers of invalid and unwanted combinations.

The book also contains a historical review of the literature on the black poplars, and a bibliography of the more important works on the genus.

R. MALVILLE.

Progress in Physics

Reports on Progress in Physics

Vol. 5. General Editor: Allan Ferguson. Pp. v+445. (London: Physical Society, 1939.) 20s. net.

THIS, the latest annual volume of progress reports sponsored by the Physical Society, is larger than any of its predecessors, and the editors' notes have been spread even more widely than heretofore. There are nineteen separate chapters, and of these general physics is divided into four sections (R. C. Brown on surface tension and Brownian motion, Cox on elasticity, and Good-ve on the viscosity of non-Newtonian fluids), and optics and spectroscopy have five sections each, specially edited by L. C. Martin and W. Jevons respectively. Atomic physics is represented by two sections, single scattering of elementary particles (Champion) and cosmic rays (Heitler). Skinner contributes a long article on the soft X-ray spectroscopy of the solid state, which might also be classified as atomic physics.

The longest individual report in this volume is that of Hartshorn on absolute electrical measurements. This, and the articles on sound (E. G. Richardson), heat (Powell) and quantum mechanics (Flint), are in the well-established tradition of these reports. Astbury's article on electric wave filters and Nunn May's on the mechanism of the Geiger counter are also in the tradition, though they reflect a little more strongly the tendency towards a somewhat increased degree of specialization. In view of the very wide scope of some of the earlier reports, this tendency is entirely natural and in no way undesirable.

Breaking entirely new ground, and reflecting the interests of many members of the Physical Society, are long reports on meteorology (Brunt) and astronomy (Crommelin), while Malville's

article on plastic is the first in this series to deal specifically with industrial physics. Further, this volume appreciably widens the appeal of the series to the physical chemist. McBain and Mills contribute an article on the Gibbs adsorption theorem, and, as has already been noted, one of the sections of general physics is from the hand of a physical chemist. Again, Mott and Gurney's report on recent theories of the liquid state is of almost equal interest to pure physicists and physical chemists.

Again on new ground, Dr. Phyllis Tookey Kerridge contributes an interesting chapter on instrumental aids for defective hearing, in which stress is laid on the medical aspects of the problem, while Dr. Mayneord's article on the use of X-rays and γ -rays in medicine is largely concerned with the difficult and purely physical problem of the accurate and unambiguous specification and measurement of dosage.

Finally, Barton's report on the teaching of physics in schools will interest a very numerous class of readers. It has been evident for some time, in the pages of the *School Science Review* and elsewhere, that there is in Great Britain an able, as well as an enthusiastic, body of science teachers. In particular, the Science Masters' Association and the Association of Women Science Teachers are doing much to raise the standard of instruction in physics in the secondary and public schools. The subject is obviously of importance to university as well as to school teachers; and as the Physical Society includes many teachers of both these types, it was a particularly happy idea to requisition a report of this kind from a practising schoolmaster with strong views.

The short list of contents given above may serve two purposes. In the first place, it may give new readers some idea of the type of fare provided;

it may be taken as axiomatic that most readers who have already used the reports will automatically subscribe to the new volume. Secondly, the *embarras de richesses* so revealed may indicate clearly enough the impracticability of setting down, in any reasonably modest space, an adequate analysis of individual contributions to the volume. In brief, we have, as an assurance of the authoritative nature of the reports, the fact that every writer is an active worker in the field that he describes. Thus, in the chapter on optics, Prof. Martin himself deals with optical instruments; Hampton and Wheat, of Messrs. Chance, with optical glass manufacture; Selwyn, of the Kodak Research Laboratories, with the theory of photography; and W. D. Wright with television optics. The spectroscopy team is drawn from an even wider area—Shenstone (Princeton), Crawford (Toronto), Foster (McGill), Hunter (Greenwich) and Pearce (Imperial College), dealing respectively with atomic spectra, hyperfine structure, Stark effect and related phenomena, astronomical spectroscopy, and the spectra of the alkali-metal hydrides.

The fact that the articles are written by specialists is not, of course, one which calls for comment; it would in these days be much more surprising if the

matter were ordered otherwise. What is rather to be noticed here is the extraordinarily high standard of readability of the articles. It has already been pointed out that the chapters differ appreciably in degree of specialization; but everywhere the specialist writers have succeeded admirably in writing for, and not ostentatiously down to, the general reader so that he, as well as the more directly interested researcher, may profit from these most valuable summaries. The general impression left by the reports is that, on the whole, the authors have rather enjoyed writing them. One guesses that each writer has been given very free hand to deal with the subject in his own way; something of this has indeed been implied in the prefaces to volumes 4 and 5, and the reports have benefited largely from the application of this sound editorial precept, at the cost, possibly, of a relatively trivial loss of homogeneity.

Prof. A. Ferguson, who has, with apparently undiminishing zest, seen the first five volumes through the press, now passes the editorial work to another hand. He has given the series a magnificent start, and there is every reason to expect that it will continue to prosper under the direction of his successor, Mr. J. H. Awbery.

The Ganges Delta

The Changing Face of Bengal

A Study in Riverine Economy. By Prof. Radhakamal Mukerjee. (Calcutta University Readership Lectures). Pp. viii + 293 + 23 plates. (Calcutta: The University, 1938.)

THE problems of the Ganges delta are immeasurably more complicated than those of the Nile and Mississippi in that there are two mighty rivers, fed by heavy rains and melting snow, which carry maximal quantities of silt from the greatest of mountains into the head of a deep bay, not on to an open coast. Rivers in gorges, cut through the foothills, have by their silt formed broad alluvial plains. South, the Ganges and Brahmaputra now meet and, to a considerable degree, are at war with each other for right of way, their battles influenced by strong tidal flows. Modern changes in their deltas, which have become conjoined, are illustrated by a dozen maps dating from the sixteenth century, but the lack of a map showing existing conditions and settlements often embarrasses the reader. Even in this late historical period the population has more than doubled, 125 millions

to-day, with a concentration which, in parts, equals that of the lower Yangtze. This has always been the richest agricultural area in India, and, as the author shows, the aim of invaders and the centre of a succession of empires. He indicates fluctuations in the sites of these, and ascribes them to the variation of the courses along which the rivers deposited their silt, particularly the gradual eastward movement of the delta. He foretells, in the not distant future, the necessary decay and abandonment of Calcutta, its water courses silted up, and its drainage impossible. It can only be saved by the further development of roads and railways; the embankments that such necessitate, have often been most damaging in hindering natural water movements, and hence producing miasmatic swamps.

An immense amount of work and a high standard of learning have been conjoined in these lectures; the facts are culled from many sources. Footnotes are useful, but great help will be given to the scientific reader by the considered bibliography. He may well desire to think more deeply of all the varied actions implied in delta formation, the

ilding of higher banks enclosing lower lands, the
 ■ting up of main water channels and in conse-
 -ence their divergences, and finally the effects of
 -ese on agriculture and population. Rich and
 -tile rice marshes—often jute to-day—may dry
 -, and perhaps the silt underlying basins may
 -ink downwards, turning them into impossible
 -amps or jungle in which the tiger finds its home.
 -story affords instances of the loss of many even
 -eat cities in such; their estuaries are to-day
 -rely swamp flats. While there is always growth
 -d reclamation seaward, the decay behind
 -lances, and no settlement has proved permanent.
 -arge areas have become malarious and have
 -ulted in great migrations of a population made
 - of many ethnographic features, and, of course,
 -th rival religions, for there was here a Moham-
 -edan conquest. In the Yangtze region, which
 -et compares, there is no such change, and
 -ability is ensured by infanticide, which the
 -ychology of the Ganges peoples does not
 -ourage.

The footnotes provided by the author suggest that the Government is fully alive to all the difficulties which confront it, and which must remain with every Government. Prof. Mukerjee refers to agricultural deterioration and rural decay in large tracts of land, but he does not attempt to balance loss and gain—and we require more information on the economic results of irrigation along the upper courses of the rivers. He gives the impression of never having personally investigated the conditions of the delta, and he is not constructive in his suggestions. We are not convinced that his proposed "Ganges River Commission" will or can do more than is being already done, presumably by a corps of specialist officers. The conclusion forced on us by a study of this work is that any "co-ordinated policy of forest, soil and water management" depends on the complete harnessing and control of the Ganges and Brahmaputra, and that this, if attempted, is as likely to destroy as much as it conserves.

J. S. G.

The Phase Rule

) The Phase Rule and Phase Reactions :
 heoretical and Practical
 y Dr. Sydney T. Bowden. Pp. xviii+303.
 ondon: Macmillan and Co., Ltd., 1938.) 10s. net.

u) The Phase Rule and its Applications
 y Prof. Alexander Findlay. Revised with the
 -istance of Prof. A. N. Campbell. (Textbooks
 n Physical Chemistry). Eighth edition. Pp.
 v+327. (London, New York and Toronto :
 ongmans, Green and Co., Ltd., 1938.) 12s. 6d.
 et.

1) **D**R. BOWDEN'S book is an elementary introduction to the subject and is suitable for general B.Sc. students, many parts being adapted to teaching of intermediate standard. It contains numerous good laboratory experiments and there are collections of questions and examples, many taken from examination papers.

Special mention should be made of the illustrations, which are very clear and in many cases have been simplified so as to make them more intelligible to students beginning the subject. A notably good feature is the grouping of diagrams in the summaries; many students feel difficulty in co-ordinating the various parts of the subject, and this plan will be a very useful help. Another good feature is the inclusion of descriptions of structure as determined by X-ray and other

methods, for example in the cases of the allotropy of sulphur, tin and iron. The contents include a good introduction to three-component systems, where the diagrams are very well chosen.

Although the book is intended to be elementary, the clearness of treatment will make it useful to more advanced students. The close relation to practical work tends to remove the rather abstract impression which most students get from a study of the phase rule. The book may be warmly recommended, and it is certain to be very popular both with teachers and students.

(2) Prof. Findlay's book is too well known to need description. It has established itself as the standard work on the subject and still remains the best introduction to the phase rule and its applications. The first part gives a very clear account of the fundamental principles, which is intelligible to students beginning the subject, and the general standard of the book is suitable for honours students.

The first edition of the book was published in 1904 and subsequent editions have left its main structure unchanged. It might be suggested that some sections could now be rewritten, and as examples those on the hydrogen-palladium system, liquid crystals and the iron-carbon system may be quoted. The book is assured of a continued and well-deserved popularity.

J. R. P.

(1) *Alpine Flowers*

36 Colour Plates from Watercolours specially prepared by Paul A. Robert. With Introductory Text by Prof. Dr. Carl Schroeter. (Art and Nature in Colour Series.) Pp. 12+36 plates. (London: B. T. Bataford, Ltd., 1938.) 10s. net.

(2) *A Gallery of Gum Trees*

By A. W. D'Ombraim. Pp. 54+21 plates. (London: H. K. Lewis and Co., Ltd., 1938.) 14s. 6d. net.

HERE are two beautiful examples of book production.

(1) The multi-coloured alpine flora of Switzerland lends itself easily to the painter in water-colours, and the many books printed and published in Switzerland containing reproductions of paintings of Swiss flowering plants are well known. Here we have thirty-six exquisite colour studies by Paul Robert reproduced by the world-famous 10-colour Iris Press of the Polygraphische Gesellschaft Laupen, Berne. These have been collected together and an introductory text has been written by none other than one of the greatest authorities on the Swiss alpine flora, Prof. Karl Schröter, who has recently died (*NATURE*, 143, 365; 1939). Messrs. Bataford, the publishers of the English edition, are deserving of special commendation for offering this splendid collection at such a very modest price. The book is to be strongly recommended to botanists interested in alpine plants, artists, those interested in colour reproduction, and anyone keen on acquiring good books for his library.

(2) This descriptive collection of Australian gum trees is equally worthy of praise for its twenty-one beautiful coloured plates and good all-round production. It was set up and printed by the Australasian Medical Publishing Co., Ltd., which is to be congratulated on another real work of art. All the plates are reproductions of original paintings in water-colour executed by Miss Tydfyl Evans. Those living in Australia should have no difficulty in identifying any eucalypt if they have this book handy, and other botanists will get a very satisfactory idea of these peculiar trees from the text and illustrations. Any lover of a well-produced book, too, would consider himself fortunate in possessing a copy of this one.

A Monograph of the British Neuroptera

By Frederick James Killington. Vol. 2. (Ray Society Volume 123 for the Year 1936.) Pp. xii+306+plates 16-30. (London: Bernard Quaritch, Ltd., 1937.) 25s.

THIS volume completes the author's account of the British Neuroptera. It is in every way up to the standard of volume 1, which was published in 1936 and has already been noticed in these columns. In volume 2 the subject-matter is concerned with the remainder of the family Hemerobiidae together with the Chrysopidae. Of the Hemerobiidae it is noticed that the genus *Hemerobius*, as now understood, comprises eleven British species. Of the other genera of the family, *Boriomyia* with five British species, has undergone change of name. In the appendix to this volume the new genus *Kimmeria*

is erected by the author to take its place. Of rarer forms, *Megalomus* and *Drepanopteryx*, each with a single British species, are still comparatively little known. Some account of the metamorphosis of the first named is given, but as regards *Drepanopteryx* progress has been made in our knowledge of biology since a brief note by Standfuss published in 1910. Of the Chrysopidae, fourteen British species are dealt with and these belong to the genera *Chrysopa* and *Nathanica*.

The volume is illustrated by fifteen plates (colour and plain) and forty-seven text-figures. These are well executed and reflect credit upon all concerned their production. We congratulate Mr. Killington on the completion of a really excellent treatise.

A. D. I

Plant Physiology

With Reference to the Green Plant. By Prof. Edw. C. Miller. (McGraw-Hill Publications in the Botanical Sciences.) Second edition. Pp. xxxi+1201. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 45s.

THE first edition of this very comprehensive textbook was favourably reviewed in *NATURE* December 5, 1931, p. 952. In the second edition about three hundred pages have been added and the price increased by ten shillings. This makes the price of the book rather excessive for the type of student for whom it is intended. All students reading for university degree would find the book very useful and research workers and other advanced students are offered an extensive bibliography at the end of each chapter. Subdivision of the text into large and small type will aid the student reading for a general degree. The questions inserted at the end of each chapter of the first edition have been omitted in this edition.

The whole text has been thoroughly revised and brought up to date, and much new material has been included.

Inorganic Colloid Chemistry

By Prof. Harry Boyer Weiser. Vol. 3: The Colloid Salts. Pp. viii+473. (New York: John Wiley & Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 30s. net.

THIS volume completes Prof. Weiser's treatise on inorganic colloid chemistry, and it is in every way a very satisfactory account of the subject with which it deals. The five parts treat of the colloids: sulphates, halides, sulphides, ferro- and ferricyanides, and silicates. The treatment is essentially experimental, although the theories concerned receive adequate treatment. Full literature references are supplied. Among other general topics which come under review are the stability of sols and the mechanism of electrolyte coagulation, adsorption on ion lattices, adsorption indicators, the permeability of membranes, and the phenomena of thixotropy and rheopexy. Technical aspects receive careful attention.

The amount of information contained in the book is very large, yet the author has been able to produce a very readable text.

The Drift of the *Sedov**

By Prof. N. N. Zubov

THE scientific importance of the drift of the *Sedov* is comparable to that of the *Fram* or the Papanin North-Polar Expedition on the drifting icefloes of 1937-38. Certain circumstances make the drift of the icebreaker specially interesting; from a theoretical and practical point of view. First, the *Sedov*, together with the icebreakers *Iko* and *Malygin*, began to drift in the Laptev Sea at lat. $75^{\circ} 91'$ N. and long. $132^{\circ} 25'$ E. on October 23, 1937, that is, while the Papanin expedition was still working.

Thus we have had the movement of the ice in the Arctic sea under continuous observation since May 21, 1937, the date when the Papanin expedition began its drift.

Secondly, a convoy of icebreakers, escorted by the icebreaker *Lenin*, was carried away by the ice from Khatanga Bay at the beginning of November, 1937, that is, soon after the commencement

of the drift of the *Sadko*, *Malygin* and *Sedov*. These vessels drifted in the south-western part of the Laptev Sea until August 7, 1938, when they were freed by the icebreaker *Krassin*, which outlasted the passage through the ice.

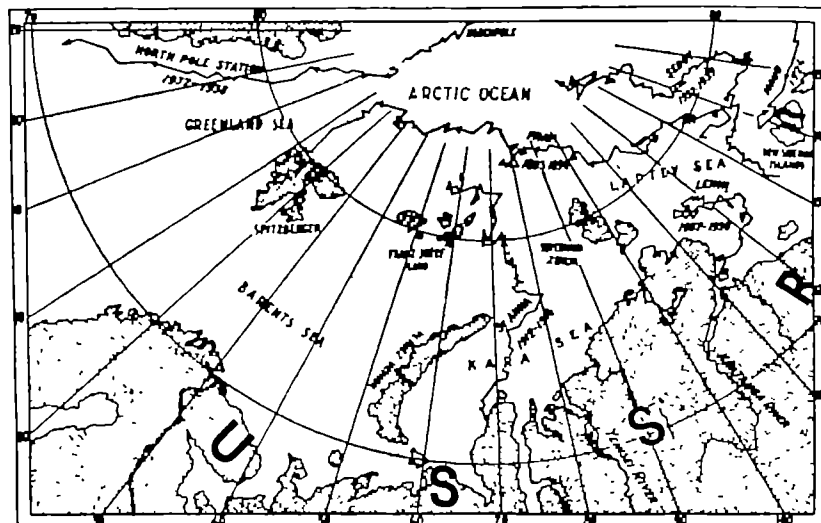
Two groups of vessels were thus drifting with the ice simultaneously at some distance from each other for the space of nine months, one group in the south-western part of the Laptev Sea and the other in the north-eastern part of the same sea, north of the New Siberian Islands.

As is seen from the accompanying map, the drifts of the *Sedov* and the *Lenin* groups, although differing in detail, are remarkably similar. The *Sedov* is being carried approximately through the same region as Fridtjof Nansen's expedition of 1893-96 on the *Fram*.

A comparison of the drifts of the *Sedov* and the *Lenin* on one hand, and of those of the *Sedov* and

the Papanin Expedition on the other, and finally a comparison of the drifts of the *Sedov* and the *Fram*, are of great scientific and practical value. The comparison of the drifts of the *Sedov* and the *Fram* is of particular interest because, as is known, climatic conditions have changed considerably since Nansen's time. As is evidenced by many facts, the atmosphere and hydrosphere in the Arctic have now become much warmer.

An examination of all the peculiar features of



DRIFT OF THE *Fram*, *Sedov*, *Maud*, *Lenin*, *St. Anna* AND THE PAPANIN NORTH-POLAR EXPEDITION.

the *Sedov's* drift will only be possible after all the data collected have been carefully studied; but from data already available, it is possible even now to draw some important conclusions.

An important achievement of the *Sedov* has been the final destruction of the legend of 'Sannikov Land'. This alleged land derived its name from a Russian hunter named Sannikov who, in 1811, observed high land to the north of Koteln Island but failed to reach it. Toll, a well-known Russian traveller, on the occasion of two visits to the New Siberian Islands made in 1886 and 1894, saw the land and even distinguished on it four high mountains, of which he drew the contours, and his guides, too, assured Toll that they had seen this land on more than one occasion.

Afterwards, several Arctic expeditions endeavoured to find this mysterious land. They were the 1900-3 expedition of the *Zarya* under

* The Soviet ice-breaker *Sedov* became ice-bound on October 23, 1937, in lat. $75^{\circ} 21'$ N., long. $132^{\circ} 15'$ E., near the New Siberian Islands. Attempts to free her last autumn failed, but some of her crew were exchanged with men from the rescue vessel *Krassin*. The *Sedov* provisioned for several years and has fifteen men on board. On January 20, 1939, she was in lat. $86^{\circ} 2'$ N., long. $119^{\circ} 5'$ E., a little more than two hundred and fifty miles from the North Pole.

Toll, the expeditions of 1913 and 1914 on the icebreakers *Taimyr* and *Vaigach*, which discovered Severnaya Zemlya, and the Norwegian expedition on the *Maud* in 1924. 'Sannikov Land' was not sighted during any of these voyages, but this did not necessarily disprove its existence. None of the aforementioned vessels succeeded in going beyond the limits of the shallow waters of the continental shelf, while sailing north of the New Siberian Islands. So long as this shelf had not been adequately explored it was always possible that an island of continental origin might be found.

One of the objectives of the high latitude expedition on the icebreaker *Sadko* in 1937 was to search for 'Sannikov Land'. The *Sadko* on that occasion went northwards along the Kotelný Island meridian, and then eastward a little below the 78th parallel, approximately as far as the Bennett Island meridian. She then sailed to Henrietta Island. No trace of 'Sannikov Land' was found.

Now, during the drift of the *Sedov*, the region to the north of the New Siberian Islands was crossed on two more occasions—once from west to east and then from the south-east to the west. Moreover, the icebreaker has proceeded beyond the limits of the continental shelf.

The air expedition under A. Alexeyev made six flights across that region from Cape Kotelný last spring, when engaged in removing part of the crews from the *Sadko*, *Sedov* and *Malygin*, which were then still drifting together. Visibility was excellent on each occasion, but nothing was seen of the mysterious 'Sannikov Land'. The legend of 'Sannikov Land' has now been finally exploded.

The second important geographical achievement of the *Sedov* is her exploration of the continental shelf and the slope down to the great depths of the Arctic Ocean.

Prior to the Nansen expedition there was no knowledge of the central part of the Arctic Ocean. Soon after he entered the ice north-west of the New Siberian Islands, Nansen found a depth of 1,600 metres, approximately at lat. 78° N. and long. 134° E. A subsequent sounding taken approximately at lat. 80° 50' N. and long. 126° E., showed the depth to be 3,850 metres, which was the deepest sounding taken by Nansen during his expedition.

These soundings established a deep-water basin. Hence, the determination of the boundaries of the continental shelf of the Arctic Ocean became one of the most important objectives of every expedition sent out to the central part of the Arctic.

The boundary of the continental shelf was established by the Papanin Expedition near the

north-east coast of Greenland; by the expedition on the *Sadko* in 1935, near the northern part of the Kara Sea, where a sounding taken at 82° 42' N. and long. 87° 4' E. showed a depth of 2,365 metres; and by the 1937 expedition of *Sadko* in the Laptev Sea, where a sounding taken at lat. 77° 34' N. and long. 118° 28' E., showed a depth of 2,381 metres; and finally, during the drift of the *Sedov*.

The data obtained by the *Sedov* are very characteristic. The continental shelf in the region of New Siberian Islands was shown to stretch farther north than had been supposed. Moreover, the continental slope proved exceedingly gradual; stretches nearly 120 kilometres in a north-easterly direction, and its gradient is only between two and three degrees.

The observations carried out by the *Sedov* during her drift have made it possible once again to verify and to establish the fact that the direction and speed of the drift depend on the direction and velocity of the wind.

Like all previous drifts of icebound vessels, that of the icefloe of the Papanin Expedition, the drift of the *Sedov* did not proceed in a straight line. The icebreaker quite frequently veered to one direction, turned back on her course, and described zigzags or even loops.

These changes in the direction of the drift are due to the changes of the wind, to which the ice fields respond very rapidly. As Nansen had discovered and explained, the direction of the ice drift in the central part of the Arctic Ocean, owing to the action of the deflecting force of the earth's rotation, deviates approximately 40° to the right from the direction of the wind blowing at a given moment over the ice. The speed of the drift is approximately one-fiftieth of the velocity of the wind. The *Sedov's* drift, too, has been subject to this law.

The accompanying diagram shows the remarkable similarity between the course of the wind and the course of the *Sedov*. Where the course of the wind is even, the drift proceeds approximately in the same direction, the only difference being that the drift is turned approximately 40° to the right. Where the wind changes sharply, the *Sedov*, too, begins to describe zigzags and loops. Very characteristic, in this respect, are the figures described by the wind and the *Sedov* between October 2 and October 25 of last year, the zigzags between November 10 and November 30, 1938, and the loops between December 17, 1938, and January 17, 1939.

An examination of available data relating to the Central Polar Basin shows that there is either no constant current in the regions of the *Sedov's* drift, or, if such a current exists, it is so negligible

likely to have any effect on the future movement of the vessel. Wind conditions will play the principal role.

The prevailing winds during the drift of the icebreaker have been south-easterly. From September 1938 to February 1, 1939, a moderate wind blew from the south-east at a velocity of about 10 metres per second. From this it follows that the *Sedov* is on the edge of a polar anti-cyclone, the centre of which is somewhere to the north-east of the vessel.

The *Sedov's* drift during the first half of last December was exceptional. At that time the vessel was under the influence of westerly and north-westerly winds. In other words, she was on the southern edge of cyclones sweeping into the central Arctic between her and the North Pole.

The North Polar Expedition of Papanin was the first to establish that these cyclones break through to the central part of the Arctic. However, they are much more likely to occur there in the first half of the winter than in the second. Hence, it may be presumed that the *Sedov* will not again be affected by such cyclones before the polar summer begins and that she will continue to drift in a north-north-westerly direction during the next two or three months.

Owing to insufficient data, there is as yet no certainty as to the way in which the ice in the central part of the Arctic Ocean moves. Some Arctic explorers are of the opinion that in general the drift of the ice proceeds simply from the seas of the Soviet Arctic, first northward and then eastward, to the strait between Greenland and Spitzbergen, and also from the shores of Alaska in a straight line across the North Pole to the Greenland Sea.

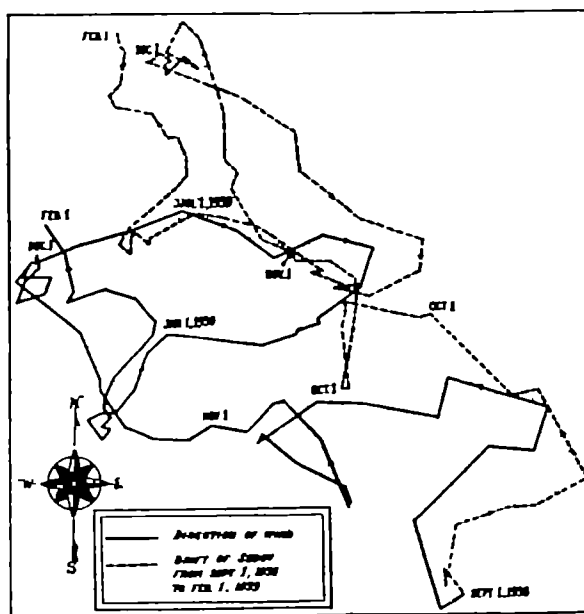
The famous drifts of the *Jeannette* (1879-81), the *Frank* (1893-96), the *Karluk* (1913-14) and the *Aud* (1922-24), which took place near the continental slope in the central Arctic, are confirmation of this view. The way in which the icefloes of the Papanin North Polar Expedition (1937-38) as carried almost in a straight line from the Pole to the north-eastern coast of Greenland also fitted in with this view.

However, from the time of Toll's expedition of 1900-3, a theory has existed that besides the general movement of the ice from east to west, under the influence of a given system of winds there is a circular movement of the ice in a clockwise direction. This movement is supposed to have its centre near the 'pole of inaccessibility', which is situated between lat. 83° and 85° N., approximately on the meridian of Bering Strait.

Should this theory be correct, it is possible, judging from the direction of the wind and the drift, that the *Sedov* will later be drawn into a

vast anti-cyclone and, consequently, into a circular movement around the 'pole of inaccessibility'. If this happens, the vessel will find herself after some time in the region between the North Pole and Bering Strait.

It may be assumed that the icefloes of the Papanin North Polar Expedition during its drift was on the eastern edge of the Greenland area of high atmospheric pressure and on the western boundary of the trough of low pressure created as a result of Atlantic cyclones breaking through into the Arctic. The *Sedov*, it seems, is on the western edge of the North American area of high pressure and on the eastern boundary of the trough of low pressure passing through the Arctic in the vicinity of the North Pole.



DIRECTION OF WIND AND DRIFT OF *Sedov* COMPARED.

The low figure obtained for the speed of the constant current by a study of the *Sedov's* drift does not seem to contradict these suppositions. Occasional but strong winds in one or other direction may draw the Papanin icefloes or into a drift similar to that of the Papanin icefloes or into a drift around the 'pole of inaccessibility'. This view was expressed by the present writer as early as the beginning of last December, and the data so far received from the vessel do not contradict it.

Another circumstance must be taken into account in connexion with these suppositions. The ice around the *Sedov* differs appreciably in its nature and movement from that observed by Soviet airmen at the North Pole. The vessel is surrounded by comparatively young ice (about two

or three years old), small fields with a considerable quantity of hummocky ice prevailing. In the region of the North Pole, old comparatively level fields were the most common. At least a year or more is necessary for the *Sedov* ice to be transformed into fields of this kind.

When flying from Franz Josef Land to the North Pole, the Soviet airmen first saw a belt of comparatively young ice. This was followed near lat. 86° N. by a peculiar belt of hummocky or jagged ice, the origin of which has not been sufficiently studied. Level fields of old ice stretched beyond this belt to the Pole itself.

To judge by the data at our disposal, the *Sea* is in the belt of hummocky ice situated between the main mass of Arctic ice and the ice carried comparatively recently into the central basin from the seas of the Soviet Arctic. This would explain the constant movement and jamming of the ice observed by the *Sedov* expedition.

Finally, it is possible that the belt of hummocky ice stretches along the trough of low pressure created by the inrush of masses of Atlantic ice into the Arctic. This is all the more probable since the passage of this air is usually accompanied by powerful winds.

Medical Research in Great Britain

FOR those who desire to obtain some conception of the progress of medical research in Great Britain, no better means can be suggested than a perusal of the latest annual report of the Medical Research Council*. Subjects to which the Council wishes to direct special attention are reviewed in the introduction; the remainder of the report falls naturally into several sections describing work carried out for different Government Departments, at the National Institute for Medical Research (including the Department of Biological Standards), by members of the Council's external scientific staff, and in clinical research units and in hospitals and other institutions by investigators aided by grants. The Council also awards research fellowships in tropical medicine, Rockefeller medical fellowships and Dorothy Temple Cross research fellowships in tuberculosis. During the year, Prof. A. J. Clark and Sir John Ledingham retired from the Council and Prof. C. R. Harington and Prof. W. W. C. Topley were appointed to succeed them.

The report mentions that a beginning has been made with the work of construction of the new National Institute for Medical Research at Mill Hill, to which reference was made in last year's report. At least two years, however, will be required for completion. The new Institute will provide accommodation for the central laboratory under the national scheme for research in chemotherapy, of which an account was also given last year. At present, research work is being gradually developed by selected investigators at different centres, the Council having assumed responsibility for supporting the chemical as well as the biological investigations: previously the former were supported by the Department of Scientific and Industrial Research. The policy of transferring

the Institute to Mill Hill has involved reconsideration of the proposed memorial to the late Sir Walter Fletcher. The original intention was to apply the balance of the fund, after providing the personal memorial, towards a new laboratory for research on nutrition at Mill Hill. With the transference of the Institute, this laboratory, instead of being the chief building on the site, will occupy only a relatively subordinate position. It has been decided, therefore, with the agreement of the subscribers to the fund, to devote it to the provision of a hall for meetings and lectures as an addition to the new Institute. The Council will meet the whole cost of the nutrition laboratory.

The Council points out that, during the past twenty-five years, since the Medical Research Committee was first set up, there has been a great increase in knowledge of the body in health and disease, greater even than that of the previous twenty-five years. This new knowledge has had two influences which, in their effect on medical practice, are often opposed to each other. In the first place it has resulted in a great improvement in methods of diagnosis and treatment of disease which has involved a vast increase in medical services. Many patients suffering from disease which, twenty-five years ago, were incurable and uncontrollable can now be restored to health and well-being. At the same time new knowledge of curative treatment may in itself also bring about a reduction in incidence of disease; for example the more rapid and effective cure of gonorrhoea by drugs of the sulphanilamide group should result in a reduction in its incidence by reducing the spread of the infection. Recent results also give hope that these drugs may lead to reduction of the number of cases of middle ear disease, which is responsible for a large proportion of the cases of disabling deafness in Great Britain.

* Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the Year 1937-38. (Cmd. 5439.) Pp. 221. (London: H.M. Stationery Office, 1939.) 8s. 6d. net.

On the other hand, medical research has brought other kind of knowledge which, properly used, leads directly to the prevention and elimination of disease. The effect on medical practice is clearly opposed to the first-mentioned effect, since, by minimizing disease, it tends to reduce the needs for curative aids. The report points out that there is often a great delay in bringing about the application of new discoveries to preventive ends. Fresh means of curative treatment, on the other hand, are generally applied within a short period of their discovery. This delay is considered to be due to the fact that there is no means of educating the public in the established advances in preventive medicine. It is responsible for much unnecessary suffering. The report illustrates this point by reference to the prevention of diphtheria and to the value of improved nutrition. Where preventive inoculation with diphtheria toxoid has been generally adopted, diphtheria as a clinical entity has practically disappeared: yet in 1937 there were more than 61,000 cases in England and Wales, with almost 3,000 deaths. The report urges parents to demand this prophylactic inoculation for their children, and considers that there is no doubt that its general adoption would lead to the virtual disappearance of the disease from Great Britain.

The need for improved nutrition has been discussed in previous reports, but the adoption of modern teaching in the subject is still depressingly slow: a much greater consumption of milk and other dairy products, of eggs, vegetables and fruit and of fat fish at the expense of bread, biscuits, sugar and sweets, will improve the physique of the people, reduce the amount of mental decay and greatly raise the standard of health. An increased consumption of the 'protective' foods would also be of great economic value to the country.

The Council is sometimes asked what is its policy in promoting research: whether it favours research on disease itself rather than on more academic problems of physiology and biochemistry. The general answer is that it welcomes both kinds of investigation. Promotion of specific research by the Council is usually done by appointment of individuals to its permanent staff, the choice depending on the subject which seems to require special attention and the merits of the person chosen. Thereafter the individual has wide liberty of action in planning investigation. The Council seldom chooses particular diseases for investigation; generally the choice is of a wider nature, to include study of an etiological factor common to a group of diseases, or a type of treatment of wide application; in fact, such subjects as virus diseases, endocrinology or chemotherapy. For another large

part of the work helped by the Council by means of personal and expenses grants, the initiative in choice of subject and method of investigation lies with the head of the laboratory in respect of some individual worker, or with the worker himself. The Council considers that at the present time there is a relatively great dearth of work in clinical science and in experimental pathology, so that it is offering scholarships and fellowships to attract young investigators into these particular fields of inquiry.

An important duty of the Council is to help Government departments confronted with immediate problems of health and disease in the course of their work. The report describes briefly some of the main investigations now being made. Important research on nutrition in the Colonial Empire has been carried out in association with the Colonial Office. In Nyasaland, the dietetic and nutritional conditions of the people are being accurately assessed and related to other surveys of the agricultural and social conditions. It is hoped thereby to determine methods of producing those agricultural products which will cause a great improvement in the physical condition of the population. It is also hoped that this survey may form a model for many similar studies elsewhere in the Colonial territories. Other investigations made for Government departments relate to the nature and causes of chronic lung disease in coal miners, and to the dangers to health which may follow the use of certain organic substances as solvents in industry. Research has been made into the best methods of ridding houses of the bed-bug; it is hoped by this work to discover new insecticides for the purpose which are rapid in action, safe and cheap; good results have already been reported from fumigation with heavy naphtha.

The report describes results obtained in the treatment of cancer of the mouth, tongue, pharynx and larynx by radium beam therapy; most of the patients have been in an advanced and inoperable stage of cancer, but the results appear to compare favourably with those to be expected from surgery. Of even greater importance than the actual therapeutic results are the new technical methods which have been elaborated as the result of close co-operation between physicists and clinicians: they are already being widely used as models to be followed in researches in radiotherapy at other centres.

For the student of medicine and the specialist, the descriptions of recent researches on the hormones, the vitamins and virus diseases should prove of particular interest. It is pointed out that as a result of intensive chemical researches in the last few years, new synthetic substances having actions closely simulating those of some of the

natural hormones have been produced in the laboratory and made available for the treatment of disease. Thus diethylstilboestrol is a synthetic oestrogen which is active by mouth and is already finding a place in treatment. A lengthy account of the physiological action of different hormones is given in the section of the report devoted to work carried out at the National Institute.

This summary is intended only to give a general

idea of the work and policy of the Medical Research Council: brief reference has also been made to few subjects in which there have been recent advances in knowledge. The interested reader will find in the report full references to all the research carried out under the auspices of the Council which have been published in the scientific journals as well as mention of the many investigations still in progress.

Observation of the Sun's Corona and Prominences without Eclipses

M. BERNARD LYOT, of the Astrophysical Section of the Paris Observatory, delivered the George Darwin Lecture before the Royal Astronomical Society on May 12, the subject being "A Study of the Solar Corona and Prominences without Eclipses". To this research, M. Lyot has made unique and fundamental contributions for which he has been awarded this year the Royal Astronomical Society's Gold Medal. The presentation of the Medal was made prior to the lecture by the president of the Society, Prof. H. C. Plummer, who spoke of the medallist's great achievement in recording for the first time the sun's corona without an eclipse.

M. Lyot began his lecture with a brief review of past attempts made by various investigators from 1878 onwards to record the solar corona without a total eclipse of the sun. Direct photography from high altitude sites, thermo-electric, spectroscopic and polariscopic methods had all been tried but gave negative results. In consequence, the problem was generally regarded as being beyond the range of observational technique. Ten years ago, M. Lyot, encouraged by the advice of the late Prof. H. O. Barnard of the Colombo Observatory, made a fresh attempt to record the corona in full sunlight.

Measurements made during total solar eclipses showed that the brightness of the corona at 2' from the sun's edge was only about one-millionth that of the light from the disk. To obtain any success, it was therefore a primary necessity to reduce to a negligible amount the diffusion of light by the optical train of the telescope. This diffused light in an ordinary telescope is at least two hundred times greater than the inner coronal image. Furthermore, the whitish aureole of diffracted light around the sun produced by dust in the earth's lowest atmosphere and by ice crystals of cirrus cloud is generally in itself more than a hundred times brighter than the corona.

To overcome the first difficulty, M. Lyot constructed with increasing success three special coronagraphs. To avoid the dust, he took his apparatus to the Pic du Midi in the Pyrenees at height of 2,870 metres, where excellent conditions on cloudless days are obtained especially in the late spring.

The general plan on which the coronagraph were constructed is as follows: A single plano-convex lens (*A*)* forms an image of the sun on a blackened disk of brass projecting just beyond the image by 15"-20". A field lens placed behind the disk produces an image of the lens *A* in a diaphragm, the edge of which intercepts the light diffracted by *A*. A small screen placed in the centre of the diaphragm intercepts the light of the solar image produced by reflection from the surfaces of *A*. Behind the diaphragm and the screen, protected from the diffused light, an over-corrected objective forms an achromatic image of the corona on the plate. The whole optical train is contained in a tube, open only during the observations and coated inside with thick oil to trap the particles of dust. The primary lens must be wiped frequently with particular care.

M. Lyot showed a number of slides of the observatory and instruments. Even under the best conditions, the last part of the ascent of the Pic du Midi has to be made on foot. The coronagraphs are made to telescope into sections for manual transport often over deep snow.

THE CORONA: DIRECT PHOTOGRAPHS

Lyot's work on the direct photography of the corona was made in two stages: (1) 1930-34, when the new method by his coronagraphs was being

* The two later objectives were cut from flawless disks of borosilicate crown glass produced by Messrs. Parra-Mantoux. The lens of the second coronagraph was ground in the Institut d'Optique in Paris, while that of the third instrument was figured by M. Couder at the Paris Observatory.

ted; (2) after 1934, when new results were attempted. The first positive result was obtained July 25, 1930, with his coronagraph of 8 cm. aperture (stopped down to 3 cm.) and 2 metres focal length. Using a red colour-filter, prominences were easily seen. The sun's image was surrounded by a slight halo without detail. Interferometer tests showed the light of this halo to be polarized in a radial plane like the corona as observed at total eclipses but less strongly. The measures, in point of fact, indicated that one fifth the light of this halo belonged to the corona, the remainder being due to diffusion. But there was other evidence to prove that Lyot had in reality isolated the sun's inner corona. On July 21 and the following days, an attached spectrograph showed amongst the absorption lines due to diffused solar light, an emission line in the green of the wave-length of which to within one angstrom was the same as that of the well-known coronal line, λ 5303. The red coronal line, λ 6374, was also faintly visible.

A year later, a larger and more perfect coronagraph (13 cm. in aperture and a focal length of 15 metres) had been constructed and transported with accessory apparatus to the Pic du Midi. With this instrument the first direct photograph of the sun's corona was obtained on July 21, 1931. This photograph and others exhibited on the screen showed the distinctive features of the inner corona—photographed at total eclipses—luminous arches, dark spaces, fine jets of coronal matter, etc. Changes of structure were also apparent within a few hours. To this coronagraph was attached a spectroheliograph, isolating a part of the spectrum of λ A. wide containing the green line 5303. Thus the distribution and strength of this coronal line around the sun could be studied.

Slides of the earliest direct photographs of the corona had to be made by successive copying on the same plate, and in exact superposition, of the best of twelve negatives taken in succession on any one day, the coronagraph being turned on its axis through 30° between each exposure. This procedure diminished considerably the effect of spots produced by dust particles deposited on the second lens of the coronagraph. In 1938, a rotatory mechanism was added to the latest of Lyot's coronagraphs (20 cm. in aperture and 4 metres focal length) which annuls the effect of dust particles on the lens. A single negative is sufficient to gain a good picture of the corona (on a scale of 5 mm. to the solar diameter) with an exposure as short as seven seconds.

Among the many slides shown by M. Lyot to illustrate the delicate, complex structure of the inner corona and its changes, were some taken on May 11, 1937, when Mercury passed close to the

sun's disk. At 10h. 10m., when the planet was only $1' 11''$ from the sun's edge, it was seen projected against a prominence. Later, at 11h. 14m., when at a distance of $2' 37''$, it was outlined against the corona itself; the sky then clouded.

THE CORONAL SPECTRUM

New and powerful spectrographs were devised by Lyot to be used with his two latest coronagraphs, and with these the spectrum of the corona has been explored from 3350 Å. (the limit of the transparency of the coronagraphs) to 1200 Å., which represents the limit of the sensitivity of the plates. To compass this range of spectrum, seven different kinds of plates had to be used, with exposures ranging from 10 minutes in the visible spectrum to 4 hours in the infra-red. M. Lyot then proceeded to show examples of the two hundred or so spectra which he has obtained up to the present time. The slit of the spectrograph is in the form of an arc crossing the east and west sides of the corona about $40''$ from the sun's edge between latitudes $\pm 70^\circ$. These spectra, usually on a scale of $5\text{--}7\frac{1}{2}$ Å. per mm., show in addition to a continuous spectrum from the corona (and also the spectra of any prominences present), eleven coronal emission lines of which five are new lines not previously recorded under conditions of total solar eclipse. These emission lines are as follows, the new lines being indicated by an asterisk :

3386 Å.	7000 Å.* †
5116	7892
5303	8024*
5694*	10747*
6374	10796*
6702	

† Found later by Menzel on spectrograms taken at the eclipse of 1936.

The wave-length of the fourth and seventh lines listed are given more exactly as 5694.42 Å. and 7059.62 Å.

A notable feature of all the coronal lines shown is their great width. Allowing for instrumental corrections, their average widths are 0.8 Å. in the green, 0.9–1.0 Å. in the red, and greater than 1 Å. in the infra-red. The distribution of these lines around the sun show differences from one another which are being studied. As an example, M. Lyot cited the curious distribution of λ 5694, which is invisible where λ 5303 is at a maximum. Another anomaly is the absence from the above list of the line λ 5536, of which no trace appeared on spectrograms taken in 1936, 1937 and 1938 under very favourable conditions and high solar activity. Perhaps the line does not extend to $40''$ above the sun's limb like the other lines. Lyot considers

that the eleven lines listed fall into three groups : (a) $\lambda\lambda$ 5303, 3388, 5116, 6702, 7059, 8024, and probably 10747 and 10798 ; (b) 5694 ; (c) 6374 and 7892.

By measuring the differential Doppler effect given by the strong emission line, 5303 Å., at the east and west edges of the sun, it is found that the corona rotates in the same sense as the general body of the sun and at approximately the same rate.

SPECTRA OF PROMINENCES

Some of the Pic du Midi spectrograms are very rich in lines from the spectra of prominences. The hydrogen spectrum was shown represented by the Paschen series (from the 6th term at 10939 Å. to the 31st term, and the Balmer series in the ultra-violet from the 8th also to the 31st term. The lines of the Paschen series are much fainter than those of the Balmer series, but the atmospheric diffusion, greatly reduced in the infra-red, allows spectra of the Paschen series to be obtained easily without an eclipse.

PROMINENCES THROUGH COLOUR FILTERS

The continuous spectrum of prominences has been observed during eclipses, but it was thought that the spectrum was emitted only by some particular parts of the most intense prominences. To test this, three filters were used transmitting (a) continuous spectrum from 6100 Å. to 6400 Å. ; (b) the D_α line of helium ; (c) $H\lambda$ of hydrogen. It was seen that (a) and (b) gave identical pictures both with respect to form and relative intensities. These results, taken in conjunction with polarization measurements, indicate that this continuous spectrum comes from all parts of a prominence, and in the visible range would appear to be due to the diffusion of the sun's light by the electrons that they contain.

MOVEMENTS OF PROMINENCES

Lyot's coronagraph, supplied with a filter isolating the line $H\lambda$, shows the prominences with great brilliancy against a very dark sky, and their faintest details appear. Since 1935, the movements of stable and eruptive prominences have been recorded at the Pic du Midi on cinematograph films, usually at a rate of two per minute and, in projection, speeded up 600 times. The height of the pictures which M. Lyot showed usually represented about 380,000 km., that is the distance of the moon from the earth, or thirty times the

earth's diameter. These gave an extraordinary exhibition of prominence movements, of which few examples may be outlined :

(1) Filaments fading away as they rise and brightening again as they fall back into the sun with a speed of 180 km./sec.

(2) A suspended cloud pours luminous material inwards to the chromosphere.

(3) A fountain-like prominence is suddenly thrown up by an explosion.

(4) A particularly stable prominence ; small internal motions are, however, perceptible. After many hours, part of the cloud becomes very bright. A chromospheric eruption leaves the sun at the speed of 700 km. per sec. and cuts the prominence into two parts. The luminous material, its equilibrium lost, flows into the sun and seems to flow around an invisible obstacle.

(5) A prominence similar to those called "coronal prominences" by Pettit and McMath, originating in invisible clouds, flows downwards on both sides of a loop or arch in the chromosphere.

In conclusion, M. Lyot said that it would be very interesting to compare the observations of the corona by both methods—with and without eclipses. The outer parts of the corona can be obtained only during eclipses ; the new method without an eclipse shows only the inner corona but daily or even hourly variations of the corona can be recorded. With regard to the coronal spectrum ; in the ultra-violet, the violet and the blue, the atmospheric diffusion is very strong and the new method is in consequence very inferior to the old method. In the green, the diffusion is less strong, and its effects can be diminished by increasing the dispersion and making longer exposures. By choosing days on which the corona is intense, the faint coronal lines appear. The numerous spectrograms on a large scale possible with the new method, enable the lines to be distinguished from the agglomerations of grain on the plate, and their wave-lengths are measurable with great precision. In the infra-red the new method is superior.

For studying prominences, the extra-eclipse method alone enables the solar observer to wait for the appearance of very bright objects having the richest and most interesting spectra. Observations made without eclipses can therefore not replace the work of expeditions investigating total eclipse phenomena, but the two methods complement one another in numerous ways and their simultaneous use would increase our knowledge more rapidly of the sun's outer atmosphere.

Obituary Notices

Miss M. F. Rich

BY the death on April 20 at Ruislip, Middlesex, of Mary Florence Rich, botanical science has lost an active and enthusiastic contributor to our knowledge of freshwater algae. Born at Weston-super-Mare in 1865 and educated at Aske's School, Hatcham, Miss Rich studied at Somerville College, Oxford, where she held a Clothworkers' scholarship. Taking up the teaching profession she held for some years a post at Roodean and then established a girls' school (Granville School) at Leicester, which acquired a considerable reputation and which she continued to direct until 1923.

Although not primarily trained as a botanist, Miss Rich had already so far back as 1903 taken up the study of freshwater algae, to which she devoted a considerable amount of her leisure time while she was at Leicester. During this period she published with her husband a series of papers on the periodicity of these forms and also compiled a valuable list of the algae of Leicestershire. After her retirement from scholastic work, she devoted the remaining years of her life to algal work, settling in the Department of Botany, Queen Mary College (then East London College), in which she afterwards held the position of honorary research assistant. As witness to her activity during these last fifteen years of her life, we have a long series of taxonomic papers, largely dealing with the freshwater algae of Africa, including the phytoplankton of the Rift Valley lakes in Kenya and that collected by the Cambridge Expedition to the East African lakes. Many of the research workers in the Department owed much to her kindly help and her keen interest in any work that was in progress. In recognition of her services she was made a fellow of Queen Mary College in December last. She was elected a fellow of the Linnean Society in 1926.

F. E. FRITSON.

Prof. I. M. Gubkin

SOVIET science has sustained a great loss in the death on April 21 of Prof. I. M. Gubkin, the oil geologist, known not only in the U.S.S.R. but also to geologists throughout the world.

Born in 1871 of poor peasant parentage and requiring an education with difficulty, Gubkin, though early interested in geology, was compelled to spend some years in teaching before he managed, at the age of thirty-two years, to enter the Mining Institute, where even as a student he attained distinction for original work.

He had made a study of the oil deposits of Maikop, Kuban and the Taman Peninsula, adjoining the Caucasus, and later of the Apsheron Peninsula, where he determined the stratigraphy and tectonics of the oil layers. In 1917, he was sent on a commission to the United States to study oil

deposits of various ages and methods of their prospecting.

After the revolution, Gubkin organized the Soviet slate industry, became chairman of the council of the oil industry, and later, in the region of the Kursk magnetic anomaly, directed the boring operations which led to the discovery of big deposits of iron ore at a depth of 200-300 metres from the surface.

Gubkin was the first professor of the geology of oil deposits at the Moscow Mining Institute, of which he afterwards became the rector. He founded the Institute of Research in Petroleum, of which he was the head for a long time. He gave courses of lectures on the geology of world and Soviet oil deposits, creating a school of numerous pupils now engaged in studying and prospecting for oil on the territory of the U.S.S.R.

In 1929, Gubkin was elected a member of the Academy of Sciences of the U.S.S.R. In the Academy he founded the Institute of Combustible Minerals, of which he became the head. He was elected vice-president of the Academy in 1936. In 1933, he headed the Soviet delegation to the Geological Congress at Washington, and in 1937 he presided at the International Geological Congress in Moscow, where he read a paper on the oil reserves of the Soviet Union which, largely as the result of his own work in the discovery of new deposits, had been increased by several times during the period of the Soviet regime.

As head of the Geological Department, Prof. Gubkin directed work in the study of geological formations in the Soviet Union and the compilation of geological maps of the country. He was the author of a hundred and fifty scientific works. One completed not long before his death is entitled "Estimated Oil Reserves of the Soviet Union".

PROF. JOSEPH KLOBOUČEK, a distinguished Czech mathematician, died in Prague on April 18 at the age of sixty-four after a long illness which had necessitated his retirement early last year. He studied at the Universities of Turin and Milan but graduated at Prague, and before obtaining a professorship in 1919 had taught mathematics and science in secondary schools. He was a member of many Continental scientific societies and had contributed a number of papers, mainly on analytical geometry, to Czech and other periodicals.

We regret to announce the death of Prof. Edward A. Burt, professor of botany in the Henry Shaw School of Botany in the University of Washington during 1913-25. He was an authority on the morphology and physiology of the Basidiomycetes.

News and Views

Dr. J. D. Cockcroft, F.R.S.

DR. J. D. COCKCROFT, whose election to the Jacksonian professorship of natural philosophy, in the University of Cambridge, has just been announced, is, like his predecessor, the present secretary of the Department of Scientific and Industrial Research, both a member of St. John's College and a northerner. Having gained valuable experience in heavy electrical industry at an early stage in his career, Dr. Cockcroft entered St. John's College from the University of Manchester as Dowman Sizar and Hoare Exhibitioner in mathematics in October 1923. In 1924, he obtained the highest possible honours in Part II of the Mathematical Tripos and was elected scholar of his college. Thereafter he was engaged in research in Cambridge, first of a mathematical nature, concerning the heating of transformer coils (1925) and later, at the Cavendish Laboratory, of an experimental character regarding the deposition of surface films by atomic beams (1928). He took his Ph.D. and was elected fellow of St. John's College in 1928. Although his publications have not been numerous since that date, during the last ten years he has contributed in a remarkable degree to the prosecution of physical research in Cambridge. He was largely responsible, with Kapitza, for the design of much of the equipment used in the production of intense magnetic fields in the early years of this period (and latterly the direction of the Royal Society Mond Laboratory has devolved almost entirely upon his shoulders)—and, with Walton, of the arrangement by which nuclear disintegration was first effected by artificially accelerated particles (1932). More recently, he has been the moving spirit in the construction and development of the Cambridge cyclotron, and he has taken over the major work of supervision of the building operations made possible by Lord Austin's bequest. Then, in college, he has filled the office of junior bursar for the last six years, and in the University has been indispensable on numerous executive bodies. He was elected a fellow of the Royal Society in 1936 and this year was the recipient with Walton of the Hughes Medal of the Society. His many friends will wish him well in his new office, and some measure of relief from his numerous extraneous duties.

The Royal Society: New Foreign Members

At a recent meeting of the Royal Society the following were elected to the foreign membership of the Society: Prof. Walter Bradford Cannon, professor of physiology in Harvard Medical School, Boston, U.S.A., distinguished for (a) his X-ray investigations of the movements of the alimentary canal, (b) his analysis of the mechanism and conditions of excitation of the suprarenal gland, and (c) his work on the chemical transmission of impulses in

peripheral nerves as shown by the sympathetic system; Prof. George von Hevesy, research professor in the Institute of Theoretical Physics, Carlsberg Laboratory, Copenhagen, distinguished for (a) his work in experimental chemical physics, particularly the use, for the solution of biological and chemical problems, of radioactive and isotopic substances as indicators, (b) for his discovery of hafnium, and (c) for his geochemical researches and for his work on isotopes and their separation; Prof. Herbert Freundlich, University of Minnesota, Minneapolis, U.S.A. distinguished for his researches in colloid chemistry and colloid physics.

The Linnean Society: New Foreign Members

THE following five biologists were elected foreign members of the Linnean Society of London at the general meeting on May 11: Prof. Alfred Ernst, director of the Institute of General Botany in the University of Zurich, distinguished for his work on apogamy in plants and related subjects, and for his fundamental investigations on heterostyly in Primulaceae and tropical Rubiaceae. His monograph on the new flora of the volcanic island of Krakatau was translated into English more than thirty years ago. Dr. William King Gregory, of the American Museum of Natural History, New York, distinguished for his researches on the morphology and evolution of the vertebrate skull and locomotor systems, the evolution of mammalian molar teeth, the phylogeny of fish skulls and the origin of man. Dr. William Marinus Docters van Leeuwen, formerly director of the Botanic Gardens, Buitenzorg, distinguished for his work on galls and the various relations between plants and insects, on the regeneration of vegetation on lava and the biology of plants on mountain tops. His recent "Biology of Plants and Animals occurring in the Higher Parts of Mount Pangrango-Gedeh in West Java" and "Krakatau 1883-1933" are outstanding contributions to tropical botany.

DR. ALFRED REHDER, associate professor of dendrology and curator of the Herbarium, Arnold Arboretum, distinguished for his outstanding contributions to the taxonomy of trees and shrubs. His "Manual of Cultivated Trees and Shrubs" is a standard work, as is also "The Cultivated Conifers", which he wrote in collaboration with Prof. L. H. Bailey. His contributions to botanical bibliography include the preparation of the monumental "Bradley Bibliography". He has played a valuable part in suggesting practical additions and emendations to the International Rules of Botanical Nomenclature. Prof. William Albert Setchell, emeritus professor of botany in the University of California, distinguished for his researches on the classification and distribution

of marine algae, particularly kelps, calcareous algae and parasitic red algae. In addition, he is the author of several papers on mosses, fungi and flowering plants. At the same meeting Mr. John Ardagh, clerk in charge of the Library, Department of Botany, British Museum (Natural History), was elected associate of the Society. Mr. Ardagh has an extensive knowledge of botanical literature, and those engaged upon investigations in taxonomy or botanical history greatly appreciate the readiness with which this knowledge is placed at their service.

Dr. E. W. R. Steacie

DR. E. W. R. STEACIE has been appointed director of the Division of Chemistry, National Research Council of Canada, in succession to Dr. G. S. Whitby, who recently resigned to accept the post of director of the Chemical Laboratories of the Department of Scientific and Industrial Research in Great Britain. Dr. Steacie, who will assume his new duties in July, has been a member of the teaching staff of McGill University for the last ten years, being at the present time associate professor of chemistry. During his period most of his time has been spent in the supervision of research by graduate students working on problems in the fields of hydrocarbon chemistry, combustion, chemical kinetics and photochemistry, in which work he is recognized as an authority. Dr. Steacie's studies have been directed largely along lines of fundamental research on problems of industrial importance, such as gaseous combustion, catalysis, pyrolysis of organic compounds, gases in metals, and high-pressure reactions. He has published many scientific papers and treatises, and is an associate editor of the *Journal of Chemical Physics*.

Sir John Eliot, K.C.I.E., F.R.S., 1839-1908

ON May 25, 1839, the distinguished meteorologist Sir John Eliot was born at Lamesley, Durham. Though the son of a schoolmaster, he did not matriculate until he was twenty-six years of age, and he then entered St. John's College, Cambridge. In 1869 he graduated as second wrangler and he was first Smith's prizeman. After graduating he went to India and successively was professor of mathematics at Roorkee Engineering College (1869-72), at Muir College, Allahabad (1872-74), and professor of physical science at the Presidency College, Calcutta (1874-86). This last post he relinquished to succeed Henry Francis Blanford (1834-98) as meteorological reporter to the Indian Government. He had already served as reporter to the Government of Bengal. In 1899 he became director-general of Indian observatories, retiring from this post in 1903, being made K.C.I.E. He wrote largely on meteorological subjects, and his "Handbook of Cyclonic Storms in the Bay of Bengal" proved of great use to commerce and shipping. Elected a fellow of the Royal Society in 1895, after his return to England in 1904 he was president of the sub-section of astronomy and cosmical physics of the British Association. He died suddenly at his estate at Var, in the south of France, on March 18, 1908.

Civil Defence Research Committee

SIR JOHN ANDERSON, the Lord Privy Seal, has appointed a Civil Defence Research Committee, to be constituted as follows: Dr. E. V. Appleton (chairman), formerly Jacksonian professor of natural philosophy at the University of Cambridge, now Secretary of the Department of Scientific and Industrial Research; Prof. J. F. Baker, professor of civil engineering at the University of Bristol; Prof. J. D. Bernal, professor of physics at Birkbeck College, University of London; Dr. C. G. Darwin, director of the National Physical Laboratory; Prof. A. J. S. Pippard, professor of civil engineering in the Imperial College, University of London; Prof. R. V. Southwell, professor of engineering science at the University of Oxford; Prof. G. I. Taylor, Yarrow research professor of the Royal Society at Cambridge; Prof. W. N. Thomas, professor of engineering at University College, Cardiff. The secretary of the committee is Dr. E. N. Fox, Clarendon House, Page Street, S.W.1. The committee will advise the Lord Privy Seal on programmes of research and experiment. The aim is to secure the fullest possible co-ordination over the wide field of work now comprised in civil defence.

Pottery from Mersin, Cilicia

EXAMPLES illustrative of the whole of the remarkable range of pottery discovered by Prof. John Garstang in his archaeological investigations on the prehistoric Cilician site of Mersin in Asia Minor (see NATURE, March 18, p. 484) are to be available for study in Great Britain. Prof. Garstang, in the course of an account of his excavations before the Society of Antiquaries of London on May 11, paid a tribute to the Turkish Government not only for the facilities afforded him for excavation, but also for the generosity with which the authorities had allowed a selection of no fewer than five hundred pieces to be brought to England for exhibition on long-term loan. In making his selection, Prof. Garstang added, his aim had been to secure that the series should be as representative as possible of the whole sequence of development on this very ancient site, and also to demonstrate in the sequence the position of the remarkable early architectural remains, which had been discovered—at present the oldest known. A number of specimens of the pottery were shown by Prof. Garstang to illustrate his lecture, including wares of the Cilician-Hittite periods, as well as of the whole range of the series of the chalcolithic culture, in which several new types are included. Attention was specially directed to the examples of the black ware with white decoration of the late chalcolithic culture of about 3000 B.C., and the trichrome ware from the sixteenth level, showing direct contact with predynastic Mesopotamia and the Tell Halaf culture. Wares from the neolithic level, still incompletely explored, were also shown. Arrangements are being made for the pottery to be allocated to the British Museum and museums at Oxford, Cambridge, Birmingham, Liverpool, Edinburgh, Glasgow and elsewhere. Prof. Garstang also spoke of his discoveries in Cilicia in a Friday evening discourse at the Royal Institution on May 12.

Sir Robert Mond's Bequest to the British Museum

At the meeting of the Trustees of the British Museum on May 13 the receipt was reported under the terms of the will of the late Sir Robert Mond of the biggest and most important collection of Egyptian antiquities of all periods that has reached the Museum for at least fifty years. The bequest includes 260 objects, which fill gaps in the collections in every class of Egyptian art. Among the sculptures are an Eighteenth Dynasty three-quarter size head and shoulders of an official, a number of *ushabtis*, among which is one contained in a nest of model coffins, also belonging to the Eighteenth Dynasty, and a statuette in steatite, which is especially fine, of an official, Sunuri, of the Nineteenth Dynasty. Of the bronzes, one of the most remarkable, as well as one of the best, is an axe-head of the Eighteenth Dynasty, obviously intended for ceremonial or ornamental use. It is in the Syrian style, and has inserted within its margin an extremely beautiful group of a dog bringing down a wild goat. The bequest also contains jewelry, scarabs, pottery, copies of the Book of the Dead, and some examples of the now well-known Roman portraits from the Fayum. Of these, one represents a woman with a gold tiara and necklace, and is most vivid and convincing. Among other accessions to the Egyptian collections reported is an open-work scarab in gold of the Middle Kingdom c. 2700-2300 B.C.), which is of a type new to the Museum. It has been given by Prof. P. E. Newberry. Two fragments of Anglo-Saxon sculpture, the first to be received for some years, have been presented by Mrs. G. W. Haswell and Mr. F. T. Haswell. Both pieces are in red sandstone, and are North Mercian work of the ninth or tenth century A.D. from Chester or its neighbourhood. The finer fragment is ornamented on both faces and on the sides and end with an interlaced pattern of animals and scrolls, the chief figure being a large lion of barbaric design.

Archæology and A.R.P.

A DISCOVERY of considerable interest to archaeologists has been made at Canterbury in the course of excavations for an A.R.P. Control Centre at the rear of the municipal buildings on the Dane John. A Roman pottery kiln has been found in the natural clay at a depth of about seven feet below the present ground level. Associated with the kiln were a number of potsherds, together with some forty to fifty of the tops of jars and other vessels in a variety of shapes and sizes. Among fragments of Belgic and Samian ware is a base which bears the name of the potter, 'Pavlim'. A trench running across the excavation, and extending some four to five feet into the clay, is, it is presumed, the source of the clay from which pots were made. A.R.P. excavation is also responsible for a find, in certain respects of even greater interest, which is reported from Barton-on-Humber, Lincolnshire (*The Times*, May 15). Here human skeletons have been found in association with a number of objects, which are held to be Anglo-Saxon of the fifth or sixth century A.D. They have been examined by Mr. T. Sheppard, of the Hull

Municipal Museum. Among the associated antiquities are a large hanging bowl of bronze, with three escutcheons for attachment, probably originally used in the Saxon church of St. Peter, a cylindrical bronze box, with a lid highly decorated, used by Saxon women for needle and thread and having an attachment for suspension to the waist, and a large decorated gold bead. The find of the bronze bowl is of particular interest, as it belongs, presumably, to a class of antiquity which has been made the subject of study by Mr. T. D. Kendrick of the British Museum and has been shown by him to be of British (Celtic) derivation.

Culture of Pre-Industrial Britain

SIR CYRIL FOX, director of the National Museum of Wales, delivered the annual Im Thurn Memorial Lecture to the Scottish Anthropological and Folklore Society on April 17. Sir Cyril emphasized the urgent need of making an adequate record of the cultures of Britain of the pre-Industrial Revolution era, cultures which survive more or less intact in outlying districts, and the material remains of which are still very widely distributed. He had cast his title "A Field Museum To-morrow: What's to be To-day?", into a colloquial form to emphasize his view that the matter concerned the man-in-the-street in every geographical or political region in Britain. The collection of material for the future national open-air museums should be carried out on rigidly scientific lines, special attention being devoted to things related to life and work on the land. We need the furniture of farmhouse and cottages of every century from the sixteenth; the carts, tools and implements used on the farms; tools used in, and products of, rural industries. Techniques of farm and house building should be recorded and photographed; farm lay-outs should be planned. Only adequately provenanced objects should be collected only so can we hope to map, ultimately, the culture regions of pre-industrial Britain. We want to know whether the boundaries of these regions are political or economic. If political, do they go back to the Heptarchy in southern Britain? Outside a few museums, the fate of British folk-material is a sad one—torn from its environment, it is regarded as 'old world' and ' quaint', collected by those from whom its real interest and importance as a manifestation of a once vigorous culture are hidden. How many collectors trouble to record the exact provenance of their specimens?

Exhibit of Historic Aeroplanes

A SPECIAL exhibit of aeroplanes representing an epoch in the history of aviation has been arranged in No. 1 Gallery at the Science Museum, South Kensington, and will be on view for about six weeks. The machines have been lent by Mr. R. G. J. Nash who has carefully restored them to their original condition and has flown them on various occasions. The exhibit is an interesting supplement to the permanent National Aeronautical Collection which contains such historic machines as the original Wright

planes of 1903 and the Vickers-Vimy trans-Atlantic monoplane of 1919. A Blériot monoplane, type XI (cross-Channel type), was flown by M. Leon Molon from Doncaster in October 1909, where it gained a flight record. It has a speed of about 40 m.p.h. and is similar to the machine in which Louis Blériot made his historic crossing of the Channel from the French coast to Dover on July 25, 1909. Another Blériot (type XXVII) with a speed of 80 m.p.h. is the original Gordon Bennett Cup racing machine which Alfred Leblanc flew at Long Island, U.S.A., in 1911. These machines represent the aeroplane in an early stage of its development as a mode of transport—still experimental and confined mainly to exhibition flying and competitions. No degree of standardization had then been reached, and the aeroplane was not regarded as a really proved instrument; the situation was still one of uncertainty as to the future of flight. The advent of the Great War in 1914 had, however, a profound effect on the aeroplane, and it induced an intensive development which may be estimated from the example of a Sopwith "Camel" of 1917, a famous fighter scout which was the first aeroplane to be fitted with twin synchronized guns and had a performance undreamt of in 1909, namely, speed of 113 m.p.h. at 10,000 ft. and a climb to 10,000 ft. in five minutes. An actual wartime Fokker D.VII fighter, which belonged to Jagdstaffel 71 of the German Air Force, also shows the rapid development of the aeroplane for military uses which resulted from the stimulus of war. Another famous aeroplane of the War period is the Vickers-Vimy bomber, which made the first non-stop flight across the Atlantic on June 14-15, 1919, piloted by the late Sir John Alcock with Sir Arthur Whitten Brown as navigator, now exhibited in Gallery VI.

An Early Wet-Plate Folding Camera

VALUABLE additions to the photography collections at the Science Museum, South Kensington, include a complete outfit for the wet-plate process, of date 1854, presented by His Grace the Duke of Devonshire. The outfit comprises a folding wood camera by Ottewill, a sensitizing bath, and a complete set of chemicals and reagents in its original leather carrying case. These objects are all of considerable interest as showing the types of apparatus and accessories necessary for "photography in the field" in the early days of the "photographic art".

Water Pollution

THE forty-sixth Bedson Lecture was delivered by Sir Robert Robertson on May 8 in King's College, Newcastle-upon-Tyne. Sir Robert confined himself to two recent investigations connected with the subject of water pollution. The first of these concerns the pollution problems of the River Tees. A thorough biological and chemical survey of this river has been carried out. This has shown that, whilst the river is unpolluted until its union with the Skerne, the entry of sewage from Darlington in this tributary causes appreciable pollution of the lower reaches. In the estuary, the condition of the river is

rendered much worse by industrial refuse containing cyanide. As a result of the investigation, the sewage disposal system of Darlington has been improved, and several undertakings upon Teeside have modified their plants, so that cyanide does not enter the river. With regard to the second topic—the disposal of milk factory waste—Sir Robert said that diluted milk, on account of its easily oxidizable nature, is a potent fish poison. As a result of its consistency, the refuse is difficult to treat by ordinary filtration methods, and success was first obtained by a modified activated sludge process. However, better results have been obtained by use of two filters in series. The refuse is passed first to one filter, *A*, and thence to the second, *B*. When *A* shows signs of clogging, usually in about three weeks, the direction of flow is reversed, that is, the liquid passes first to *B* and then to *A*. Filter *A* then recovers, and in due course the direction of flow is again reversed, and so on.

A Utilitarian Classification of Fragmentary Fossils

It is generally understood that the generic and specific names given to fossils cannot often be defined so precisely as those given to existing organisms. It is also recognized that the classification of extinct genera into families and orders is not always satisfactory. At the same time, readily distinguishable fossil fragments with definite characters need names, because they can frequently be used to determine the geological age of the rocks in which they occur. Such names are now proving especially useful in the microscopical study of sponge spicules, holothurian and echinoid spicules, plates of star-fishes and crinoids, conodonts, fish teeth and scales, otoliths, pollen grains, and other fragments which denote special conditions or mark horizons in series of rocks. The names are always in the Linnean form, and the so-called genera and species are grouped into so-called families and orders on the Linnean plan. Prof. Carey Cronquist, in a recent letter to *Science* (89, 314; April 7, 1939), and in an earlier article in the *Journal of Geology* (46, 975-984; Oct.-Nov. 1938), points out that this classification is misleading. For the various grades he proposes adopting the terms used in the old Roman army: for species he would use 'centuria'; for genus, 'manipulus'; for family, 'cohort'; and for order, 'legio'. He would thus distinguish a utilitarian classification from one which has the appearance of being natural.

Prevention of Road Accidents

THE report of the Select Committee of the House of Lords, appointed to consider what steps should be taken to reduce the number of casualties on the road, is discussed in *Roads and Road Construction* of May. It is pointed out that since 1910 the number of vehicles on the roads has increased twenty times, and in addition there has been a marked increase of mileage run per vehicle. During the same period the increase in road production is only about two per cent. The Committee is unable to accept the con-

clusions of the Ministry as to the causes to which these accidents are attributed. First, only one cause has been assigned to each accident, although the blame should be distributed in various proportions between road conditions, the road user, the vehicle and both parties involved in the collision. Secondly, the system of police reports on road accidents is often inadequate. Thirdly, the vehicles are sometimes so damaged that it is impossible to say whether they were defective or not. Fourthly, the Committee does not agree with the general principle on which the Ministry proceeds, that even if the condition of the roads and cars was unimpeachable the total of accidents would not be appreciably affected. The Committee believes that segregation of drivers, cyclists and pedestrians on the main roads must come and that the attainment of this ideal is essential if road safety is to be ensured. The highway code should be revised and it should be given the force of law. Witnesses before the Committee were strongly of opinion that an extensive and persistent campaign of educational propaganda should be undertaken and that it should be aimed at every class of road user. The improvement of main roads and the construction of new roads should be carried on simultaneously. 'Lay-byes' and 'draw-ins' should be made on every few miles of highway. The costly system of erecting kerbs should cease and guard posts should be erected 18 inches outside the edges of roads, at suitable intervals, sloping outwards at an angle of 15° from the vertical and provided with reflectors. Many other useful suggestions are made and we hope that some of them will be adopted.

The National Botanic Gardens of South Africa

In September 1938, the National Botanic Gardens of South Africa, at Kirstenbosch, and the Botanical Society celebrated their silver jubilee, and in the close of the year was produced a special number of the *Journal of the Botanical Society* with some very fine photographs, which show something of the beauty of the Kirstenbosch Botanic Garden with its ideal site on the slopes of Table Mountain. The number contains a brief note by the editor, Prof. R. H. Compton, upon the history of the Gardens, the site of which was selected in 1913 by the late Dr. Pearson, then professor of botany at the South African College. On a motion by Sir Lionel Phillips, the House of Assembly and the Senate passed unanimously in that year a motion that Kirstenbosch, bequeathed to the people of the Cape by Cecil Rhodes as part of his great Groot Schuur Estate, should be granted by the Government as the site of the National Botanic Gardens. The Government consented, making an annual grant towards its support, and at the same time the Botanical Society was formed, with some three hundred subscribers, to enlist public support for the new venture. The early onset of the Great War and the subsequent financial depression has caused delay, but the Director can record many striking indications of progress in the Gardens, and the Botanical Society has now nearly 2,000 members enrolled.

Biology in Education

THE Educational Advisory Board of the British Social Hygiene Council is attempting to give a new orientation to the teaching of biology by bringing more into touch with individual needs and social problems of to-day. With this aim in view, a Summer School has been arranged at Keble College, Oxford, during July 28–August 4. The School is primarily intended for teachers and others who are concerned with the place of biology in education, but membership will be open to anyone who is interested in the biological problems of modern human life. The inaugural address will be given by Prof. J. S. Watson. One section of the School will deal with current problems in social biology and their repercussions on the school-child, and another section will be concerned with problems of personal growth and development. These sections will be contributed by lecturers with considerable experience in the particular fields. The third course will include lectures on subjects of topical interest by prominent workers in biological research, including Mr. C. Elton, Dr. S. Zuckerman, Dr. H. N. Sinclair and Dr. Keith Murray. There will be considerable opportunities for discussion, while excursions to places of academic interest are being arranged. Further particulars can be obtained from Mr. T. H. Hawkin, Education Officer, British Social Hygiene Council, Tavistock House South, Tavistock Square, London, W.C.1.

The League of Nations Union

A LEAFLET issued by the League of Nations Union for the assistance of teachers preparing to address their pupils on Empire Day emphasizes the part played by representatives of the British Empire in drafting the Covenant of the League, which is described as a first attempt to apply on a world scale the ideals of democratic government common to the British Commonwealth of Nations and the United States of America. It suggests the possibility of federation of these and all other democratic States and the sharing of the control of colonial territories and our responsibilities for the development of colonial peoples to full nationhood. The League of Nations Union's arrangements for the summer include (a) for schoolboys and schoolgirls, Nansen Pioneer camps in Devon, Shropshire and Peebleshire and summer school at Geneva, and (b) for educational administrators and teachers, a conference to be held partly at Geneva, where members will attend the lectures and discussions of the Geneva Institute of International Relations, and partly at a mountain chalet.

The International Seismological Summary

THE April, May and June 1933 number of the *International Seismological Summary* has just come into the hands of those recipients who previously stated their wish to have copies straight from the press rather than wait until the annual set could be prepared and bound. This number consists of 14

dealing with 180 epicentres, 77 being new and the remainder repetitions from old epicentres. Five deep-focus shocks are listed, namely, those of April May 6, 24, 27 and 28. These were respectively in the Pacific Ocean north-west of the Ladrone Islands, in the Pacific Ocean south of Panama, in the deep ocean off the east coast of Japan, near the Marianas north-west of India, and in the Pacific Ocean immediately to the south of the main island of Japan. It would be an advantage if all recording stations could send in their readings promptly, so that the interval of six years between the occurrence of earthquakes and the publication of authoritative data on them could be reduced.

Wells and Steel Institute Awards

The following awards have been made by the Wells and Steel Institute: the Andrew Carnegie Gold Medal for 1938 to Dr. James White, of Glasgow, in respect of his paper on "Equilibrium at High Temperatures in Systems Containing Iron Oxides"; the Andrew Carnegie Gold Medal also to Dr. W. Ruff, of Stettin-Lahn, Germany, in respect of his paper on the Running Quality of Liquid Malleable Iron and Steel, published in 1936; the Williams Prize for 1938 for a paper of practical interest to Mr. D. V. Ishna Rao of Bhadravati, India, in respect of his paper on "The New Steel Plant of the Mysore Iron and Steel Works, Bhadravati, India"; the Ablett Prize for 1939, for a paper by a junior engineer, to H. Escher of Wollongong, Australia, for his paper on "Ten Years' Development in Steam Engineering at the Port Kembla Steel Works, N.S.W., Australia". The following Andrew Carnegie research scholarships have been awarded: O. Gessner (Breslau, Germany), £100 in aid of a research on the viscoelasticity of cast-iron alloys, steel, metals and alloys and slags; Ljunggren (Stockholm, Sweden), £100 for a microscopical investigation of grain boundaries; Parker (University, Leeds), £100 in aid of a research on oxidation and scaling of steel.

Institution of Electrical Engineers Awards

The Council of the Institution of Electrical Engineers has made the following award of premiums for papers read or published during the session 1938-39: *Institution Premium*, to Dr. T. E. Allibone, E. Bancroft and G. S. Innes; *Ayrton Premium*, to F. W. Lawton; *Fahie Premium*, to K. L. Wood; *John Hopkinson Premium*, to N. F. T. Saunders; *Oliver Premium*, to Dr. L. Hartshorn and E. Rushton; *Paris Exhibition (1881) Premium*, to R. Nelson; *Webster Premium*, to N. F. S. Hecht; *Overseas Premium*, to H. S. Hvistendahl; *Extra Premiums*, to G. H. Fletcher and A. Tustin; Dr. W. Betteridge and J. A. Laird; F. Brailsford; J. Higham and P. Wolfenden; Dr. K. L. Jensen; *Wireless Section Premiums*, to L. W. Hayes and B. N. McLarty (Duddell Premium); Dr. J. D. McGee and Dr. H. G. Lubczynski; Dr. R. L. Smith-Rose and Dr. H. G. Hopkins; P. R. Coursey and S. N. Ray; *Motor and Instrument Section Premiums*, to Dr. E. G. Ames, G. R. Polgreen and G. W. Warren (Silvanus Thompson Premium); Dr. H. M. Barlow; D. C.

Gall; G. F. Shotton; *Transmission Section Premiums*, to Dr. W. G. Radley and C. E. Richards (Sebastian de Ferranti Premium); Prof. W. J. John and Dr. C. H. W. Clark; E. W. W. Double and W. D. Tuok; T. R. Scott and R. C. Mildner.

Announcements

MR. F. J. DU TOIT, representative of the Union of South Africa on the executive council of the Imperial Agricultural Bureaux, has been appointed chairman of the council, in succession to Lieutenant-Colonel George P. Vanier, who resigned on taking up an official appointment abroad.

A COMMITTEE has been formed to present Prof. Jules Bordet, director of the Brussels Pasteur Institute, with a medal on the occasion of his being made a Commander of the Legion of Honour. Subscriptions should be sent to M. Georges Masson, 120 Boulevard Saint Germain, Paris 6^e.

At the annual general meeting of the Institute of Wireless Technology held on April 28, the following officers were elected for the year 1939-1940: *President*, Mr. Sydney A. Hurren; *Honorary Treasurer*, Mr. George Lea. The assistant secretary is Mr. E. Carter, I.W.T., 4 Vernon Place, Southampton Row, London, W.C.1.

PROF. FREDERICK C. LEONARD, chairman of the Department of Astronomy of the University of California, Los Angeles, will be visiting professor of astronomy in the summer session of the University of British Columbia, Vancouver, Canada, during July 3-August 18, while Prof. Daniel Buchanan, dean of the Faculty of Arts and Science and head of the Department of Mathematics of the University of British Columbia, will be visiting professor of astronomy and mathematics in the summer session of the University of California, Los Angeles, during June 26-August 4.

THE twenty-sixth annual meeting of the Swiss Röntgen Society will be held in Zurich on June 3 and 4, when the subjects for discussion will be cosmic radiation, the biology of cosmic radiation and the radiological appearance of pulmonary tumours. Further information can be obtained from the secretary, Dr. Max Hopf, Effingerstrasse 49, Bern.

VOLUME 35A of the *American Journal of Science* (1938) is dedicated to Dr. Arthur L. Day and contains a series of papers by members of the scientific staff of the Geophysical Laboratory of the Carnegie Institution of Washington, from the directorship of which Dr. Day retired in 1936. In a short foreword it is stated that the publications from the Laboratory number one thousand and contain a body of knowledge which is being successfully employed in the interpretation of geological observations. The volume contains several very interesting papers, among which may be mentioned those on the system water-boron oxide and the system calcium sulphate-water, which elucidate some previously obscure points in these subjects.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 860.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Emission of Neutrons accompanying the Fission of Uranium Nuclei

THE experiments of Halban, Joliot, and Kowarski described in NATURE¹ give an indirect proof of the neutron multiplication accompanying the fission of uranium nuclei after neutron capture. It can be deduced from these experiments that the additional neutrons are, on the average, faster than the photo-neutrons from radium C-beryllium used as active primary radiation. This conclusion is confirmed in a subsequent note² by the same authors in which they find that the neutrons contributed by uranium are able to produce the endo-energetic reaction $S(n,p)P$.

I have made some experiments on the same problem by a different method. Any increase of neutron effects observed when neutrons are allowed to pass through a given medium may be due: (a) to the inelastic scattering of neutrons, (b) to the reaction $(n,2n)$ or, exceptionally $(n,3n)$; (c) to an unknown cause, as in the case of uranium to the fission of its nuclei. In the experiments of Halban, Joliot and Kowarski, effects (a) and (b) are excluded owing to the integrating method adopted and to the low energy of the primary neutrons. But if these effects are present, it is possible to estimate their importance relatively to effect (c) by comparing uranium with substances in which only effect (a) or only (a) and (b) are possible. I have used aluminium and copper as comparison substances of the first and of the second type respectively.

A radon plus beryllium source was placed in the cylindrical axial hole of a cylinder of aluminium, of 2.2 cm. diameter and 5 cm. height, or, alternatively, of a cylindrical double-walled vessel of identical dimensions filled with uranium oxide (U_3O_8) or copper oxide. The mass of aluminium was 40 gm., of uranium oxide 49 gm. and of copper oxide 42 gm., and the thickness of walls could be neglected. The number of absorbing or scattering uranium nuclei was therefore 9.2 times smaller than the corresponding number of aluminium nuclei and 3.3 times smaller than the number of copper nuclei. One would expect, therefore, that the effect (a) due to aluminium, and effects (a) and (b) due to copper would be at least of the same importance and probably larger than the same effects due to uranium. The number and quality of neutrons issuing from these substances were compared by measuring the activation of a silver foil surrounding the cylinders in two cases: first, when no appreciable scattering of neutrons took place outside the cylinders, and secondly, when the neutrons were scattered back by a cylindrical sheet of paraffin wax of 6 mm. thickness. The results are given below, the figures being the total numbers of counts of a Geiger-Müller counter in corresponding series.

It can be inferred from these data that uranium gives off, in fact, more neutrons than aluminium or

copper. The increase is larger relatively to aluminium than to copper, which must be attributed to the reaction $(n,2n)$ occurring in this last element. In both cases, the increase is larger when the neutrons are slowed down by a small quantity of paraffin which shows that the additional neutrons from uranium are, on the average, slower than the bulk primary neutrons emitted by the source. As, from other evidence, they appear to be faster than the radium C-beryllium neutrons, we can estimate that their average energy must be of the order of 1 Mev.

Owing to the small number of uranium nuclei acting as absorbers or scatterers, it seems very unlikely that the apparent excess of neutrons given off by these nuclei should be due to some trivial cause like the inelastic scattering or the reaction $(n,2n)$. It probably represents the 'neutron shower' accompanying the fission of an activated uranium nucleus. Assuming the cross-section for this process produced by the neutrons from radon plus beryllium equal to 5×10^{-28} cm.², I calculate that the number of neutrons emitted in a single fission is equal to 6.

J. ROTBLAT.

Miroslaw Karnbaum Radiological Laboratory
of the Scientific Society of Warsaw,
Warsaw. April 8.

¹ NATURE, 142, 470 (1939).

² C.R., 208, 995 (1939).

Statistical Calculation of Composite Decay Curves

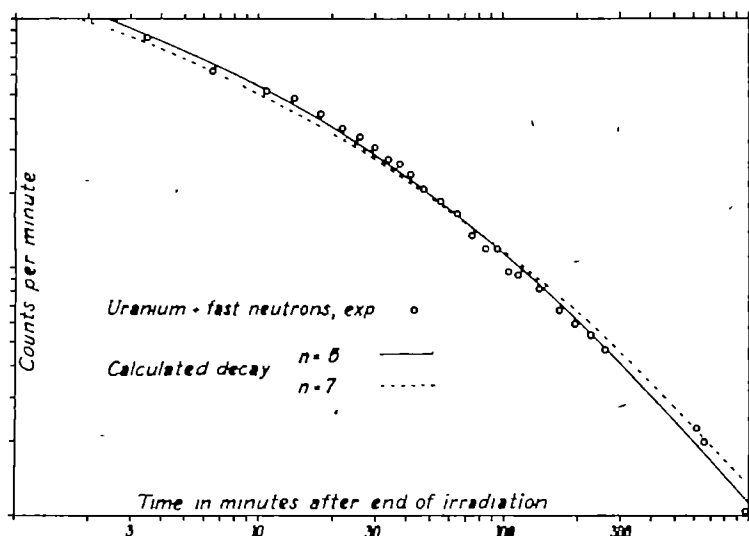
WHEN uranium or thorium is bombarded with neutrons, a number of radioactive bodies are formed with periods ranging from a few seconds to several days. The decay of this assembly of fission product (not chemically separated) has been studied by Bjerger, Broström and Koch¹ and found to be practically the same for thorium and uranium. They have pointed out that this may be due partly to the fact that some of the fission products are the same for uranium and thorium but that, apart from this, the large number of periods would tend to wipe out any individual features of the decay curve.

This suggests that it would be possible to calculate the decay curve of such an assembly by the use of statistical assumptions on the distribution of periods. I have made such a calculation, based on admittedly crude assumptions, the result of which is indicated by the full line in the accompanying diagram, while the circles represent the measured decay².

In this calculation, the actual (discontinuous) assembly of periods is replaced by a continuous distribution with a suitable density function $f(\lambda)d\lambda$, where λ is the decay constant. We introduce the decay energy E , using Sargent's law $\lambda = k.E^2$, and assume the density function with respect to E to be constant.

(This may be justified by arguing that the decay energy of a radioactive isotope is roughly proportional to the

	Aluminium	Uranium	Increase (%)	Copper	Uranium	Increase (%)
No paraffin	9,089	9,335	2.6	4,810	4,900	1.8
With paraffin	10,195	10,775	4.8	10,049	10,323	2.4



difference, in nuclear charges, from the stable bar and that, after infinitely long irradiation, all values, within relevant limits, for this difference will be about equally represented among the nuclei resulting from the fission and subsequent β -decay.) The decay curve is then obtained by integrating:

$$J_{\infty}(t) = \int_0^{\infty} f(\lambda) e^{-\lambda t} d\lambda = \int_0^{\infty} \text{const.} \cdot e^{-\lambda t} d\lambda = \text{const.} \cdot t^{-1/n},$$

here $J_{\infty}(t)$ is the number of atoms decaying per unit of time, at the time t after the end of an infinitely long irradiation. If the irradiation has the finite duration T , we get

$$J_T(t) = \text{const.} (t^{-1/n} - (t+T)^{-1/n}).$$

This function, for $T = 100$ minutes and $n = 5$, is represented by the full line in the diagram. The close agreement with the experimental points would seem to support the choice of $n = 5$, but actually $n = 7$ (the dotted line) fits almost as well. The small differences are probably real and due to the individual periods. The smallness of these deviations emphasizes to what high degree the influence of the single periods is smoothed out, and indicates that the similarity between the thorium and uranium decay curves can be explained entirely on this basis, without assuming any similarity in the details of the distribution of periods.

O. R. FRISCH.

Institute of Theoretical Physics,
University,
Copenhagen.
May 4.

¹ Bjerge, Brostrom and Koch, *NATURE* [143, 794 (1939)].

² Hahn and Strassmann, *Naturwissenschaften*, 27, 80 (1939). Aton, Bakker and Heyn, *NATURE*, 143, 679 (1939).

Specific Heat of Copper Sulphate below 1° K.

It is well known that caesium titanium alum exhibits no specific heat anomaly due to Stark splitting, but only a large increase at very low temperatures attributed to magnetic interaction between the ions. This is explained by the well-supported hypothesis that the orbital momentum is quenched, leaving the ion effectively in an ^1S state since it possesses only

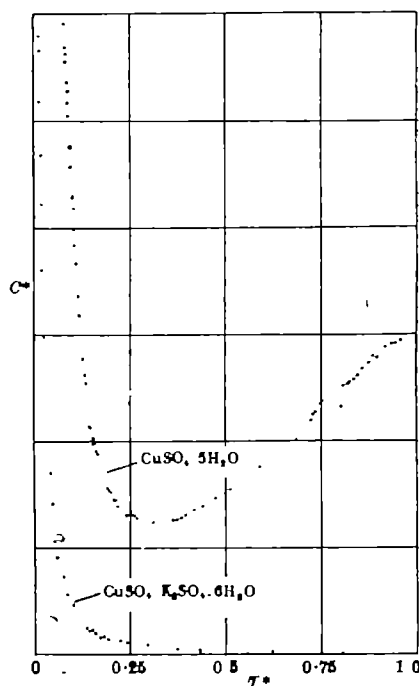
one electron spin, and Kramers has shown that the ^1S state is remarkably free from splitting due to the lattice field. The cupric ion would be expected to behave similarly, since susceptibility measurements show that the orbital momentum is largely quenched and since there is only one electron spin.

Experiments have therefore been carried out on the specific heats of copper sulphate and copper potassium sulphate below 1° K. Only relative measurements were attempted, so that the ordinates in the two graphs below are arbitrary. A constant influx of heat was maintained by an external γ -ray source, and the susceptibility was measured very precisely with an inductance bridge as the salt warmed up. The temperatures T^* in the curve below were derived on the

assumption that the Curie law holds below 1° K., but it seems unlikely that this is very much wrong in the upper part of the range since the law holds approximately at helium temperatures. No correction has been applied for the demagnetizing coefficient.

The specific heat of copper potassium sulphate is entirely in accord with expectation as it exhibits only a sharp rise due to magnetic interaction at a very low temperature ($0.01^\circ T^*$). It was accordingly possible to reach $0.005^\circ T^*$ by demagnetizing from 35.9 kilogauss and 1.17° K. The salt thus compares favourably with caesium titanium alum as a means of reaching extremely low temperatures, and has the advantage of being cheap and easily obtained.

It would be expected that copper sulphate would behave in much the same way as the double salt since the ionic moment is the same when calculated from the low field susceptibility of either compound



in the helium range¹, so that the quenching of the orbital momentum should apply equally in the two cases. Owing to the closer approach of the ions, the magnetic interaction specific heat is naturally shifted to a higher temperature, but the most remarkable feature is the presence of a very large specific heat throughout the whole region below 1° K. A first survey of the specific heat in the helium range indicated that it only falls to a low value at about 4.5° K. The large extent of the maximum is remarkable and may have important applications in experimental technique. The specimen was an ellipsoid of axis ratio 3.18:1, and consisted of very many small crystals of purity better than 99.9 per cent compressed by about 100 atmospheres into a coherent mass.

An attempt was made to estimate absolute temperatures by demagnetizing from different fields at the same bath temperature, and calculating the entropy of magnetization assuming the Brillouin formula and taking $j = \frac{1}{2}$. The calculation broke down for demagnetization from those fields which were so low that the level splitting was comparable with the energy of magnetization, but we may accept with caution the values for the lower temperatures produced by demagnetization from the higher fields. It appears probable that the susceptibility becomes extremely large at 0.05° K., so that we might expect ferromagnetism near this temperature. The lowest point reached with copper sulphate was 0.08° K. (0.03° T*), but no hysteresis was observed with a ballistic galvanometer, though the arrangement was amply sensitive to detect the effect in ferric alum.

While it would be rash at this stage to attempt a detailed explanation, the general conclusion must be drawn that in copper sulphate there does exist a splitting of the energy levels such as to give a high specific heat in the helium range. Unless the effect is due to exchange forces, which seems improbable in view of the high dilution, it must be assumed that the electric field of the lattice can, in certain circumstances present in copper sulphate but absent in copper potassium sulphate, produce a level splitting even in an ion which is effectively in an ¹S state owing to the quenching of its orbital momentum.

J. ASHMOAD.

Royal Society Mond Laboratory,
Cambridge.
March 29.

¹ Reekie, J., in the Press.

Sparking Potential of Deuterium (Heavy Hydrogen)

THE sparking potential of heavy hydrogen between parallel electrodes was recently measured in this laboratory, and the influence of the material of the cathode was also examined. In accordance with the general theory of the discharge, the effect of a change of cathode material was most pronounced at the minimum sparking potential, which was found to be characteristic of the metal of the cathode after it had been de-gassed. Further, for any given metal the minimum sparking potential was found to be very sensitive to the state of the cathode surface even after it had been de-gassed in a vacuum furnace, as exposure of the cathode to the gas for any length of time had a marked effect in lowering the sparking potential.

The value of the minimum sparking potential of heavy hydrogen characteristic of a steel cathode was found to be 339 volts, as the experiments indicate that lower values, obtained after the metal had been exposed to the gas at pressures exceeding about 20 mm. of mercury, were probably due to adsorbed layers of the gas on the cathode surface. However, in many cases, bombardment of the cathode by positive ions in a discharge was able to restore the higher values of the sparking potential. Similar effects were also observed with light hydrogen, and the minimum sparking potential with a steel cathode was found to be more than 10 per cent greater than that recently given for a platinum cathode¹.

Hence the results show that typical diatomic gases like hydrogen and deuterium behave like the monatomic gases^{2,3}, in that the minimum sparking potential is strongly characteristic of the cathode material, and increases with the work function of the cathode, a result which was not supported by the early measurements with the diatomic gases.

In comparing the two isotopes, it was found that for six different cathodes the minimum sparking potential of deuterium was greater than that of hydrogen by about 3 per cent, but that when the spark parameter pd was about 5 (mm. of mercury $\times$ cm.) the sparking potential V of the two gases was the same. The normal cathode fall is also known to be greater in deuterium than in hydrogen⁴. Now, it is reasonable to assume that the coefficient of ionization of deuterium by electrons is not very different from that of hydrogen, especially at high values of the ratio of V/pd , a view supported by the measured values of the force in the positive column⁵. On this assumption, then, the difference between the sparking potentials of the two gases can be accounted for if at the same value of V/pd , the deuterium positive ion is 20 per cent less effective than the hydrogen ion in liberating electrons from the cathode, although both ions have the same potential energy. The difference must therefore be due to the lower velocity of the deuterium ion. Further, if this constitutes the main difference between the electrical properties of the two gases, it also accounts for the equality in the sparking potentials when pd is about 5.

F. LLEWELLYN JONES.

Department of Physics,
University College,
Swansea.
April 14.

¹ Whrenkranz, *Phys. Rev.*, **55**, 219 (1939).

² Llewellyn Jones and Galloway, *NATURE*, **138**, 973 (1936) *Proc. Phys. Soc.*, **50**, 207 (1938).

³ Llewellyn Jones and Henderson, *Phil. Mag.*, in the Press.

⁴ Guntherohnke und Schnitzger, *Z. Phys.*, **103**, 491 (1936).

⁵ Steenbeck, *Z. tech. Phys.*, **11**, 397 (1936).

Penetration of the Potential Barrier and Formation of AlH

SEVERAL investigators have observed peculiar anomalous intensities in the band system ¹II — ¹Σ of the spectrum from AlH. Generally the lines from rotational levels $J > 17$ in $v = 0$ and $J > 7$ in $v = 1$ ¹II are weakened or absent according to the circumstances in the light-source.

In order to investigate whether formation of AlH takes place in the ¹II-state, I have repeated an experiment of Wurm¹, who investigated the spectrum of aluminium in a hydrogen atmosphere in an electric furnace. My spectrograms show that all

lines from upper levels with $J > 19$ in $v = 0$ and > 7 in $v = 1$ have appreciably greater intensities than lines from levels with lower J -values. These enhanced lines are those absent at low pressure in the spectrum of the arc, that is, lines emitted from the predissociating levels above the limit of dissociation in $^1\Pi$. In the furnace, however, at all pressures investigated (1-400 mm.) the AlH-spectrum is the appearance mentioned above, if the exposures are taken immediately after the furnace was filled with fresh aluminium and hydrogen. The great intensities of the enhanced lines show that a considerable new formation of AlH-molecules takes place in these states. This is a direct proof and demonstration of molecular formation by the hydrogen atom penetrating the potential barrier.

During the investigation of this problem, the following observations were made:

(1) When the temperature is increased in the tube, the intensity is shifted toward larger J -values of the enhanced lines.

(2) The (1,1) band is more intense than the (0,0) band and the (1,2) band more intense than the (0,1) band. These intensity relations are the opposite to those in the spectrum of the AlH arc.

(3) In the (0,0) band the enhanced lines of the β -branch have almost the same intensities as the corresponding lines of the Q -branch and considerably greater intensities than the corresponding R -branch lines.

(4) The effects mentioned in (3) are not appreciable in other bands of $^1\Pi - ^1\Sigma$ investigated.

(5) If several exposures are taken successively without changing the conditions of the light-source, the spectrograms show that the intensities of the bands, especially the intensities of the enhanced lines, decrease, so that the enhancing effect is gradually diminished.

(6) The effects of (5) develop faster at low than at higher pressures.

(7) The intensity ratio between the enhanced and the remaining lines is greater in the (0,0) band than in the other bands.

(8) In the (0,0) band, Q_1 and P_2 are superposed, and this line has on all my plates anomalous low intensity.

Further work in this line, which is in progress, will be published later in detail in connexion with discussions regarding the origin of these very distinct facts. Further, I shall try to apply the results obtained to explain the anomalous intensities in the spectrum of HgH and the pressure effects in AlH.

G. STENVINKEL.

Department of Physics,
University,
Stockholm.

Feb. 19.

Warm, K., *Z. Phys.*, **76**, 309 (1932).

Stress Tensor and Particle Density in Special Relativity Theory

THE stress-momentum-energy tensor of a relativistically perfect fluid in the absence of exterior forces

$$T_{ij} = -(\rho + p)\delta_{ij} + pg_{ij}, \quad (1)$$

where δ_{ij} , $i, j = 1, 2, 3, 4$, g_{ij} is the fundamental tensor of space-time (signature $---+$),

$\frac{dx^k}{ds}$ is the Minkowskian velocity of the macro-

scopical motion ($\delta^k_k = 1$), p the pressure and ρ the proper energy-density. Elsewhere¹ I have shown that a fluid is only perfect in the relativistic sense if it is 'perfectly perfect', that is, if not only viscosity but also heat conduction is negligible. So long as (1) holds, no transition of heat between adjacent parts of the fluid occurs and the motion takes place without increase of entropy.

The question has been raised by Eddington² whether ρ/mc^2 can be identified with the proper particle density if the fluid is chemically homogeneous, m being the mass of one molecule. Eddington's answer is in the negative; according to him, the particle-density is ρ_0/mc^2 where $\rho_0 = -T^i_i = \rho - 3p$. Recently Synge³ has shown Eddington's result to be incorrect and re-established ρ/mc^2 as the particle density.

It can be shown, however, that the proper particle density is neither ρ/mc^2 nor ρ_0/mc^2 but a third quantity, say, $\bar{\rho}/mc^2$, independent of both and not even derivable from T^i_i at all. But for an ideal gas of not excessively high temperature, $\bar{\rho}$ is approximately the mean value of ρ and ρ_0 . Hence, though Eddington's value ρ_0 for the proper particle density was wrong, his criticism against Schwarzschild's value ρ was right. The general discussion will be given elsewhere; here the following elementary argument may suffice. Though the result is valid in general relativity also, it has been formulated here for special relativity theory only. For simplicity, factors $\sqrt{-g}$ have been dropped.

The argument depends upon the fact that the molecules have motions different from the macroscopical motion. Let v be the proper particle density of molecules moving with a definite Minkowskian velocity

$$e^k = \frac{dx^k}{ds} (\delta^k_k = 1), \text{ so that } v \text{ is a function of } e^k \text{ and}$$

that ndV is the number of molecules contained in a 3-dimensional element dV orthogonal to their world-lines, that is, to e^k . Elements like dV are supposed to contain still a large number of molecules. Then the number of molecules contained in an arbitrary 3-dimensional element of magnitude dV and normal to the unit-vector n^k is $ve^k dV_k$, where $dV_k = n^k dV$. Hence the total momentum and (negative) energy of these molecules is $-mc^2 ve_k e^k dV_k$. After summation with respect to all directions e^k this must become $T^k_k dV_k$ hence

$$T^k_k = \Sigma - mc^2 ve_k e_k. \quad (2)$$

In particular, $\rho_0 = -T^i_i = \Sigma mc^2 v_i$. Moreover, choosing orthogonal co-ordinates at rest with respect to the macroscopical motion (so that $\delta^1_1 = \delta^2_2 = \delta^3_3 = 0$, $\delta^4_4 = 1$), $e_k = 1/\sqrt{1 - v^2/c^2}$, where v is the ordinary velocity belonging to e^k . Hence

$$\rho = -T_{44} = \Sigma mc^2 v(e_4)^2 = \Sigma mc^2 v/(1 - v^2/c^2) \sim \rho_0 + \rho_1 + \rho_2, \quad (3)$$

where $\rho_1 = \Sigma mv^2 v$, $\rho_2 = \Sigma mv^4/c^2 v$, and powers of v^2/c^2 higher than the second have been neglected.

The number of molecules $\bar{\rho} dV/mc^2$, however, contained in an element dV orthogonal to the macroscopical world-lines, that is, to δ^k_k is $\Sigma ve^k \delta^k_k dV = \Sigma ve_k dV$; hence

$$\bar{\rho} = \Sigma mc^2 ve_k = \Sigma \frac{mc^2 v}{\sqrt{1 - v^2/c^2}} \sim \rho_0 + \frac{1}{2}\rho_1 + \frac{1}{2}\rho_2. \quad (4)$$

The equation of state for an ideal gas (which is valid in relativity theory also⁴) leads to the relation $p = kT\bar{\rho}/mc^2 = \tau$, where kT is the proper temperature measured in energy units, so that $\tau = kT/mc^2$

is a very small number (of the order of about $10^{-12}T$); ρ_1 is of the order of τ and ρ_2 of the order of τ^2 . As, moreover, $p = \frac{1}{2}(\rho - \rho_0)$, we have:

$$\rho = \bar{\rho} + \frac{1}{2}p + \frac{1}{2}\rho_2 = \bar{\rho}(1 + \frac{1}{2}\tau) + \frac{1}{2}\rho_2 \quad (5)$$

$$\rho_0 = \bar{\rho} - \frac{1}{2}p + \frac{1}{2}\rho_2 = \bar{\rho}(1 - \frac{1}{2}\tau) + \frac{1}{2}\rho_2 \quad (6)$$

In the second member of (5), the first term corresponds to the sum of the proper energies of the molecules (which is smaller than the proper energy of the element of matter they constitute), the second term to the classical kinetic energy of the relative translatory motion, and the third term to the relativistic correction. If the latter is neglected (which means neglect of v^2/c^2 in (3), (4)), we obtain from (5), (6):

$$\bar{\rho} \sim \frac{1}{2}(\rho + \rho_0) \quad (7)$$

Finally, it may be remarked that in the case where p is a function of $\bar{\rho}$ alone, so that the hydrodynamical integral $P = \int d\rho/\bar{\rho}$ exists, $mc^2(1 + P)$ is the average value per molecule of the so-called proper *enthalpy* or heat-content $E + pV$, so that¹

$$T\dot{\eta} = -\bar{\rho}(1 + P)\dot{\eta} + p\dot{\eta} \quad (8)$$

D. VAN DANTZIG.

Technische Hoogeschool,
Delft.
March 22.

¹ van Dantzig, D., "On the Phenomenological Thermodynamics of Moving Matter". To be published in *Physica*.

² Eddington, A. S., "The Mathematical Theory of Relativity", p. 122 (Cambridge, 1924).

³ Synge, J. L., *Trans. Roy. Soc. Canada*, (3), III, 22, 127-171 and 156 (1934); *Proc. Lond. Math. Soc.*, (3), 46, 376-416 and 396 (1937).

⁴ Jüttner, F., *Ann. Phys.*, (4), 34, 850-882 (1911); (4), 35, 145-161 (1911); *Z. Phys.*, 47, 542-566 (1928). Tolman, R. C., *Phil. Mag.*, 23, 583-600 (1914).

⁵ Cf. Paull, W., *Ann. Math. Phys.*, 2, 602 (1920), where the older literature is mentioned.

Motion of the Spiral Nebulae

THE shift of the spectrum lines of the spiral nebulae towards the red is commonly accepted as evidence of a high velocity in the line of sight away from the solar system.

I venture to suggest that the shift may not be a Doppler effect at all; but the well-known genuine slowing down of atomic vibrations predicted by the Lorentz-Larmor electromagnetic theory, which has recently been conclusively demonstrated in laboratory experiments in the case of hydrogen canal rays by Ives and Stilwell¹.

On this interpretation, all the extra-galactic nebulae must be regarded as rotating about the galaxy as centre, so that we have a velocity of revolution instead of a radially outward one; but its magnitude is even more staggering than the required radial velocity. If $\Delta\lambda$ is the increase in the wave-length, λ , the required radial velocity u is given by $\Delta\lambda/\lambda = u/c$, where c is the velocity of light; but the required transverse velocity v is given by $\Delta\lambda/\lambda = (1 - v^2/c^2)^{-1/2} - 1$; or by $\Delta\lambda/\lambda = v^2/2c^2$ if v^2/c^2 is negligible. In this case the relation between v and u for the same shift is $v^2 = 2cu$.

Thus, taking the typical nebulae velocities at distances of 10^7 and 10^8 light-years as 1,700 and 17,000 km./sec. respectively, the required transverse velocities work out as 32,000 and 100,000 km./sec. respectively. So nebulae at these two distances would take 580 and 1,850 million years respectively to perform one revolution; this gives proper motions too small to have been detected so far.

Since the radial velocity u has been found to be proportional to the distance r , we shall have v^2/r constant. Thus all the nebulae possess approximately the same radial acceleration. If the nebulae occupy a spherical volume, with rough symmetry, this means that the total mass inside a sphere of radius r is proportional to r^3 . But the radial acceleration requires a much greater amount of mass than appears actually to be present. I find that the number of nebulae, each of mass 3,500 million suns, which would be required inside spheres of 10^7 and 10^8 light-years, works out at 2×10^8 and 2×10^{10} respectively. This latter seems about 10,000 times too great. The acceleration might be accounted for by the supposition of cosmic dust between the nebulae, of densities 2.7×10^{-10} and 2.7×10^{-12} gm./c.c. at 10^7 and 10^8 light-years respectively, which shared in the general rotation of the system of nebulae. This would give a mass (about 12 grams of material per sq. cm. of cross section, lying between distances of 10^8 and 10^9 light-years, which, although it is only about 1 per cent of the earth's atmosphere, will be difficult to reconcile with no more absorption than actually exists, unless the material exists as separate atoms or molecules instead of as dust particles.

This possible rotation of the whole system of spiral nebulae makes the estimated rotation of the galaxy require further investigation.

I put forward this suggestion on the motion of the spiral nebulae to see if it can be found tenable in the face of criticism. I know it has its difficulties, especially as far as I know, no evidence of symmetrical distribution with respect to any axis has been discovered among the spiral nebulae; but it avoids some of the difficulties associated with the idea of radial velocities.

ALBERT EAGLE.

The University,
Manchester, 13.
April 1.

¹ *J. Opt. Soc. Amer.*, 28, 215-226 (1938).

Influence of Micelle Formation on Flotation

It has been noted¹ that cetyl-trimethyl-ammonium bromide is a collector for (that is, induces floatability of) several different types of mineral. The minimum effective concentration of the compound (threshold concentration) required to induce flotation differs from mineral to mineral, but when the concentration has been increased to a value lying between 100 mgm and 500 mgm. a litre, flotation ceases to be possible for all minerals. This is about the concentration (280 mgm. a litre) at which micelle formation of the ammonium salt becomes considerable².

We have recently found that flotation ceases to be possible in solutions of certain other paraffin chain compounds, for example, sodium cetyl sulphate and potassium laurate, at the concentration at which micelle formation occurs. Moreover, neutral salt such as sodium and calcium chlorides, which diminish the concentrations necessary for micelle formation also diminish the concentrations necessary to prevent flotation. It is concluded that there is a direct correlation between micelle formation and prevention of flotation.

Flotation is dependent upon orientated adsorption of the collector at the mineral surface, which enables contact with the air bubble to occur, but contact is hindered¹ when the air bubble is 'armoured' by adsorbed paraffin chain molecules and micelles. The

proved by the fact that, in solutions just below the strength required for micelle formation, contact between mineral and a newly formed bubble may be possible when contact with an aged bubble is impossible.

Chemistry Department,
University,
Melbourne.
Feb. 20.

E. E. WARK.
I. W. WARK.

Wark, I. W., *J. Phys. Chem.*, **40**, 661 (1936).
Adam, N. K., and Shute, H. L., *Trans. Farad. Soc.*, **31**, 769 (1935).

Structure of Alginic Acid

ALGINIC acid, the industrial importance of which is increasing, constitutes a large proportion of the dry weight of certain seaweeds. It is noteworthy among polysaccharides in that it appears to be built up entirely of *d*-mannuronic acid residues, although its resistance to hydrolysis is so great that no quantitative transformation to *d*-mannuronic acid has been achieved¹. The results we have recently obtained from a study of the action of methyl alcoholic hydrogen chloride on the polysaccharide show that high yields of *d*-mannuronic acid are obtainable from alginic acid.

Furthermore, we succeeded in isolating, by the use of the same reagent, a partially degraded form of alginic acid of comparatively low molecular weight. Except for the lower viscosity of its solutions, this material differed little from the original alginic acid, but it was more amenable to chemical transformation. From it, by use of thallium ethoxide and methyl iodide, we obtained the corresponding fully methylated derivative. This methyl derivative was exceptionally stable towards hydrolytic agents, but two methods were developed which gave insight into its chemical structure. When boiled with strong nitric acid it underwent hydrolysis, followed by degradative oxidation, with formation of *meso*-dimethoxy succinic acid (v). This indicated that in each of the mannuronic acid residues the methyl groups were attached at C₂ and C₃.

Conclusive proof of this was provided as follows. Methylated alginic acid on drastic treatment under pressure with methyl alcoholic hydrogen chloride

gave the methyl ester of 2:3-dimethylmannuronide (ii). The latter, after hydrolysis followed by oxidation (bromine water), yielded 2:3-dimethyl mannosaccharic acid (iii), and this in turn was oxidized by periodic acid (reagent for oxidative degradation of α β glycols²). The products were glyoxylic acid (iv), and the half aldehyde of *meso*-dimethoxy succinic acid from which the crystalline methyl *meso*-dimethoxy succinate (v) was then obtained quantitatively. It follows that in the methylated alginic acid the methyl groups were situated at C₂ and C₃, respectively, and it appears that alginic acid is composed of *d*-mannuronic anhydride residues linked glycosidically. In addition, it is clear that in alginic acid there occurs a chain of *d*-mannuronic acid residues in each of which the hydroxyl groups at C₂ and C₃ are free. The glycosidic linkage must therefore be either 1:4 (pyranose ring structure) or 1:5 (furanose ring structure).

In view of the extreme stability of alginic acid and its large negative rotation, it is highly probable that the ring structure is pyranose and that the linkage between the residues is 1:4. We conclude therefore that at least the major portion of the alginic acid molecule is composed of β -*d*-mannuronic acid residues linked as shown in (i). At present, owing to the experimental difficulties connected with the hydrolysis of such intractable material, it is not possible to say whether the whole of the alginic acid molecule is so constituted, and further work on this subject is in progress.

The structural resemblance between (i) and the formula for cellulose (chains of β -*d*-glucopyranose units with 1:4 linkage) is apparent, and a further point of interest is that in pectic acid³, as shown recently in this laboratory and by Dr. F. Smith of the University of Birmingham, a similar structure is encountered, the residues in this case being α -*d*-galacturonic acid (pyranose form) linked glycosidically through positions 1 and 4.

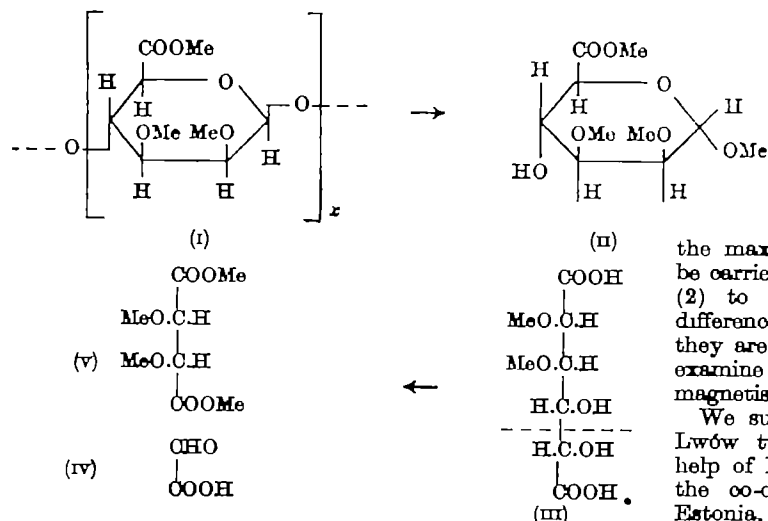
University,
Bristol.
April 5.

E. L. HIRST.
J. K. N. JONES.
WINIFRED O. JONES.

¹ Nelson and Cretcher, *J. Amer. Chem. Soc.*, **51**, 1914 (1929); **54**, 3409 (1932). Bird and Haas, *Biochem. J.*, **25**, 403 (1931). Schoeffel and Link, *J. Biol. Chem.*, **100**, 397 (1933).

² Hudson and Macley, *J. Amer. Chem. Soc.*, **60**, 2059 (1938).

³ *Chemistry and Industry* **58**, 363 (1939).



Further Experiments on Homing in Storks

As previously stated¹, white storks have a prominent instinct of direction. In order to obtain further information on this problem we carried out the following experiments in 1938: (1) to ascertain the maximal distance from which birds may be carried and still remain capable of homing; (2) to ascertain whether the birds show differences in their homing abilities, when they are taken in different directions; (3) to examine the possible influence of terrestrial magnetism on homing.

We succeeded in catching in Butyny near Lwów twelve adult birds. Thanks to the help of Polish Airways 'LOT', as well as to the co-operation of naturalists in Finland, Estonia, Germany and Portugal, the storks

have been taken: to Lisbon (2,700 km. to the west; maximal distance in air-line); to Berlin (680 km. to the west; problem of magnetism and of the west direction); and to Harviala in Finland (1,132 km. to the north; problem of magnetism and of the north direction).

Each of these three groups was composed of four birds, specially marked with bright colours and rings, so as to be easily recognized on return to their nests in Butyny. Besides that, after long preliminary experiments we succeeded in fastening magnets to the heads of three birds of each group destined for Germany and Finland. The magnetic fields of the magnets were calculated according to the formula of Gauss. They were several times stronger than the magnetic field of the earth, which would mean, according to Stresemann's hypothesis, that they ought to eliminate its influence.

Our experiments did not give quite satisfactory results. That was partly due to difficulties in obtaining a larger amount of experimental material, and also to very unfavourable meteorological conditions in the second half of June 1938 when the experiments took place.

With regard to the first problem, though the birds behaved in identically the same way as others did in our first experiments in 1937, not one of the four birds of the Portugal group landed home. Of course the maximal distance from home had been exceeded (2,700 km. by air-line in comparison to 2,260 km. of the preceding year Lydda (Palestine) to Butyny). On the other hand, it is possible that the obstacles caused by the desert-plateau of Spain, the Pyrenees and the Alps were very difficult to overcome, and the air currents, of which storks take generally great advantage, were unfavourable.

In the second experiment, three birds, out of four released near Berlin, came home. Their flight homewards was much slower this time. It varied between 43 and 107 km. daily, in comparison to 165 and 188 km. in the year 1937. It is yet impossible to give a definite decision concerning any influence that the earth's magnetism may exercise on the capacity of homing in birds, because of two control birds without magnets one came home. Yet comparing previous experiments (when birds had mostly been transported to the south, that is, along their usual migration direction) the return of birds of the Berlin group proves that they are capable of homing not only from great distances but also from directions and countries hitherto unknown to them.

The results observed of the transport of birds to Finland are still more striking. In this group three birds had magnets fastened to their foreheads and one bird a control bar, of the same weight. Owing to the fact that storks appear rarely in Finland, and owing also to the help of the members of the Zoological Museum in Helsingfors, we were well informed about the flight of the birds in Finland and partly in the neighbouring countries as well. Not one of the birds came home; two of them perished for unknown reasons. The most interesting fact is that the birds, after having left Harviala, were seen in many parts of the country, mostly on the beach of the 100 km. wide Finland Bay, which lies in between the straight and shortest air-line to Poland. From there they went back to Harviala at different intervals. Most probably the birds found the bay too wide to fly over. (The Straits of Gibraltar, the Bosphorus, Sea of Marmora, their usual routes,

are much narrower.) Their return to Harviala proves a curious attachment to a new locality.

Further experiments will be conducted in 1939.

KAZIMIERZ WODZICKI.

Department of Anatomy, WŁ. PUCHALSKI.
College of Agriculture, H. LICHÉ.

Warsaw.

March 31.

¹ NATURE, 141, 35 (1938).

Hypospadias and Non-descent of the Testes caused in Rats by Progesterone

Hain¹, Wiesner², Greene and Ivy³ have reported the occurrence of hypospadias in young female rats following the injection of oestrogens or androgens (oestrone, androstanediol, testosterone) into the pregnant mothers or into the young soon after birth. Lacassagne⁴ has observed a similar lesion in a male rabbit treated from birth with oestrone. I also have observed hypospadias in female rats and mice treated from birth with oestrone or testosterone. The males have not shown any malformation of the penis; but their testes have failed to descend into the scrotum at the normal time. In a recent experiment, fifteen new-born Wistar rats were given subcutaneous injections of 0.5 mgm. progesterone in sesame oil on each of the three post-natal days, and 1 mgm. was given three times a week until the twenty-third day, after which no further treatment was applied except that on the forty-fourth day 2 mgm. progesterone were given to each of the males. At this time the eight females all showed hypospadias and the seven males all had undescended testes. On the sixty-fifth day two only of the males have testes in the scrotum. Normally the testes would have descended not later than the fortieth day.

The comparable results obtained by all these three types of gonadal hormones seem to be worth recording.

The progesterone used was most kindly given by the Ciba Company.

HAROLD BURROWS.

Research Institute,
Royal Cancer Hospital (Free),
London, S.W.3.
April 26.

¹ Hain, A. M., *Brit. Med. J.*, 42, 101 (1935).

² Wiesner, B. P., *J. Obst. Gynaecol.*, 42, 8 (1935).

³ Greene, R. R., and Ivy, A. O., *Science*, 68, 200 (1937).

⁴ Lacassagne, A., "Certain Biological Problems Relating to Cancer, Hormones and Radiation" (1936).

New Data on Spontaneous Mutations

Among the factors that are of decisive importance in the development of the individual, but do not influence directly its germ-cells, the nutritive regime must be mentioned in the first place. The purpose we had in view was to study the rapidity of mutation process in *Drosophila melanogaster* under conditions of an avitaminous B₃ regime.

We made use of the line 'white' for investigation. By way of many times repeated transfers of the flies (Guyénot method, 1911) a complete elimination of microflora was achieved and an aseptic line obtained.

Three groups of individuals could be employed for genetical purposes: (1) the control individuals

which developed on a yeast medium (10 days duration of development); (2) individuals that had the vitamin B₁ given them on the twentieth day of their larval life (the flies began to emerge on the thirtieth day after the eggs had been laid); (3) individuals which had fed on yeast medium for a period at the longest of twenty-four hours after hatching and continued their development on an avitaminous B₁ medium (10 days duration of development).

The adults of group (2) did not differ from the controls in regard to duration of life and fertility (males only were studied). But these individuals in the period of their larval life preceding the addition of yeast medium have quite certainly been subjected to a strong and unfavourable effect of an avitaminous B₁ regime (when no yeast medium is added more than 99 per cent of individuals die on the eighteenth or the twenty-second day of their larval life). In adults of group (3) the duration of life and fertility are greatly diminished: the vitamin B₁ not only influences metamorphosis (a minimal amount suffices for securing the setting in of the pupal stage and the emerging of the fly), but the organism as a whole is likewise strongly influenced by it.

The rate of lethal mutations found in the X-chromosomes (method *OLB*) of the control ♂♂ (0.21 ± 0.08) and the ♂♂ of group (2) (0.15 ± 0.07) is about the same in both cases (difference = 0.06 ± 0.11). At the same time, if the number of originated mutations corresponded to the time elapsed, the percentage of mutation brought into evidence in the experimental material (duration of development thirty days) should have been three times as large as in the control (10 days duration of development).

The percentage of lethal mutations found in the II chromosomes (method *Cy sp/L**) in experimental ♂♂ of group (2) (1.07 ± 0.16) is about on a par with the rate of mutations in the II chromosomes in the control (0.66 ± 0.13) or even somewhat lower than the latter (difference = 0.41 ± 0.21). Statistically the difference between the number of mutations found in II chromosomes of group (2) and the number of mutations to be expected if the rapidity of the mutation process did not depend on the rapidity of individual development is quite real (difference = 43.07 ± 8.30). The experiment just described contains, moreover, the data indicating that the suggestion of a germinal selection acting in our experiment has no validity: the relation of the percentage of mutations found in ♂♂ of group (2) to that in the control is about the same for the X as for the II chromosome.

The question arises whether it is a simple coincidence that the percentage of mutations relative to the number of chromosomes studied proves to be about equal in ♂♂ of group (2) and in control ♂♂. Does not this fact indicate that in ontogenesis forces are acting that occasion accumulation of a certain number of mutations in the individual's germ-cells up to the close of metamorphosis? For the solution of this problem individuals of group (3) were employed (their development as in control group lasts 10 days).

The percentage of lethal mutations found in the II chromosomes in group (3) and in the control group is the same in both cases (difference = 0.01 ± 0.43). Thus we may consider it as proved that the decrease in rapidity in the mutation process, brought into evidence in the preceding experiments in which ♂♂ of group (2) were studied, is due to the fact that in this group the development is of longer duration. The decisive role may quite possibly belong here to

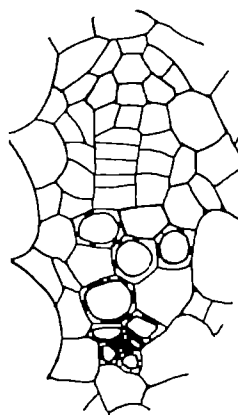
a slowing down of the process of spermatogenesis, or more exactly, in connexion with the latter, a slowing down of the rate of reproduction ('multiplication') of the genes.

J. M. OLENOV.

State Roentgenological Institute,
Leningrad.
April 5.

Centripetal Xylem in the Pedicel of a Monocotyledon

THE centripetal xylem in the stem among the vascular plants is confined to the Pteridophyta and lower gymnosperms, the Pteridosperms and the Cordaitales. The vegetative stem of Cycadales and Coniferales lacks centripetal xylem; but it occurs in a poorly developed condition in certain conservative regions like the reproductive axes and the leaf traces. In the Gnetales and the angiosperms the axial organs show exclusively the endarch condition, and the centripetal xylem is altogether absent from the primary vascular bundles.



In my study of the floral anatomy of *Gagea fascicularis* Salisb., however, I have seen distinct traces of centripetal xylem in the vascular bundles of the pedicel. The pedicel in this species at its distal end shows six bundles. Three of these are large and three alternating are small. The smaller bundles frequently show in addition to the

normal centrifugal xylem one or two vessels to the inside of the first-formed narrow protoxylem elements. The structure is shown by the accompanying figure. Details will be published elsewhere.

The structure of the vascular bundles in the flowers of *Gagea fascicularis* is also interesting in showing a distinct intrafascicular cambium.

A. C. JOSHI.

Benares Hindu University.
April 1.

Ethmoplax, a New Name for *Stratiphyllum* Smyth

At a meeting of the Royal Irish Academy held on May 8, 1933, I proposed the name *Stratiphyllum* (as *Stratophyllum*) for a Carboniferous tabulate coral from Tournai, Belgium. The name was not published until September 8 of that year¹. Dr. Stanley Smith has directed my attention to the fact that in the meantime Dr. Walther Scheffen had published the same generic name for some Silurian rugose corals from Norway².

I therefore wish to rename the Tournaisian form *Ethmoplax* (ἔθμος, a strainer; πλάξ, anything flat and broad, a plain).

LOUIS B. SMYTH.

Trinity College,
Dublin. April 27.

¹ Proc. Roy. Irish Acad., 41, Sect. B, 18, 171 (1933).

² Skrifter Norske Vidensk.-Akad. Oslo (1933), I, Mat.-Naturvid. Klasse, 2, No. 5, 35 (May 1933).

Kinetochore or Centromere?

IN his recent communication¹, Dr. Mather seems to have no argument against the applicability of 'kinetochore'. He sponsors 'centromere' largely because it is used by a number of investigators. But I, for one, am not convinced that it is the "best term in use to-day". To Dr. Mather 'centromere' may imply a visible particle, but to many it will connote a part that is centrally placed in a topographical sense. No such meaning is of course intended. My advice concerning the confusion that may arise from the addition of still another to the series of words involving 'centre' rests on my experience as a teacher. Perhaps the validity of such advice will be more apparent if I point out that in 1936 Darlington² himself used 'centrosome' when he evidently meant 'centriole'. The argument that no such confusion has attended the use of a series of terms involving 'chroma' is not well chosen, for in one place in the same paper (p. 266) Darlington writes 'chromosome' when he means 'chromomere'.

So far as priority is concerned there seems little room for argument. Sharp proposed the term 'kineto-

chore' in 1934. Nebel³ adopted it in 1935 and myself⁴ first used it in June 1936. Darlington², in 1936, was still using "spindle attachment chromomere" and, if I am not mistaken, it was not until December 1936, six months after my publication, that he employed 'centromere', probably unaware of its previous use in a different sense by Waldeyer. He made no reference at all to 'kinetochore' which, as I have said, does not carry the disadvantages of the term sponsored by himself.

I suggest that we submit the matter to the proper committee at the coming Congress of Genetics at Edinburgh. I, for one, should be quite willing to accept its decision.

FRANZ SCHRADER.

Department of Zoology,
Columbia University,
New York.
April 4.

¹ Mather, K., *NATURE*, 143, 290 (1939).

² Darlington, C. D., *Proc. Roy. Soc., B*, 131, 264 (1936).

³ Nebel, B. B., *Smoker*, 7, 113 (1936).

⁴ Schrader, F., *Biol. Bull.*, 70, 484 (1936).

⁵ Darlington, C. D., *Proc. Roy. Soc., B*, 118, 33 (1935).

Points from Foregoing Letters

J. ROTBLAT compares the increase in the neutron effect obtained by means of uranium with that produced by aluminium and copper, and concludes that v. Halban, Joliot and Kowarski are correct in ascribing the uranium effect to the increase in the number of neutrons resulting from the fission of uranium nuclei, rather than to the simple reaction ($n, 2n$).

O. R. FRISCH compares the radioactive decay curve of the uranium fission products with a calculated curve, the calculation being based on simple statistical assumptions about the distribution of decay periods. The good agreement indicates that the individual features of the decay curves are very nearly eliminated on account of the large number of decay periods.

J. ASHMEAD has measured the specific heats of copper sulphate and copper potassium sulphate below 1° K. The curve for copper potassium sulphate has only a maximum due to magnetic interaction, but copper sulphate has also a maximum at higher temperatures. This indicates that there may be a contribution to the specific heat from Stark splitting even when the orbital momentum would normally be considered quenched, leaving the ion in an ^4S state.

The minimum sparking potential of deuterium is found by F. LLEWELLYN JONES to be strongly characteristic of the cathode material, and is about 3 per cent greater than that of hydrogen. At higher pressures the sparking potentials are identical.

G. STENVINKEL states that the emission spectrum of AlH from an electric furnace shows that AlH is formed in an activated electronic state. This formation is a function of the time. There are several anomalies in the intensity relations of this band spectrum.

D. van DANTSIG considers that the particle density of a chemically homogeneous, relativistically perfect fluid cannot be calculated from the stress tensor, as it depends upon the temperature also. For an ideal gas the relations between these quantities can be

determined explicitly. This is done to a second approximation.

A. EAGLE suggests that the whole system of extragalactic nebulae may not be retreating from the galaxy but revolving about it; the displacement of the spectrum lines being due to a change of period of vibration due to the velocity.

E. L. HIRST, J. K. N. JONES and Miss W. O. JONES show that the polysaccharide alginic acid, which is an important constituent of certain seaweeds, can be transformed into a less viscous form of low molecular weight. A major feature of the structure of alginic acid is a chain of *d*-mannuronic acid residues linked together by glycosidic links connecting the 1:4 positions. This structure is compared with that of cellulose and that of pectic acid.

Further experiments on homing in white storks carried out by K. WODZICKI, W. PUCHALSKI and H. LISCHE, attempted to examine the influence of the magnetic field of the earth and the reactions of birds taken in different directions.

The three main types of gonadal hormone will produce in some circumstances a similar biological effect. A new example is recorded by H. BURROWS, who finds that, given to rats on the day of birth and afterwards progesterone, like oestrone or testosterone, will cause hypospadias in females and delayed descent of the testes in males.

J. M. OLSEN states that the percentage of lethal mutations found in the X and also in the II chromosomes in *Drosophila melanogaster* individuals that had vitamin B₁₂ withheld until the twentieth day of their larval life is about the same as in the control group. If the number of induced mutations corresponded to the time elapsed, the percentage of mutations brought into evidence in the experimental group (duration of development thirty days) should have been three times as large as in the control (duration of development ten days). The decrease in rapidity in the mutation process may be due to a slowing down of the process of spermatogenesis.

Research Items

Origin and Physical Qualities of the Minoan Shield

THE peculiar shields represented on seal stones, etc., of the Middle and Late phases of the Minoan bronze age culture have been repeatedly discussed, especially since they were claimed by Wolfgang Deibel as the type described in the Homeric poems. The construction of this kind of shield and its connexion with certain other shields is discussed on strictly archaeological evidence by Prof. J. L. Myres in *Man* of March 1939, while Prof. A. E. H. Love considers its shape and physical qualities. The famous Lion Hunt inlaid bronze dagger from Mycenae shows two types of shield: (a) a rectangular shield, and (b) the 'figure of eight' shield. The former is also seen in side view as an upright semi-cylinder—the 'tower shield'. Both were worn suspended by a strap from the left shoulder, either in front or behind, leaving both hands free. The shields are recognizably of ox-hide, and were flexible. They were stiffened around the margin by a metal rim or reinforcement of leather, affixed with stitches or rivets. Nothing quite like these Minoan shields is known from neighbouring cultures. They were evolved, not from the Egyptian parrying shield, but from some such protective wrapping as that shown on a fragmentary case of silver from Mycenae, where the fighting men wear a loose body protection slung over the shoulder and hanging to the knees. The elaboration of this protection was in two directions: (a) if the ox-hide were stiff enough, it could be bent permanently into a half-cylinder, resulting in the 'tower shield', or (b) if a lighter and more flexible hide were used, it buckled with its own weight, but the buckling was utilized to produce the 'figure of eight' shield, with its peculiar combination of rigidity along the two lines of folding and elasticity elsewhere, increasing towards the margin. When manipulated in action by the two hands exerting pressure at the point of rigidity and suspension, it assumed the 'figure of eight' shape, essentially two obtuse cones intersecting along the two halves of the original fold, which Prof. Love suggests are the stiffest of the generators of such cones.

Individual Interests and Vocational Adjustment

J. G. W. DAVIES has recently published an account of the place of interests in vocational adjustment (*Occup. Psych.*, 13, No. 1). Vocational adjustment is satisfactory when a person's occupation provides a sufficient outlet for his abilities, interests and disposition characteristics. The degree of vocational adjustment is infinitely varied, and most people occupy a position near the mean, but the standards of the mean might be raised by scientific vocational guidance. Most people desire an interest in their job, therefore it is important to discover if there is any kind of general stability in the interests of children from pre-adolescent years to maturity. There is some evidence suggesting that several important interests can be expected to remain permanent. The author divides interests into three main categories, intellectual, practical and social, and using the genetic method he shows what kind of pursuits would be followed in childhood by people

whose dominating interests are in one or other category. Then, presupposing that anyone who is in one of these groups will in adult life continue to have the same interests, he shows the types of occupations most likely to satisfy him. It is, of course, necessary to discriminate between interest and ability, and also to understand the motives that lie behind certain ambitions. Some light is thrown on the major mental mechanisms and emotional disturbances which must be considered in order to give appropriate weight to the enthusiasm of adolescent decisions regarding vocation. The article shows how advice, founded on scientific insight, can be used to prevent unnecessary vocational maladjustment, and can give some guiding principles to be observed in making a wise choice.

Fibrillary Contractions Produced by Physostigmine

J. Szeloczey and J. Horváth (*Magyar Orvos Archiv.*, 39, 671; 1938) have found that intravenous injection in rabbits and intraperitoneal injection in rats of 0.37 mgm. physostigmine per kgm. of body weight produced fibrillary contractions lasting thirty minutes. Neither atropine nor calcium stopped the contractions, but only weakened them for a short time. Previous administration in rats of a nearly lethal dose of atropine might prevent occurrence of the contractions. No relationship was observed in the rabbits between the strength of the contractions and the calcium content of the blood. Potassium chloride did not increase either the duration or the strength of the contractions in rabbits. These findings show that the fibrillary contractions produced by physostigmine are not the result of any conservation of acetylcholine, but are manifestations of the specific effect of the drug.

Scyphozoa of the Red Sea

THE Scyphozoa of the Red Sea have recently been critically described by G. Stasny (*Verh. Konin. Nederland. Akad. Wetens. Amsterdam*, 1938). The author has already published an account of the specimens of this group collected by the John Murray Expedition. Since then the examination of further material from the Red Sea and from the museums of Leyden, Paris and London has made possible a more comprehensive study of the forms from that area which, up to now, have not been well known. No representatives of the Cubomedusae or Stauro-medusae are recorded. Four species of the Semastomae are described, and in addition two specimens of a form that is obviously congeneric with *Cyanea* but does not allow of specific identification. Similarly, in addition to the eight members of the Rhizostomae there is also an unidentified species of *Mastigias*. The author adds a note on the prevailing winds and currents of this interesting sea.

A New Parasitic Slime-Fungus

G. A. LEDINGHAM has recently issued an account of a new member of the Plasmodiophorales which has been found parasitizing the roots of wheat in

Ontario (*Canadian J. Res.*, 17; 1939). In addition to spore clusters, large, septate zoosporangia are present with conspicuous tubes for zoospore discharge. In the development of resting spores, naked multinucleate myxamobae develop first, then segment to form spore clusters. All zoospores have two flagella of unequal length. The somatic nuclear divisions are characterized by the simultaneous division of both nucleolus and chromatin within a persistent nuclear membrane; prior to the segmentation of the myxamobae to form spore clusters and in all divisions during growth of the zoosporangia, the nucleoli and nuclear membranes disappear, and the divisions are of the ordinary mitotic type. Since the zoosporangial characters of this fungus differ from those of other genera in the order, it is suggested that it be placed in a new genus, and the binomial *Polymyza graminis* is proposed.

Colchicine in the Production of Polyploid Plants

THE discovery by Blakeslee and Avery of the value of colchicine as an agent for the production of polyploids in plants has stimulated investigations by a large number of workers in various parts of the world. The practical possibilities for the plant breeder have made it desirable for a review of all available information. J. L. Fyfe, of the School of Agriculture, Cambridge, has issued a report on the subject (Imperial Bureau of Plant Breeding and Genetics 576.356.5:581.04). A description of the different types of polyploids is given and the ways in which they arise. The value of a not too laborious method for their production is stressed. The chemical formula of colchicine differs from other alkaloids in having no heterocyclic ring, its nitrogen atom being in a side chain. It has been recognized for some time as a specific for gout, but its action on mitosis has been appreciated only recently. A number of accounts of the influence on mitosis have been offered, but that of Levan is detailed as being the clearest. Colchicine inactivates the spindle mechanism, prevents anaphase separation of the daughter chromosomes, and this leads to doubling. This doubling may be repeated several times. Influence on meiosis is also discussed and the way in which it differs from that on mitosis. Methods of application vary from that of soaking the seed to painting of shoots or spraying of flowers. Dilutions used vary from 1.6 per cent to 0.02 per cent, according to the technique employed. Experimenters often give scanty details, and methods of identifying polyploidy do not always render results convincing. The only concrete achievement reported is that of the production of a tetraploid *Zinnia*. The review ends with an account of acenaphthene as a substitute for colchicine.

Flower Colour in the Sweet Pea

G. H. Beale, G. M. Robinson, Sir Robert Robinson and R. Scott-Moncrieff (*J. Genetics*, 37, 375; 1939) give the results of a combined genetical and chemical analysis of *Lathyrus odoratus*. Purple flowers are *EE Sm* or *Ee sm* in constitution while red flowers are *e Sm* and salmon flowers are *e sm*. Chemically, *e* and *sm* control the state of oxidation of the anthocyanin molecule; purple flowers contain derivatives of delphinidin, red flowers contain cyanidin and salmon flowers contain pelargonidin. The gene *d* for dullness exerts its bluing effect on flower colour by raising

the pH of the cell sap and does not, as formerly supposed, affect the methylation of the anthocyanin. There are at least seven genes concerned in the quantity produced of anthoxanthins and anthocyanins; but it is interesting to note that the type anthoxanthin does not change no matter whether the anthocyanin is delphinidin, cyanidin or pelargonidin in type. The leuco-anthocyanins of the seed react in accordance with the anthocyanin of the flower to changes in the genetical constitution.

Mycorrhizal Fungi

E. J. BUTLER has investigated the distribution and morphological characters of the vesicular-arbuscular mycorrhizal fungi (*Trans. Brit. Mycol. Soc.* 22, Pts. 3 and 4, 274, Feb. 1939). The chief characteristic of this group of organisms is the production of bladder-like vesicles, the arbuscular-sporangial apparatus, within the roots of their host plants. These vesicles are apparently concerned with the accumulation of fatty material and its transfer to the plant. Accessory nutrients may also be stored therein. The fungi concerned are closely related to the Endogonaceae, and the generic name *Rhizophaga* is considered to be the first legitimate name applicable to a member of the group, which is thought to consist of a number of allied species in this genus. The species are widely distributed in the soil, and probably form mycorrhizal associations with most plants.

Comet Notes

NEW orbits of comet Kosik-Peltier have been computed, using observations over nearly a month, and it is now established that it is a long-period comet the eccentricity being about 0.995. Mr. Przybylski has undertaken the work of computing a definitive orbit of this comet. J. G. Porter and A. E. Levi used Cowell's method for the computation of the perturbations of comet Pons-Winnecke during two revolutions, 1927-33 and 1933-39, and published the results of their work in "Handbook of the British Astronomical Association" for 1939. From the new orbit and ephemeris, Jeffers, at Harvard, rediscovered the comet on March 17, very close to its predicted position. It was diffuse, with central condensation magnitude 17. The assumed date of perihelion passage was June 23.5042^d, and the observation shows that a correction of -0.76 day gives practically exact agreement with the ephemeris. The comet will make its closest approach to the earth about July 3 and it will be then 10 million miles away. On March 14.9215^d U.T., the comet Vaisala (1939 b) was observed at Turku by Vaisala, its position being R.A. 9^h 37.1^m, Dec. 23° 07' (equinox 1939.0) and its magnitude 15. The following orbit has been computed by Oterma and Vaisala, earlier observations of the object, which was at first considered a minor planet, being used:

Epoch	1939 Feb. 9-000 U.T.	
<i>M</i>	352° 25'	
<i>e</i>	44 23	} 1960.0
<i>Q</i>	135 30	
<i>i</i>	11 04	
<i>s</i>	0.63433	
<i>μ</i>	352° 8	

The period is about ten years.

Relations of the Flora and Fauna of Ireland to those of other Countries*

As the most western land of the great Eurasian continent, Ireland is of peculiar interest. It, like Great Britain, stands on the Continental shelf and is surrounded by a mere film of water as compared with the oceanic depths prevailing to the west. Terrestrial and faunal movement has been chiefly east to west. The opposite has been rare, as suggested by the few organisms in the British Isles which are restricted in area, and have a range, often discontinuous, which suggest relict rather than insipient distribution. They would appear to be mostly broken-remnants of past invasions rather than the first colonies of new species destined to push eastward. The high winter temperature has allowed of the migration northward of plants and animals which elsewhere in Europe are confined to lower latitudes—the Mediterranean region and the Spanish peninsula chiefly. Mixed with these, in Ireland, especially in the west, are a small number of plants and one animal—the freshwater sponge *Heteromoyenia ryderi* which belong to North America. There are many other problems of distribution which give to the flora and fauna of Ireland a special interest.

In spite of the instability of the earth's crust and climatic conditions in and around the British Isles during recent geological times, the occurrence of various extraneous elements derived from the north and from the west, as well as the absence from the British Isles—one or both—of many widespread continental types raise interesting questions. The effects of intermittent water barriers must also be considered.

In spite of the generally low level of the British Isles, submergence has been only very partial from the beginning of the Tertiary period, and only in the eastern and south-eastern England do Tertiary marine deposits point to the disappearance of that region as a land surface during much of the Eocene, Oligocene and Pliocene periods.

The sea forms a very effective barrier to plant and animal transport, except for winged creatures. Even seeds, plants cannot travel very far by sea, for the author has shown that the seeds of 786 different British plants sank either at once or within the course of a few days. Transport of seeds by wind is not very successful. Only plumed seeds have attained a high efficiency. Reduction in size in the seeds of nanerogams has not gone far enough, and winged seeds are not efficacious. The best results are obtained with seeds which combine reduction in size with a plume of hairs such as those of *Typha* and *Epilobium*. Clearly, normal transport by wind may for practical purposes be ruled out except for a few especially efficient seeds and for very narrow barriers.

Transport of seed by animals over sea must be confined to birds. They are, indeed, efficient agents of dispersal, provided the barriers are not wide, for migration in birds is very rapid. Migrating birds have been shown to arrive empty of food and without seeds adhering to their feet or feathers.

Furthermore, success does not follow merely from

the surmounting of the barrier. The main difficulty—successful colonization—still confronts the individual.

The flora of Ireland as compared with that of Britain, and of Britain as compared with that of adjoining Continental countries, do not display any undue proportion of those plants which, by having floating seeds, might have arrived by water; or those which, having flying seeds, might have come by air; or those which are eaten but not destroyed by birds, and might, therefore, have arrived through their agency.

The case for terrestrial, and not trans-marine, immigration is greatly strengthened by considerations of the fauna, and thus are we led to looking for land-connexions in order to account for the present peopling by plants and animals of the British Isles.

Land-connexions have existed during a good deal of recent geological time, and the question follows as to the period or periods of immigration. This raises the problem as to how much of the pre-existing flora and fauna was exterminated by the Ice Age and how much survived. Forbes in 1846 concluded that certain groups in Ireland, including the southern or Lusitanian element, survived the Ice Age, while the bulk of present plants and animals owe their presence to terrestrial immigration in post-Glacial time. Forbes also accounted for the comparative paucity of the Irish flora and fauna in relation to those of Britain by the breaking down of the Irish-British land-connexion prior to the severance of Great Britain from the Continent. Though many agree with Forbes, others have expressed divergent opinions—several, such as Stapf and J. R. Mathews, expressing the view that practical extermination took place during the Ice Age.

The crux of the problem rests on whether during the Ice Age there were ice-free areas with reasonable climatic conditions or whether there was a continuous ice sheet. In the later event, complete extermination seems inevitable and post-Glacial immigration must have been vigorous. But there is no evidence of simultaneous glaciation over the whole of Ireland. In fact, evidence is to the contrary. Thus there is no need to postulate complete extermination during the Ice Age. Further support is given by present-day Greenland, which is probably no better now than Ireland was during the Ice Age, and in Greenland there are four hundred flowering plants and ferns and more than 1,500 lower forms of plants. The same refutation of extermination can be made for England.

The present-day Lusitanian flora and fauna are represented on the Continent chiefly in Spain. These reached the southern British Isles by overland dispersal. The American species in Ireland are of the northern American type, and since none of the species occurs in Siberia, presumably followed the shorter Atlantic route via Greenland and Ireland. None of them occurs in Europe south of Ireland. They probably arrived in Ireland during a pre-Glacial epoch. There is a corresponding group of

* Substance of the Hooker Lecture delivered by Dr. J. Lloyd Sager before the Linnean Society of London on May 11.

European plants in a limited area of north-eastern North America; this clearly represents a similar migration in the opposite direction. These species, both in America and in Ireland, by their very nature could not have migrated across wide stretches of sea. A relatively high land-level may have existed in the late Pliocene, but it must be admitted that the whole matter of these migrations bristles with difficulties.

The flora of Ireland (1100 species of Phanerogams and vascular cryptogams) is only little more than half that of Great Britain. The greater area, range of latitude, and diversity of surface and soil of the latter cannot wholly explain this paucity in flora and fauna of the former. There is little doubt that

many of these British species would have invaded Ireland had they been able, but the Irish Sea forms the barrier to western migration, while Britain is still connected by land with the Continent.

There are, too, many interesting, but puzzling cases of discontinuous species in Ireland, occur only in one or a few bare patches. It is possible that they have been introduced by air from across channels to places unsuited for them. There are, also, certain species more successful in Ireland than in the British island. The outstanding problems of the Irish flora and fauna are still many and varied, and the study of fossils and of peat can be expected only to reveal part of the story. But research is going apace.

Medicine in the Renaissance

THE Institute of the History of Medicine at Johns Hopkins University in Baltimore, which is the only one of its kind in the United States of America, was the last creation in 1929 of that remarkable and radiant personality, William Henry Welch. "My ambition," he wrote to Dr. L. W. Weed, dean of the Medical School, in a letter dated November 21, 1927, "is to create a real institute of medical history with a good reference library and a salaried staff, where facilities are offered not only for teaching, but for serious study and research. A 'Lehrstuhl' merely is not enough". The professorship in the history of medicine in the University was originally intended as a retirement chair for Dr. Welch who, however, insisted on the organization of a properly equipped department. He was succeeded by Dr. Henry E. Sigerist, a former director of the Institut für die Geschichte der Medizin at Leipzig, who, with his magnetic personality, relentless energy, and immense erudition, has built up a magnificent institute serving the triple purpose of research, education, and nucleus for medico-historical activities in the country. Supported by a grant from the Rockefeller Foundation, it is situated on the top floor of the William H. Welch Medical Library. Dr. Sigerist is ably assisted by his associates Drs. Owsei Temkin, Ludwig Edelstein, John Rathbone Oliver, and Sanford V. Larkey. Initially designed as a house-organ, to contain papers written by members of the Institute and by others connected with the University, in January 1933 the *Bulletin of the Institute of the History of Medicine* began to appear as a supplement to the *Johns Hopkins Hospital Bulletin*, from 1935 functioning as an independent organ. At the beginning of 1939 it changed its name to "Bulletin of the History of Medicine. Organ of the American Association of the History of Medicine and The Johns Hopkins Institute of the History of Medicine".

So successful was the first Graduate Week in Medical History held at the Institute in April 1938 that a similar course was planned for the week of April 24-29, 1939. While last year's programme dealt with the principles and methods of research and teaching, the subject this year was "Medicine in the Renaissance". The course was attended by thirty-nine medical historians and students of the Renaissance, including Prof. Leicester Bradner, of

Brown University; Dr. Iago Galdston, of the New York Academy of Medicine; Prof. Richard Shryock, of the University of Pennsylvania; Kate Campbell-Hurd Mead; Dr. Benjamin Speck and Dr. Richmond C. Holcomb. Each morning lecture, illustrated by an exhibit of the most authoritative literature, and followed by a discussion, was given by Dr. Sigerist and by members of his staff, and the afternoons were devoted to informal round-table seminars. The programme was carefully planned as to leave sufficient time for individual work and conversation with the director and his associates.

In the opening lecture on April 24, entitled "Economic, Social, and Political Foundations of the Renaissance", Dr. Sigerist described the medieval world as a static world in which man was born in a definite place and function. Everything was dominated by religion. When the new period started the system of feudalism began gradually to disintegrate. The struggle between the old and the new orders lasted for three centuries, for feudalism in Western Europe was only overthrown by the French Revolution. The Reformation had enormous economic repercussions: it broke the doctrine of the Church that production is for service only and that the idea of profit is sinful. The fifteenth century witnessed great development in finance and banking, better and shorter ways of traffic were sought, Western Europe was linked with the New Worlds, and navigation proved a great stimulus to science. Everywhere men felt his individuality, which he desired to apply to a definite purpose. The afternoon's seminar was given up to a discussion of "The Concept of the Renaissance". The term "Renaissance" was first used in art by the sixteenth century Italian art critic and painter Giorgio Vasari. Its technical use dates from Jacob Burckhardt's book "Die Kultur der Renaissance in Italien", 1860. In the evening a play was performed at the Baltimore Museum of Art "The Black Dart of Death", adapted by Dr. Larkey from William Bullein's "A Dialogue against the Fervent Pestilence", 1564.

The following day's programme included a lecture by Dr. Edelstein on "Ancient Traditions in Medieval and Renaissance Thought", a seminar on "Bibliographic Problems of Renaissance Literature", and an evening meeting of the Cordell Historical Society, the University of Maryland in the chemical hall.

sh had witnessed the bestowing of honorary degrees on Lafayette and Ephraim McDowell. On April 26, Dr. Sigerist spoke on "Science and Technology in the Renaissance", and to the afternoon's dinner on "Some Biological Problems of the Renaissance". Dr. Larkey contributed an account of anatomical text-books of the period, while Dr. Aikin discussed the anti-Aristotelian movement. April 27, Dr. Temkin, lecturing on "The Physician in the Renaissance", attributed the esteem in which he was held not to his efficiency (in contemporary times he is more freely attacked than the surgeon), rather to the academic and financial difficulties attending the acquisition of the M.D. in the sixteenth century. Bearing in mind that the average lifetime man in those days was not more than fifty years, the end of his training the young doctor had already spent more than half his life in study. The medieval physician was restricted in his interests, all scientific knowledge being centred in the philosophers and the theologians. With the Renaissance, the physician began to enter the field of mathematics, mineralogy, chemistry, zoology, and literature. The afternoon's seminar dealt with "Diseases prevailing in the Renaissance and their Interpretation". On

April 28, Dr. Larkey spoke on "Hygiene and Public Health in the Renaissance", the subject of the afternoon's discussion being "Medical Literature in the Vernacular: English, German, French, Italian". The closing address of the course was delivered by Dr. Alan M. Chesney, dean of the Medical School, who dealt with the early history of the Johns Hopkins Hospital, the fiftieth birthday of which is commemorated this month.

The intellectual fare of the Graduate Week was temptingly seasoned with tea and cocktail parties, dinners and visits to shrines of interest, such as the Tudor and Stuart Club of Johns Hopkins University, with which the name of Revere Osler, Sir William's only son, is inseparably linked.

The following exhibits had been arranged: Leonardo da Vinci; medical books from the Renaissance presses; and recently published literature in medical history.

At the banquet on April 28, Dr. John Rathbone Oliver spoke on "The Oxford of Anthony Wood", and a presentation was made to Dr. Sigerist and to the very efficient and charming machine behind his brain—his secretarial staff.

WALTER BETT.

Soil Mechanics

PROF. KARL VON TERZAGHI delivered the forty-fifth James Forrest Lecture at the Institute of Civil Engineers on May 2, taking as his subject "Soil Mechanics: a New Chapter in Engineering Science".

At the opening of his address, Dr. von Terzaghi contrasted the empirical methods which were in general use until about twenty-five years ago with the much greater reliability which is now obtainable by allowing for the effects of soil movements and pressures. So satisfactory to progressive engineers had the old procedure become of ascertaining the bearing capacity of subsoil that concerted action was taken to study its properties and behaviour of soil and to place it on a sound basis in accordance with the laws of mechanics. The new study was designated 'soil mechanics', a name which in 1936 received confirmation when the first International Conference on Soil Mechanics and Foundation Engineering was held at Harvard University in Cambridge, Massachusetts. Dealing with the first section of his subject, "The Pressure of Earth on Lateral Supports", Dr. von Terzaghi showed that Coulomb's theory, which is the more reliable of the two in use and dates from 1773, is based on several untenable assumptions. The modifications made in the formulae as now used have arisen from the discovery that the intensity and distribution of earth pressure depend on many more factors than were realized by earlier workers. Dr. von Terzaghi indicated the nature of, and justification for, these modifications.

Passing to the closely related problem of earth pressures involved in the stability of slopes, Dr. von Terzaghi showed that the old method was to prescribe that slopes of fills and cuts should be established at angles somewhat smaller than the appropriate angles of repose. Mention was made of what is known as

the Swedish method of determining the degree of stability of a slope, which is based on the empirical fact that the profile of the surface of sliding always approaches the form of a circular arc. For masses of earth having little cohesion and subjected to seepage forces, as in the case of an embankment for water storage, the formulae adduced in recent studies were shown to give satisfactory results. In the case of clays, however, the determination of the shearing resistance is far more difficult and the position at present is still highly controversial.

A submerged body of soil with little cohesion and in a loose state is liable on the least disturbance to behave as a liquid and to flow on a horizontal surface, a phenomenon which is known as 'flow-slide'. Here the condition was shown to be that the material should be loose enough to be capable of reducing to a denser state as a result of the applied deformation. Flow-slide was thus shown to be associated with porosity, and no flow failure can occur unless the volume at this occurrence is less than the initial volume. The necessity, therefore, of specifying that the porosity of water-retaining embankments should be well below the critical value was thus made clear.

The compaction of embankments is an effective means of limiting the amount of settlement, as in the case of fills for road making, and R. B. Proctor has demonstrated that the degree of compaction produced by a given method depends on the moisture content, being greatest for a certain medium water-content, determinable by experiment. These observations have led to fill-construction methods in which moisture-content controls are introduced. In Germany, the compaction of sandy soil by vibration has been brought to a high state of perfection, and it has been found that the greatest compacting effect is

produced when the frequency of the vibrator is equal to the specific vibration of the soil. The same process is also used for comparing the degree of compaction of fills before and after completion.

Dr. von Terzaghi then dealt with the failure of dams due to piping, a subject which is nearly allied, from the point of view of its mechanics, to the stability of slopes subjected to seepage forces. Bligh's empirical rule was faulty in that it was based on the tacit assumption that the critical percolation factor depends only on the grain size of the subsoil. By model dams so constructed that, by Bligh's rule, the critical head should have been the same for all, it was shown by the highly divergent results that the assumption is greatly in error. Dr. von Terzaghi explained how he came to the conclusion that piping can be eliminated by the provision of an inverted filter between the body of the dam and the foundation, and he described such a filter which he has designed for incorporation in a rock-fill dam in Algiers.

The time factor in relation to earth pressures and movements was next discussed. Using a cylinder filled with water and having a perforated piston supported by springs as an illustration, Dr. von Terzaghi pointed to the fact that, when a constant load is applied, the piston can only descend as the water percolates through the interstices in the piston. At first the water pressure supports the load, but it falls off as the descending piston compresses the spring. A similar process occurs in clay when loaded, and the mechanics of it can be expressed, in terms of time, by a partial differential equation of the second degree. This is known as the fundamental equation of the processes of consolidation. The case was quoted of a power-house where, for a supply of water, a well was driven through the clay to water-bearing gravel below. As a result, the time-rate of settlement of the power-house increased alarmingly, and within a few months the corner nearest the well had subsided more than a foot. When the well was closed, the settlement practically ceased. Dr. von Terzaghi pointed to other instances in which the operation of the theory of consolidation is exemplified, and explained that settlements of this nature can now be computed with reasonable accuracy.

University Events

CAMBRIDGE.—Dr. J. D. Cockcroft, lecturer in physics in the University and fellow of St. John's College, has been elected Jacksonian professor of natural philosophy as from October 1 (see also p. 846).

LONDON.—The following representatives have been elected by Convocation to the Senate: *Medicine*, Sir Ernest Graham-Little, M.P.; *Science*, Prof. G. B. Jeffery, Prof. Major Greenwood; *Engineering*, Sir Charles Breesey.

A Keddey Fletcher-Warr studentship, of the value of £300 a year for three years, has been awarded to Dr. Vernon E. Coslett (Birkbeck College), for research on the application of electron optics to the design of X-ray tubes and to the measurement of X-ray diffraction patterns.

SHEFFIELD.—Alfred Wright, at present research assistant in mining, has been appointed lecturer in mining; J. W. Watson has resigned from his post of assistant lecturer in geography.

Science News a Century Ago

Wells in the London Clay in Essex

IN a paper read to the Geological Society on Feb. 22, 1839, Dr. Mitchell dealt with "The Wells in Gravel and London Clay in Essex". The greater part of Essex, he said, consists of London Clay. Its greatest thickness of the clay is not known, but probably exceeds 400 ft. Extensive districts covered by gravel, sand and detritus. In the district composed of London Clay, no land springs occur. The wells generally penetrate to the bed of a between the Clay and the chalk. The Clay is various colours, the lower beds being sometimes blue but it is sometimes blue at the bottom. In districts where it is thickest, it is often interstratified with two or three beds of sand, but near the site Fairlop Fair, it was found to consist of 398 ft solid clay. Dr. Mitchell gave a list of nineteen wells selected from a very large number, the deepest being in Foulness Island, 460 ft. Artesian wells have been productive of the greatest benefit in Essex.

Photography with the Aid of Incandescent Coke

IN the *Athenaeum* of May 25, 1839, it was under the heading "Photogenic Drawing", that "Mr. Robert Mallet has communicated to the Royal Irish Academy a notice of the discovery of property of the light emitted by incandescent coke to blacken photogenic paper; and proposed it a substitute for solar light, or that from the ordinary hydrogen blow pipe with lime. One of the most important applications of the photogenic process, yet suggested, is its adaptation to the self-register of long-continued instrumental observations. Few artificial lights emit enough of the chemical rays to act with certainty on the prepared paper; while those which are known to act well, as the ordinary hydrogen light, are expensive and difficult to manage. A considerable time since, the author discovered that the light emitted by incandescent coke at a 'Twyer' (or aperture by which the blast is admitted of a cupola or furnace for melting cast iron, contained the chemical rays in abundance; and lately trying the effect of this light on the prepared paper, he found it was intensely blackened in about forty-five seconds.

Robert Mallet (1810-80), engineer and physicist was a graduate of Trinity College, Dublin, and was a partner with his father. Among his works was the Fastnet Lighthouse. He was well known for his study of volcanoes and earthquakes. He was elected a fellow of the Royal Society in 1834.

A Criticism of Davy's Safety Lamps

THE *Mechanics' Magazine* of May 25, 1839, published a report of a lecture by Faraday at the Royal Institution on May 10, on "Some General Remarks on Flame". Faraday had referred to Davy's safety lamps, and in his comments on the lecture, the *Mechanics' Magazine* said: "We have no disposition whatever to detract from the merit or brilliancy of Sir H. Davy's discovery as a scientific fact, but his lamp is a poor fragile thing. . . . Thus instead of protecting the light in a strong lantern he (Davy) contented himself with merely placing around it a flimsy tissue of wire, which besides numerous other objections, is, by its gloomy effect, ever tempting the miner to remove it, or to use a better but more dangerous light."

Societies and Academies

Paris

Academy of Sciences (C.R., 208, 1081-1124,

April 3, 1939).

- .. GUILLERMOND and R. GAUTHERET: The so-called reducing power of the chondriosomes towards *ius green*.
- I. GODCHOT and Mlle. G. CAUQUIL: Application of the Raman effect to the study of some cyclanones.
- t. DEDBANT and P. WHEHL: Turbulent motion.
- .. GLANGEAUD and Mlle. Y. BONNICHON: Dynamics of the variations of turbidity and of solid content in the maritime Garonne and the Gironde in course of the tides.
- .. A. PROGA: The fundamental length relating to elementary particles.
- .. ROUBAUD-VALETTE: Possibility of constructing the wave equations relating to particles of multiple spin of $\frac{1}{2}(h/2\pi)$.
- .. GUASTALLA: Very dilute films of some proteins; attempt to determine the molecular masses. A weighed quantity of protein is deposited on water in surface manometer, and the film is compressed and area measured.
- J. GILLOD: A new method of stabilization of an atomometer lamp.
- B. KWAL: A phenomenon observed with a Rutherford-Geiger tube-counter submitted to relatively strong radiation.
- .. G. BECK and P. HAVAS: Dissymmetry of the capture of uranium.
- Mlle. N. GOLDOWSKI: Solution potential: the case of aluminium in presence of different gases.
- P. SIE: Thermal equilibrium between Nb_2O_5 and H_2O .
- Y. DEUX: Isomerization of phenyl-1 vinyl-2-oxy-1,2 butane in phenylvinylethylacetaldehyde, and dehalogenation of the corresponding iodohydrate phenyl-3 hexene-1 one-4.
- O. SACKUR: Action of organo-magnesium derivatives on chloro-1 cyclohexylmethylketone and chlorocyclohexylphenylketone; secondary replacement of chlorine by pinacolic transposition.
- Mlle. P. RAMART-LUCAS: Structure and absorption of hydroxylated colouring matters of triphenylethane; existence of isomeric forms of hydroxy-chalcones.
- Mlle. D. Biquard: Contribution to the spectral study of β -tetralone and β -indanone.
- J. EISENSTEIN: Influence of temperature on the elasticity and the rupture of crystals. A discussion based on the probability of abnormally large displacements of the position of equilibrium of one or more atoms.
- J. NORDLIE: Volcanism and nuclear chemistry. It is suggested that volcanism is due to localized accumulation of neutrons which are enabled to set up nuclear disruption with release of energy much as occurs in the disruption of uranium.
- Mlle. M. JOUVENEL-MARCOILLAC: Meiosis in *Lophomus sativus*.
- G. MANGENOT: Rootlet development and colchicine. Giant cells with single nuclei which are polyploid to a high degree are formed.
- R. COMBES and Mlle. M.-T. GERBUDE: Contribution to the study of the biochemical possibilities of a plant species. Submitting *Veronica Anagallis*

to illuminations down to one sixth of normal, to high altitude and to immersion produces changes in its chemical make-up; thus reducing glucides vary from 0.77 to 10.23, soluble nitrogen compounds from 0.15 to 1.44, and so on.

G. DELOFFRE: Wound phenomena of nuclear growth in the lupin.

M. ROSE and J. BERTHELOT: Production of experimental tumours in higher plants by inoculation with the venom of the cobra *Naja tripudians*.

H. DES ABBAYES: Geographical distribution of the lichens *Cladonia alpestris* and *C. rangiferina*, and the true identity of *Lichen giganteus* Bory.

P. REX: Effect of removal of the principal lobe of the hypophysis on the annual cycle of the male sexual cells of *Bufo vulgaris*.

Mlle. S. THÉVENET: Viscosity of solutions of serum albumin in media of different hydrogen ion concentration. Viscosity is a minimum at about the iso-electric point.

A. BOUTARIC and Mlle. M. ROY: Study of the variation of optical activity of protein solutions in alkaline media.

M. FRÉREJAQUE: Presence of *d*-arabitol in *Fistulina hepatica*.

Washington, D.C.

National Academy of Sciences (Proc., 25, 55-111, Feb. 15, 1939).

E. W. SINNOTT: Growth and differentiation in living plant meristems. Seeds of some of the smaller grasses are made to germinate on moist paper on microscope slides, and the root tips observed under a water-immersion lens. The meristem cells can be observed directly at regular intervals of time. The cells are in regular longitudinal rows, and new walls are generally transverse, tending to join the side wall half-way between the nearest cross-walls. 'Sliding growth' was not observed. Root-hairs are usually early differentiated.

E. D. CHAPPEL: Quantitative analysis of the interaction of individuals. The separate actions of two interacting individuals alternating with their silences or inactions were recorded; an improved apparatus for this purpose is being made.

O. STREVE, K. WURM and L. G. HENVEY: Astrophysical consequences of metastable levels in hydrogen and helium.

E. B. WILSON and JANE WOBESTER: Resolution of six tests into three general factors.

W. J. CROSBY: Temperature and the critical intensity for response to visual flicker (2).

J. BARDEN and J. H. VAN VLECK: Expressions for the current in the Bloch approximation of 'tight binding' for metallic electrons.

G. E. HUTCHINSON, E. S. DAVEY, jun. and ANNE WOLLAKE: Oxidation-reduction potentials of lake waters and their ecological significance. Data for some North American lakes suggests that when the water half a metre above the deepest mud has a potential of 0.4 volt, the mud has a *Tanytarsus* fauna; when the potential is below 0.3 volt, a true *Chironomus* fauna is found.

J. F. RETT: Ideals of differential polynomials.

M. RMADE and E. F. BROCKENBACH: Generalizations to space of the Cauchy and Morera theorems.

G. H. FRENKEL: An equivalence theorem for series of orthogonal polynomials.

E. KASNER and J. DE CICCO: Curvature element transformations which preserve integrable fields.

Appointments Vacant

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

GEOLOGIST in the Geological Survey of Great Britain—The Director, Geological Survey and Museum, Exhibition Road, South Kensington, S.W.7 (May 31).

ASSISTANT LECTURER IN GEOGRAPHY in the University of Manchester—The Registrar (June 5).

SENIOR DEMONSTRATOR IN PHYSIOLOGY in St. Bartholomew's Hospital Medical College—The Dean (June 10).

DEMONSTRATOR IN ZOOLOGY in Bedford College for Women, Regent's Park, N.W.1—The Secretary (June 15).

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Reports of the Council and Auditors of the Zoological Society of London for the Year 1938. Pp. 80. (London: Zoological Society of London.) [174]

The Training of Teachers and Grants to Intending Teachers. Being a Report of a Committee of Investigation appointed by the Executive of the National Union of Teachers and adopted by the Executive on 3rd March 1939. Pp. xxxi+323. (London: National Union of Teachers.) [184]

Report by the Food Council to the President of the Board of Trade for the Year 1938. Pp. iv+32. (London: H.M. Stationery Office.) 6d. net. [304]

Iron and Steel Institute. Special Report No. 26: First Report on Refractory Materials. Pp. vi+478. (London: Iron and Steel Institute.) [304]

Predatory Birds of Great Britain. Prepared on behalf of the British Field Sports Society by Eric Parker; Schedules showing the Protection afforded to the Birds, County by County, prepared by Phyllis Barclay-Smith and Edward Barclay-Smith. Pp. 84. (London: British Field Sports Society.) 2s. [314]

Ancient Monuments of Great Britain. List of Monuments (to 31st December 1938), prepared by the Commissioners of Works. Pp. 110. (London: H.M. Stationery Office.) 2s. net. [314]

Other Countries

Smithsonian Institution: Bureau of American Ethnology. Bulletin 120: Basin-Plateau Aboriginal Sociopolitical Groups. By Julian H. Steward. Pp. xii+346+3 plates. (Washington, D.C.: Government Printing Office.) 50 cents. [144]

U.S. Department of the Interior: Geological Survey. Bulletin 894: Geology of the Chitina Valley and Adjacent Area, Alaska. By Fred H. Moffit. Pp. iv+133+13 plates. 1.25 dollars. Bulletin 896: Lexicon of Geologic Names of the United States (including Alaska). Compiled by M. Grace Wilmshurst. Part 1: A-L. Pp. 144. Part 2: M-Z. Pp. ii+1246+2296. 1.50 dollars. Bulletin 897-C: Gold Places of the Fortymile, Magic and Circle Districts, Alaska. By J. B. Mertie, Jr. (Mineral Resources of Alaska, 1938). Pp. iv+133+261. 30 cents. Bulletin 898-B: Spirit Leveling in Missouri. Part 2: South-Central Missouri, 1896-1937. By J. G. Staack. Pp. xii+133+308. 30 cents. Bulletin 898-C: Spirit Leveling in Missouri. Part 3: East-Central Missouri, 1896-1937. By J. G. Staack. Pp. xiv+309+450. 25 cents. Bulletin 898-D: Spirit Leveling in Missouri. Part 4: Northwestern Missouri, 1896-1937. By J. G. Staack. Pp. xiv+451+580. 25 cents. Bulletin 902: The Brown Iron Ores of Eastern Texas. By Edwin B. Bockel. Pp. vi+167+20 plates. 1 dollar. Bulletin 903: The Nushagak District, Alaska. By J. B. Mertie, Jr. Pp. iv+96+13 plates. 65 cents. Bulletin 904: Geology of the Siana-Tok District, Alaska. By Fred H. Moffit. Pp. iv+54+4 plates. 35 cents. Bulletin 909-A: Geophysical Abstracts 92, January-March 1938. Compiled by W. Ayrasoglou. Pp. i+50. 10 cents. (Washington, D.C.: Government Printing Office.) [144]

U.S. Department of the Interior: Geological Survey. Professional Paper 187: Geology of the Marathon Region, Texas. By Philip B. King. Pp. ix+143+24 plates. 2.50 dollars. Professional Paper 188: The San Juan Country, a Geographic and Geologic Reconnaissance of Southeastern Utah. By Herbert M. Gregory, with Contributions by Malcolm B. Thorpe. Pp. vi+123+25 plates. 60 cents. Professional Paper 189-D: Oligocene Foraminifera from the Choctaw Bluff, Alabama. By Joseph A. Cushman and Winnie McGlamery. (Shorter Contributions to General Geology, 1937.) Pp. ii+103+120+plates 24-28. 10 cents. Professional Paper 190-B: The Forces Required to Move Particles on a Stream Bed. By William W. Rubey. (Shorter Contributions to General Geology, 1937.) Pp. ii+131+143. 10 cents. Professional Paper 190: Lower Pliocene Mollusks and Bivalves from the Los Angeles Basin, California, and their Inferred Environment. By W. P. Woodring. Pp. ii+68+9 plates. 30 cents. Professional Paper 193-A: A New Upper Cretaceous Rudistid from the Kemp Clay of Texas. By Lloyd William Stephenson. (Shorter Contributions to General Geology, 1938.) Pp. ii+16+5 plates. 25 cents. (Washington, D.C.: Government Printing Office.) [144]

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 801: Surface Water Supply of the United States, 1936. Part 1: North Atlantic Slope Basins. Pp. viii+402. 50 cents. Water-Supply Paper 802: Surface Water Supply of the United States, 1936. Part 2: South Atlantic Slope and Eastern Gulf of Mexico Basins. Pp. vi+223. 30 cents. Water-Supply Paper 803: Surface Water Supply of the United States, 1936. Part 3: Ohio River Basin. Pp. vii+463. 50 cents. Water-Supply Paper 806: Surface Water

Supply of the United States, 1936. Part 5: Hudson Bay and Mississippi River Basins. Pp. vi+238. 45 cents. Water-Supply Paper 816: Surface Water Supply of Hawaii, July 1, 1935, to 30, 1936. Pp. iv+108. 25 cents. Water-Supply Paper 824: Surface Water Supply of the United States, 1937. Part 4: St. Lawrence River Basin. Pp. iv+150. 25 cents. Water-Supply Paper 830: Surface Water Supply of the United States, 1937. Part 10: The Columbia River Basin. Pp. iv+97. 20 cents. Water-Supply Paper 832: Surface Water Supply of the United States, 1937. Part 12: Pacific Basins in Washington and Upper Columbia River Basin. Pp. v+30 cents. Water-Supply Paper 833: Surface Water Supply of the United States, 1937. Part 13: Snake River Basin. Pp. vi+221 cents. Water-Supply Paper 834: Surface Water Supply of the United States, 1937. Part 14: Pacific Slope Basins in Oregon and the Columbia River Basin. Pp. v+188. 30 cents. Water-Supply Paper 837: Inventory of Unpublished Hydrologic Data. By William Holland and Clarence S. Jarvis. Pp. 78. 15 cents. Water-Supply Paper 839: Quality of Water of the Rio Grande Basin above Quitman, Texas. Analytical Data by Carl S. Goodfield. Pp. ii+30 cents. Water-Supply Paper 840: Water Levels and Artesian Pressure in Observation Wells in the United States in 1937. Prepared under the direction of O. H. Menner and L. K. Wenzel. Pp. iv+1. 1 dollar. (Washington, D.C.: Government Printing Office.)

Carnegie Institution of Washington: Department of Terrestrial Magnetism. List of Publications for the Year 1938. Pp. 12. (Washington, D.C.: Carnegie Institution.)

Advisory Committee on Education. Staff Study No. 8: Vocational Education. By John Dale Russell and associates. Pp. x+324. (Washington, D.C.: Government Printing Office.) 40 cents. [1]

Proceedings of the U.S. National Museum. Vol. 85, No. 3040: some Species of Chinese Earthworms, with Special Reference Specimens collected in Szechwan by Dr. D. C. Graham. By G. Gates. Pp. 405-508. Vol. 86, No. 3050: Notes on the Birds of Szechwan. By Alexander Wetmore. Pp. 175-244. (Washington, D.C.: Government Printing Office.) [1]

Stanford University Publications, University Series. Biology Sciences, Vol. 6, No. 4: The Effect of Different Percentages of Protein in the Diet of Six Generations of Rats. By James Rollin Slonim. Pp. 68. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press.) 1 dollar. [1]

Survey of India. Professional Paper No. 23: The Readjustment of the Indian Triangulation. By Major G. Bomford. Pp. viii+100+plates. (Dehra Dun: Survey of India.) 4.8 rupees; 7s. 6d. [1]

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 25: The Progress of Agricultural Science in India during the Twenty-five Years. By Dr. W. Burns. Pp. ii+49. (Dehra Dun: Manager of Publications.) 1.8 rupees; 2s. 3d. [1]

Indian Central Cotton Committee: Technological Laboratory. Technical Bulletin, Series A, No. 47: The Effect of Humidity on Different Species in the Draw-Frame on the Quality of Yarn. By V. V. Gupta and Dr. Nasir Ahmad. Pp. ii+18. (Bombay: Indian Central Cotton Committee.) 8 annas. [1]

Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University. Vol. 21, No. 7 (Mathematics, No. 35): Beitrage zur Geometrie der Kreise und Kugeln. Von Sadao Matsumura. Pp. 177-253. (Taihoku: Taihoku Imperial University.) [1]

University of Toronto Studies. Applied Mathematics Series, 2: 8: An Outline of the Theory of the Allowed Cone of Cosmic Radiation. By M. S. Vallarta. Pp. 56. (Toronto: University of Toronto Press; London: Oxford University Press.) 7s. net. [1]

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 203: A Comparative Test of the Field of F. Hybrid between Imbred Lines of Maize. By Dr. James Philip. Pp. 6+plates. Mills. 15. Bulletin No. 218: Cotton-Breeding Techniques evolved at Giza. By O. H. Brown. Pp. 13+2 plates. P.T. 3. (Cairo: Ministry of Finance.) [1]

League of Nations Health Organization. Technical Commission on Nutrition. Guiding Principles for Studies on the Nutrition of Populations. By Prof. Dr. H. J. Bigwood. (Official No.: C.H. 1401.) Pp. 281. (Geneva: League of Nations; London: George Allen & Unwin, Ltd.) 6s. [1]

U.S. Department of the Interior: Office of Education. Leaflet No. 29: Textbook Expenditures in Large City School Systems, 1934-1935 and 1936. By Lester B. Herlihy. Pp. 8. 5 cents. Vocational Division, Leaflet No. 3: Teaching the Control of Loose Scraps of Wheat and Barley in Vocational Agriculture Classes. Revised edition. Pp. iv+11. 5 cents. (Washington, D.C.: Government Printing Office.) [1]

U.S. Department of Agriculture. Circular No. 506: Control of the Corn Earworm on Fordhook Lima Beans in Eastern Virginia. By Lloyd W. Brannon. Pp. 16. (Washington, D.C.: Government Printing Office.) 5 cents. [1]

Advisory Committee on Education. Staff Study No. 17: Education of Children on Federal Reservations. By Lloyd H. Blanch and William L. Iverson. Pp. xiii+145. (Washington, D.C.: Government Printing Office.) 25 cents. [1]

Cornell University: Agricultural Experiment Station. Bulletin 706: Soils in relation to Fruit Growing in New York. Part 11: Seasonal Fluctuations of Soil Moisture in some Important New York Orchard Soil Types. By Damon Boynton and R. F. Savage. Pp. 2. Bulletin 707: An Economic Study of Land Utilization in Wyoming County, New York. By H. R. King. Pp. 56. Bulletin 708: Weed Control and Bulb Development in the Onion (*Allium cepa* L.). By H. C. Thompson and Ora Smith. Pp. 21. Memoir 115: Growth and Development of the Potato as Influenced especially by Soil Reaction. By Ora Smith. Pp. 46. Memoir 216: Biochemistry and Biophysics of the Developing Hen's Egg. 3: Influence of Temperature. By Alexis L. Romanoff, Laura L. Smith and Royal A. Sullivan. Pp. 4. Memoir 217: Studies of the Factor in Ood-Liver Oil concerned in the Production of Muscle Dystrophy in certain Herbivora. By Georg Davis, L. A. Maynard and C. M. McCoy. Pp. 28. (Ithaca, N.Y.: Cornell University.) [1]

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Research in Civil Defence

WE are to-day faced with conditions hitherto almost unknown in history. Whereas, prior to the Great War, wars were fought between professional armies comprising a comparatively small section of the population, to-day war means that the whole community is involved in a life-and-death struggle. Air attack as a weapon used for the destruction of lives and property and as a means of undermining the morale of a nation is a very potent one, and there can be no doubt that until nations abandon aerial bombing, whatever the type of bomb used, whether it be high-explosive, incendiary or gas, it is imperative that the best resources of a country should be enlisted to reduce the effects of such enemy action and to maintain the confidence of the people in their strength and ability successfully to resist such attacks.

The organization of Great Britain for this purpose has now been in progress for some time. Much has been done to devise means for protecting the civilian population from the effects of aerial bombing, particularly by the provision of gas masks constructed on a scientific basis and later by the provision of steel shelters which will give some measure of protection against the effects of modern high-explosive bombs. Pamphlets and handbooks have been issued dealing with a variety of subjects giving the best-known means of protection from exploding bombs and gas, and for reducing the risks from fire. These publications give the latest information actually available, but the work of research goes on and there are many problems still awaiting solution. In the early days of the work of A.R.P., a considerable amount of valuable work was done by the Department of Scientific and Industrial Research. With the rapid expansion of the Air Raid Precautions Department, however,

it became increasingly clear that the special problems that arose demanded the setting up of a special section of the Department to deal with them.

A few weeks ago, a new Division of the Air Raid Precautions Department of the Home Office was accordingly set up to deal specially with problems which may arise in connexion with air raid precautions, and requiring scientific research and experiment. This work is under the direction of Dr. R. E. Stradling, director of building research of the Department of Scientific and Industrial Research. But to speed up as rapidly as is desired, it is necessary to enlist every suitable and available facility for scientific research.

It is therefore to ensure, so far as practicable, that the population is given the greatest degree of protection which the skill of science can devise that Sir John Anderson has now brought into being a special Committee for Civil Defence Research. This Committee, the members of which were announced in *NATURE* of May 20, p. 847, is not only an advisory body. It is also intended that through it the Department will be able to make use of the resources of the universities and scientific institutions in Great Britain for the solution of problems as they arise. Facilities undoubtedly exist for conducting experiments; but it is earnestly to be hoped that they will be made freely available to assist in the extensive and intensive work now in hand. Great Britain is now alive to the risk of being unprepared to meet attack from the air, and the whole country is steadily being organized to resist the menace. Members of scientific bodies will no doubt be prepared to give their services to assist in the prevention and amelioration of suffering, and the Government is now in effect inviting all who can

to contribute to the task of research and experiment to this end. Much has already been done, but there is still much to do. The difficulties with which investigators are faced are often new, and call for fresh methods of approach. It is one matter to devise weapons of destruction, but quite a different problem to devise methods of mitigating the effects produced by that weapon or of rendering it innocuous.

This important extension of the work of the Air Raid Precautions Department will, we believe, meet with general approval. Not only is the help of scientific workers necessary to the country, but also men of science themselves have shown that they desire to help. The new Committee will meet under the chairmanship of Dr. E. V. Appleton, who is secretary of the Department of Scientific and Industrial Research. The field of investigation that lies before it is large and involves practically every branch of science—chemistry, mathematics, physics, geology, engineering and biology among many others. There is, in fact, no limit to the scope of such investigation.

The Committee, as at present constituted, consists of some leading men of science in Great Britain, but drawn exclusively from the physical and engineering sides. This would appear to be deliberate, for the immediate task of the Committee is to deal with questions arising out of the provision of shelters for the civil population, and it is believed that physical aspects will need first consideration. No doubt it will be possible to widen the basis of the inquiries undertaken in due course, by extending the membership of the Committee to cover other subjects.

The conditions under which we have lived hitherto are not intended to meet a menace such as a modern air attack. Homes suitable enough for times of peace are not constructed to withstand the shock of a modern high-explosive bomb. Some alternative protection must be provided that will withstand most of the shock that it may possibly receive. Thousands of workers employed in factories must be protected, and employers will expect advice from the Government with regard to the best means of constructing shelters for employees who are working in older types of buildings, and also to assist in the design and layout of protected quarters in new buildings. There are also questions arising in connexion with obscuring internal lighting of factories, and on the various means of giving satisfactory warnings of an approaching raid. These are only a few of

the more obvious matters that in their many variations must be dealt with, and for which solutions are needed, not some day, but immediately, so that appropriate steps may be taken.

Among the problems that call for research are problems on which there is at present little or no information, are the effects of explosion on structures of different types. This involves large-scale experiments. A clear space having a radius of a mile, and with suitable subsoil, on which full-scale experiments can be conducted, is required to be put at the disposal of the Department. Such sites are very difficult to obtain in Great Britain as the failure to obtain one will inevitably handicap the work of research in this important matter. It is understood that the Department has not yet found such a site, and would welcome assistance in the matter. Research into the many problems arising in connexion with the effects of explosion—for example, transmission of shock, equivalent static pressure of blast, pressure waves produced in the ground by an explosion, and physiological effects of explosive pressures—are among the matters that call for early solution. Many other problems arising in connexion with anti-gas measures, obscuration of lighting and air-raid warning suggest that the field for research is very wide.

The full weight of scientific knowledge is now being marshalled in the services of the Air Raid Precautions Department. It is a bitter comment on international affairs that scientific effort should have to be devoted specifically to this end, but failing the effective prohibition of aerial bombing no other course appears to be open. Indeed the call for service is now urgent, for if Great Britain is to maintain its independence and its civilization, the country must be protected effectively and speedily from what is probably the worst form of warfare yet devised by man.

While condemning, with all reasonable men, the utter folly of war, scientific workers must recognize the dangerous qualities of the times in which we live, and will welcome the formation of the Civil Defence Research Committee. The investigations it will institute can scarcely fail to make contributions which, in the long run, will prove of value to mankind; further, its immediate task, which is directed towards the amelioration, if not the prevention, of suffering on the part of hundreds of thousands who in past years would have been respected as non-combatants, will appeal to all who are imbued with the spirit of service to humanity.

Zoological Miscellany

estschrift zum 60. Geburtstage von Prof. Dr. Embrik Strand.

enthaltend dem Jubilar gewidmete Arbeiten ländischer Zoologen und Palaeontologen. Vol. 1. Pp. ii+644+14 plates. Vol. 2. Pp. ii+652+37 text-figures. Vol. 3. Pp. ii+608+20 plates. Vol. 4. Pp. ii+784+16 plates. Vol. 5. Pp. ii+750+11 text-figures. (Riga: Prof. Dr. Embrik Strand, Sistēmatiskās Zooloģijas Institūta, Pasta kastīte 802; London: H. E. Knowles, 1938-39.) 24s. 6d. each.

It is customary in some countries, particularly in Germany, to honour a distinguished man of science on the anniversary of his sixtieth or seventy-fifth birthday by the issue of a volume containing papers written for the occasion by former pupils and other friends and admirers. In order to preserve the element of surprise for the *Jubilar*, it is understood that the matter is kept a secret. Prof. Dr. Embrik Strand, professor of zoology and rector of the Systematic-Zoological Institute and the Hydrobiological Station of the University of Latvia at Riga, evidently did not like the usual proceeding and, dispensing with secrecy, invited all and sundry to send manuscripts for a festive publication in commemoration of the anniversary of his sixtieth birthday.

The promise to publish all was most generous, at the present time when scientific periodicals are overwhelmed with manuscript. The response was equally generous, the result being a *Festschrift* such as has never before been issued in honour of any zoologist. The five volumes contain 194 articles, which occupy more than 3,400 pages and are illustrated by 687 text-figures, 6 text-plates and 3 line and half-tone plates. Most articles are in German, others in English, French and Italian. The editor has extended great hospitality to some authors, one of whom contributes no fewer than fourteen articles and some others five, six or seven, which shows that there was a demand for such publication. Although English is the language of eighteen articles, Great Britain shines rather by absence, only one article of two pages being contributed from England. The invitations were duly received, but did not create enthusiasm among British zoologists, who are unaccustomed to this kind of publicity and evidently do not like it. It is no reflection on Dr. Strand's reputation.

The articles were obviously printed more or less in the sequence in which they were received, there being no attempt at co-ordination. The absence of order presents some difficulty to the reader

who is interested in a particular subject, but the editor supplies the want in volume 5, which brings a list of the articles grouped according to subject and an index to the scientific names used in volumes 1-5. Dr. Strand being an entomologist and arachnologist of world-wide reputation, it is very appropriate that most of the contributions deal with spiders and insects; but there are articles on all classes of animals from Protozoa to Mammalia and on a variety of subjects of more general import; every zoologist, inclusive of geneticists, will find a paper of some interest. Many of the authors begin their articles with an appreciation of the work of Dr. Strand, sometimes employing superlatives which must have brought a gratified smile to the stern face of the professor who frowns at the world from the frontispiece to volume 1. It is unfortunate that in Prof. Špaček's article on Dr. Strand as a lepidopterist special stress is laid on the discovery of a new sub-family of Castniidae in Madagascar; in reality, Dr. Strand was misled by an Agaristid with the antenna more strongly clubbed than usual.

Taxonomy and purely descriptive work take up the greater part of the volumes, and many of the new forms described are named in honour of Dr. Strand. In Dr. Obenberger's article on new Buprestidae, some fifty names are derived from Embrik and Strand singly and combined. The longest contribution (more than 400 pages) are Dr. Breuning's three articles on exotic Cerambycidae, from various collections, inclusive of that of the British Museum. The monograph of the colliurine carabids by Herr Liebke and the survey of the Palearctic Troginae (*Lamellicornia*) by Dr. Balthasar are welcome comprehensive publications; Herr Liebke's account would have been still more helpful for future specialists if references to original descriptions had been given, as Dr. Balthasar has done; the addition would have made no appreciable difference to the length of an article occupying more than 100 pages. Both these papers are mainly concerned with the characterization of the various species and sub-species. Dr. Auber's contribution, "Die Rassen- und Artenkreise des Genus *Eos* Wagler (Aves)", stands on a very different level. The author goes deeply into systematics as a science of relationship and discusses the question of the phylogeny of the forms composing the genus, illustrating his arguments with numerous figures of the details of coloration. The account is of great value for all who study the problems of species and subspecies.

Systematists will welcome Dr. F. Poche's research on the dates of issue of Esper's "Schmetterlinge" and his supplement to Sherborn's "Index Animalium"; physiologists will be interested in Prof. O. Polimanti's observations on the sleep of domesticated and wild mammals and birds, Dr. Molitor's experimental research on the colour-sense of sphegid wasps, Prof. Monti's paper on the effect of gamma rays on the reproduction of *Cladocera*, and Dr. and Mrs. Szabo's papers on physiological and old-age deaths and on duration of life and senescence.

A contribution of a very ambitious kind is Dr. G. von Kolosváry's "Generic System of the Phenomena of Life", where the evolution of organisms is explained on the basis of endogene development. According to him, the environment has no directing influence in the origin of new species, but only stimulates a predestined development. He mentions as an example the fauna of caves, and says that the modifications in the morphology of cave species are not the result of living in caves as generally supposed, but were acquired before these organisms became cave dwellers; the species having become unfit for the

conditions of a life in the open, retired into caves where they found shelter and could go on existing. An entertaining thought, but not new! An instructive paper is not very easy to read, as the author seems to contradict himself occasionally. For example, speaking of Linneons (= species and Jordanons (= subspecies or races) he says p. 196 that "the Linneon splits up into races; this division does not originate new species, that is to say, the Jordanon does not develop but into a new Linneon", a mere assertion, and p. 198 we read on the contrary "... the collected Linnean species (Linneons) have been divided into elementary species, so-called Jordanons ...". A Jordanon is a rudimentary species, it develops into a species; in fact, many Jordanons have all the characteristics of species. Erroneous conclusions are not without merit, if they are conducive to stimulating thought and research.

The reviewer sincerely congratulates Prof. Embrik Strand on the production of a unique publication which contains much valuable information, and expresses the hope that he will continue his activities in good health for a long time.

KARL JORDAN.

Progress in Seismology

Earthquakes and other Earth Movements

By John Milne. New edition, revised and rewritten by Dr. A. W. Lee. Pp. xiv+244+24 plates. (London: Kegan Paul and Co., Ltd., 1939.) 10s. 6d. net.

SINCE the sixth edition of Milne's book in 1913—the year of his death—nothing has been published in Great Britain to take its place, although with the great development of seismology in post-War years the book has long been completely out of date. The wealth of material and its wide range make the task a formidable one, and Dr. Lee is to be congratulated warmly on the discrimination, even more than on the skill that he has shown, in completely rewriting the book. It would be quite fair to say that he has used Milne's "Earthquakes" rather as an example of the spirit in which a treatise should be written.

The specialist, as well as the general reader, will find the opening chapters of great interest. They deal with the visible results of earthquakes, and are copiously illustrated with photographs of earth fissures, fault movements and damage to buildings, bridges and water-mains. There is, too, an interest-

ing chapter on "Earthquakes and Construction". The chapter on seismographs is extremely lucid and the diagrams, as throughout the book, are very clear; in spite of his intimate acquaintance with several types of instrument (or perhaps because of it), Dr. Lee avoids the temptation to go into too great detail. Of great historic interest are the reproductions of the Milne seismograph records at Kew of five famous earthquakes, including the shock that wrecked San Francisco in 1906.

To give in reasonable space an account of the onsets observed in seismograms, the working up of the records of a given earthquake, and the inferences that have been drawn concerning the interior of the earth, is a forbidding task, and it is a great achievement on Dr. Lee's part that he has managed to make this section reasonably complete without overloading it in detail. There is sufficient indication of method to show how conclusions are arrived at, yet the geologist or the general reader will not be irritated at the length of description or technique. The rather diffuse topic of the distribution of earthquakes in space and time is presented with a good sense of balance, and an adequate account is given of modern work. As one would

spect, the chapter on microseisms, a subject on which Dr. Lee is the leading authority, deals fairly and informatively with a very controversial subject. The final chapter, on seismic prospecting, includes an account of recent work on the ocean floor, by which the nature of the continental shelf

of the eastern coast of the United States has been made out.

The typography and general arrangement are good, and Dr. Lee has done his work so well that there are few loopholes for adverse criticism.

R. STONHLEY.

Structure and Existence in Mathematics

Le Progrès de l'Esprit

by Dr. Albert Lautman. 4: *Essai sur l'unité des sciences mathématiques dans leur développement actuel*. Pp. 60. 15 francs. 5: *Essai sur les notions de structure et d'existence en mathématiques, 1: Les schémas de structure*. Pp. 82. 5 francs. 6: *Essai sur les notions de structure et d'existence en mathématiques, 2: Les schémas de genèse*. Pp. 83-160. 20 francs. (Actualités scientifiques et industrielles, 589-591.) (Paris: Hermann et Cie., 1938.)

IN the introductory volume of his work on questions of structure and existence in mathematics, M. Lautman is mainly concerned with Prof. Weyl's distinction between the two types of modern mathematical systems in which the analysis of the infinite is contrasted with the synthetic methods of algebra and group theory. He shows that this distinction need not be conceived of as a fundamental opposition between two irreducible disciplines. On the contrary, among the modern theories of analysis, it is possible to discover points of view which are characteristic of algebra and group theory. For example, the theory of equations with an infinity of variables, the arithmetical theory of algebraic motions, the theory of non-Euclidean metrics, the theory of continuous groups, the analytic theory of numbers and the theory of Pfaffian forms, all occupy an equally intermediary position between algebra and analysis. For in all these, the methods are algebraic and the results extend to analysis; and although there is a certain analogy between contemporary physics and contemporary mathematics, in that both present a spectacle of facts which can be interpreted either by the calculus of the continuous or by that of the discrete, this duality of method, which is the principal source of the difficulties inherent in contemporary physics, is evidence of the profound unity of the mathematical sciences.

In the second volume, on structural schemes, M. Lautman maintains that with the concept of autology, the Russell school of logicians eliminated the idea of a reality corresponding to mathematical concepts. Thus for Wittgenstein and Carnap,

mathematics is nothing more than a language—or hierarchy of languages—which is quite indifferent to the content which it expresses. This, in M. Lautman's opinion, is a consequence of the deductive method which attempts to construct all mathematical concepts from a small number of primitive ideas and by means of which the qualitative nature of the theories thus constructed is lost.

In the course of three chapters on what he calls the "local" and "global" nature of mathematical theories, M. Lautman emphasizes the variety of logical relations which lie at the heart of mathematics. The solidarity of the whole and its parts, the reduction of relational to intrinsic properties and the passage from the incomplete to the absolute, are all forms of structural organization which confer upon mathematical entities a movement towards completion, by means of which their existence is established. But this existence is not solely dependent upon the fact that the structure of these entities is an imitation of the ideal structures to which they may be compared. On the contrary, it turns out that the fulfilment or complete designation of one entity gives rise at the same time to the genesis of others. It is in the logical connexions subsisting between essence and existence that these new creations are to be found.

Problems concerned with the passage from essence to existence, with examples derived from many different branches of mathematical theory in which this passage is either effected directly from the basic domain to the newly created entities—as in group transformations and algebraic functions—or indirectly by means of intermediaries which M. Lautman calls "les mixtes" and which are exemplified in Hilbertian space, occupy most of the third and final volume of M. Lautman's most interesting analytic study. Although these questions arise chiefly from the development of mathematical logic, the author takes the view that logic is only to be considered as one of the mathematical disciplines, and that the genesis manifested here are comparable with those to be observed in other mathematical

domains. Thus, M. Lautman's exposition of the metaphysics of logic is equivalent to an introduction to a general theory of connexions which unite structural and existential propositions. He calls the first period in the development of mathematical logic, dating from the early works of Russell to the year 1929, the "naïve" period; and the second, dating from the meta-mathematical researches of Herbrand and Gödel, the "critical" period. It is in the investigations of the critical period that M. Lautman finds confirmation of his theory of the connexions between essence and existence—a theory which differs both from the logicism of the formalists and from intuitionist constructivism. For, from these connexions he

deduces a philosophy of mathematical genes which goes far beyond the domain of logic itself and in this he has been immensely assisted by the work of Bernays on Hilbertian meta-mathematics.

For the rest, M. Lautman considers that the structure of experience cannot be detached from experience itself, and that reality consists in the discovery of an organizing structure in relation to matter, which is animated by its relations. It is of the opinion that in physics, as in mathematics, we are led to the Platonist conclusion that the nature of reality, its structure and the conditions of its genesis, only become knowable when we re-ascend to the ideas of which science incarnates the connexions. AMSTER VON ZEPPELIN.

Engineering Facts and Figures

(1) *Kent's Mechanical Engineers' Handbook*. Vol. 2: Design; Shop Practice. Founded by the late Dr. William Kent. Eleventh edition, rewritten by Robert Thurston Kent. (Wiley Engineering Handbook Series, Vol. 3.) Pp. xx+1378. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 25s. net.

(2) *The Engineer's Year-Book of Formulae, Rules, Tables, Data and Memoranda for 1939*. A Compendium of the Modern Practice of Civil, Mechanical, Electrical, Marine, Gas, Aero, Mine and Metallurgical Engineering. Originally compiled by H. R. Kempe and W. Hanneford Smith. 45th annual issue, revised under the direction of L. St. L. Pendred. Pp. lxxv+xii+2824. (London: Morgan Brothers (Publishers), Ltd., 1939.) 31s. 6d. net.

(1) **T**HE science and practice of mechanical and electrical engineering have, in recent years, developed so rapidly and to such an extent that, in the matter of the provision of suitable handbooks, the publishers of these are confronted with a problem of some complexity. Messrs. John Wiley and Sons have sponsored a number of such books in the past and, appreciating the trend of affairs, have dealt with the problem by appointing a board of editors to consider the best arrangements for future editions. They have recommended the adaptation of the handbooks which this firm publishes so as to form a co-ordinated series. The first volume deals with "Engineering Fundamentals" and contains the kind of information which an engineer associated with any branch of the profession would require to have in a readily accessible form, while the remaining four volumes of the series are devoted to the more specialized

information pertaining to distinct branches—mechanical and electrical engineering. The new arrangement will be found to have brought several advantages in its train; it has permitted a more thorough and more detailed treatment of the material included in the earlier editions; it has provided a better opportunity for the inclusion of new subjects; it has eliminated a large amount of duplication of information such as could not be avoided in a number of unrelated handbooks.

The volume now under consideration is the third of the series and retains its original title "Kent's Mechanical Engineers' Handbook". It is devoted to the two branches indicated by the subtitles "Design" and "Shop Practice", and in its preparation the advantages mentioned are much in evidence. In the first part it deals with the materials of engineering, ranging from iron and steel through all the metals and alloys used in construction to the non-metallic materials. Here are included particulars of welding as it is now applied in structures and in manufacturing processes. Corrosion-resistant metals and the methods of protecting against corrosion in different situations also find a place. The important alloys of aluminium receive appropriate treatment, and so do those of nickel and of magnesium. In the section on non-metals, the data supplied regarding cork, rubber, asbestos, carbon and the refractories are particularly valuable as they are not, as a rule readily obtainable.

The second part of the book is given over to the forms, proportions and other information relative to machine details and the thousand and one items which constitute the elements of shop work. Nystrom advised that "Every engineer should make his own pocket book, as he proceeds in

udy and practice", but while this remains good advice, the accumulation of engineering facts and figures now far exceeds any one man's practice, and he must be largely guided by the experience of others. The importance of standardization in any details also makes such a handbook a necessary part in the equipment of the engineer. Much of the information here is of the usual nature, but especial value is attached to many items by reason of their novelty, their growing importance and their reliability, for each section has been prepared by an expert in his subject. These include such matters as control mechanisms, vibration and noise, safety equipment, dust collection, and the illumination of workshops.

The general arrangement of the book should simplify the work of reference to such a vast store of information. Despite the large number of pages, the book is of convenient size and its flexible binding enables it to remain open at any selected page.

(2) There is another side to this question of handbooks, for it may, of course, be stated with certainty that every engineer feels the need of having at hand some reliable source from which he can readily obtain information, both descriptive and quantitative, on practically all branches of his profession. For a period now of forty-five years, "Kempe's Engineer's Year-Book" has been the leading publication of this kind and also the

most complete, and has become, like the slide-rule, one of those essential items that must always be within reach. Year by year it has entered upon a new edition, on each occasion being brought up to date by the excision of all that has become obsolete and the introduction of what is new and established.

The issue for 1939 is now available and once again the opportunity has been taken to incorporate new material and, where necessary, to effect the revision of tables. The information has been presented in the most concise form by experts in their several branches, and the general revision has been made under the direction of the editor of the *Engineer*. Of its two main parts, the first contains general principles and data. The second, entitled "Descriptive Sections", is devoted to practical applications of these principles in civil, mechanical, electrical, naval, automobile and aeronautical engineering works. There are also sections dealing with ancillary subjects such as acoustics, explosives, paints, depreciation, and legal notes for engineers, to name but a few of these.

The increasing revisions and additions in order to keep the book up to date with current practice have brought the 1939 volume up to 2,824 pages. It is profusely illustrated by diagrams and half-tone illustrations, and contains valuable descriptions of the products of many important engineering firms.

Expanding Horizons

Geography in the Middle Ages

By George H. T. Kimble. Pp. xi + 272 + 20 plates. (London: Methuen and Co., Ltd., 1938.) 15s. net.

MR. KIMBLE has made a valuable contribution to the history of geography in this volume. His title is somewhat misleading, for the last two chapters take us beyond the strict limit of the geography of the Middle Ages and introduce the great Age of Discovery. The author shows how, for example, Fontana blended traditions of Marco Polo with knowledge gained by the Portuguese in West Africa, and laid stress on the importance of a habitable land south of the equator. This idea may have influenced Columbus—as others have pointed out—to shape his course towards the south-west rather than due west.

An important chapter deals with medieval maps. The author goes far to establish the point that many of these maps were forgeries or at least contained inaccurate information. He instances the map of Fra Mauro and the globe of Behaim, both of which were based on Portuguese material

and both of which do not accurately represent Portuguese accomplishments, as evidence that the Portuguese policy of secrecy led to the falsification of material supplied to cartographers and to the general scarcity of Portuguese maps.

Two chapters deal with 'expanding horizons' in Asia and in Africa. In the latter, Mr. Kimble puts up a good case for the genuineness of the work of the anonymous fourteenth century Spanish Franciscan who seems to have had some knowledge of the west coast of Africa at least as far as Sierra Leone.

A number of well-produced photographs of early maps, and a select bibliography complete a work on which both author and publishers are to be warmly congratulated. To the latter a special word of thanks is due for encouraging the publication of works by English writers on the history of geography and thereby filling a serious gap in geographical literature. Mr. Kimble's book is worthy to stand by any of its predecessors.

J. N. L. B.

Kleine Erdbebenkunde

Von Prof. Dr. Karl Jung. (Verständliche Wissenschaft, Band 37.) Pp. v+159. (Berlin: Julius Springer, 1938.) 4.80 gold marks.

THIS admirable little book contains a large amount of information in a small space and, although succinct, is eminently readable. The nine chapters include such topics as macroseismic effects, the geography, nature and cause of earthquakes, the method of obtaining seismograms and information concerning shocks, the propagation of earthquake waves, microseisms, and the application of earthquake knowledge chiefly to seismic prospecting. Dealing with the cause of earthquakes, Prof. Jung says: "Concerning the fundamental causes of the formation of mountains, of earthquakes, and volcanicity there are only suppositions partly substantiated, and no one theory has yet found general recognition". Thereafter a nice balance is maintained between the various current theories, and an adequate discussion is given of the materials of the earth's crust and beneath the crust, which materials have sufficient strength to cause and maintain oscillations and yet yield to the forces required by isostatic theory.

The illustrations in the book are very clear and often give the results of much mathematical investigation without using a single mathematical symbol. The text is well informed and up to date. For more detailed information the student must consult the publications listed at the end of the book, which he must also do for the authors of the original works mentioned whose names are often omitted. The book is of handy pocket size and is very well printed.

E. T.

African Odyssey

By Joseph Crad. Pp. 286. (London: John Gifford, Ltd., 1939.) 12s. 6d. net.

MR. CRAD'S story of his youth and early manhood in South Africa is an "Iliad" rather than an "Odyssey"; for its main interest lies in combat of the truly heroic type. His story of life in South Africa, nearly fifty years ago, when he was pioneering in the country of the Matabele, is Homeric in its zest for battle. He took part in the Matabele War, which ended in the death and defeat of Lobengula; and then for a period was in East Africa, working in Zanzibar and making a trading journey on foot to Lake Tanganyika, when he was attacked by raiding Masai. He then travelled in other parts of the world; but of his adventures we are not told, his narrative being concerned with Africa only. In addition to service in the Boer War, he fought with the Natal forces in the suppression of the Zulu rising of 1906-7.

Mr. Crad's view of the native peoples of South Africa, notwithstanding his experience of the cruelties practised in their raids in his early days, is impartial, and for certain sides of their character he has no little admiration. In the light of his knowledge of the native he confidently anticipates that trouble, similar to that which caused the Zulu rising in 1906, is likely to recur.

The book, in view of its intimacy of detail is a record of a phase in the relations of black and white, now completely passed away, which is of more than ephemeral interest. It is also a vivid picture of the practical working of the Matabele and Zul military organization.

Capri

Per Immanuel Friedlaender. Tradotto da Angel de Angelis. Pp. 168+12 plates. (Roma: Societ Italiana Arti Grafiche, 1938.) 25 lire.

ALTHOUGH Capri, the small island lying at the entrance to the Bay of Naples, has a total area of only some four square miles, it has an extensive literature. Its many interests have brought it fame since the days when it was the resort of Roman emperors. Prof. Friedlaender attempts with considerable success to survey all aspects of the island. The peculiar geological structure of the caves and caverns of the island is fully discussed and the flora and fauna receive special notice. The second half of the book deals with the story of the people, the antiquities and the history, and concludes with a bibliography. If the volume contains little that is new, it collects much scattered matter in an accessible form. There is a map on a scale of 1:12,000 in an end pocket.

Practical Organic Chemistry

By Dr. Frederick George Mann and Dr. Bernard Charles Saunders. Second edition. Pp. xiii+418. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1938.) 8s. 6d. net.

THIS new issue is unchanged, except that it contains an account (2 pp.) of Middleton's sodium carbonate-zinc method for detecting nitrogen, halogens and sulphur in organic compounds, with the addition of some useful tables of physical constants (m.p. and b.p.) of organic compounds (12 pp.). The publication of a second edition of this work two years after its original appearance testifies to its fundamental soundness. It meets admirably the requirements of general degree courses in practical organic chemistry, and may be heartily recommended also to more junior students.

J. R.

Principles of Genetics

By Prof. Edmund W. Sinnott and Prof. L. C. Dunn. (McGraw-Hill Publications in the Botanical Sciences.) Third edition. Pp. xiv+408. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 21s.

WITHOUT an appreciable increase in size, this edition includes adequate treatment of recent work, such as position effect, somatic crossing-over, salivary-gland chromosomes, cytoplasmic inheritance and heterosis. This has been achieved by considerable rewriting, which appears to have improved the text. This third edition contains a remarkably complete and well-illustrated simple statement of the elements of genetics for biological students. The subjects of crossing-over and the chromosome theory of heredity, highly important in modern genetics, are dealt with particularly well.

F. W. S.

Fission of Heavy Nuclei : a New Type of Nuclear Disintegration

By Dr. N. Feather, Cavendish Laboratory, Cambridge

THE first indication that the transmutation of heavy nuclei could be effected in a laboratory experiment was obtained by Fermi in March 1934. Curie and Joliot had just discovered that short-lived radioactive species are produced as the result of α -particle bombardment of certain light elements, and Fermi, accepting the appearance of such 'induced' radioactivity as proof of transmutation, very soon showed that the nuclei of almost all elements, even those of highest atomic weight, undergo transformation when neutrons are used. From his early experiments Fermi concluded that in general the neutron is simply captured by the nucleus, and he went on to show that this process of capture is usually more efficient—and sometimes very much more efficient—when the neutron is moving with a small ('thermal') velocity, before the collision, than when its energy is large. Eventually he found that negative electrons were emitted in the disintegration of the radioactive products obtained in all these capture transformations, and thus the final result of the combined process of neutron capture and β disintegration was in every case shown to be the production of a nucleus having both mass and charge numbers greater by one unit than the mass and charge numbers of the nucleus bombarded.

In June 1934¹, Fermi and his collaborators obtained negative electron activities from thorium and uranium under neutron bombardment, and they quite naturally supposed, on the basis of their previous investigations, that in the latter case a nuclear species of atomic number $Z = 93$ must remain after disintegration of the unstable product first formed. Further examination showed that not one but several distinct radioelements were produced as a result of the bombardment of uranium, and rough chemical tests proved that one of these, at least (half-value period $\tau = 13$ minutes), was not attributable to an element of atomic number $Z = 92, 91, 90, 89, 88, 83$ or 82 . It seemed quite clear, then, that after the uranium nucleus had captured a neutron, not less than two or three transformations followed, and consequently that a new element, for which Z was not less than 94 , was ultimately produced. These conclusions at once gave rise to much argument amongst chemists as to what the chief chemical properties of these hypothetical transuranic elements might be, but a great deal of careful research in many physical laboratories throughout the world only served to

strengthen the assumption that, apart from any preconceived ideas about chemical behaviour, such elements were certainly formed when uranium was bombarded by neutrons.

By May 1937, Meitner, Hahn and Strassmann² had recognized the existence of nine separate species arising from this transformation, and had suggested genetic relations between them which supposed that every element of atomic number between (and including) 92 and 97 was represented, either as intermediate or end product of a series. They identified three of these nine products ($\tau = 10$ sec., 40 sec., 23 min.) as unstable isotopes of uranium, and the remainder, which could all be obtained by precipitation with platinum as sulphide in acid solution, as the transuranic elements already mentioned. The scheme presented certain difficulties, it was admitted, (no evidence for the final return of the unstable nucleus within the ordinary range, Z less than 93 , could be found, and awkward questions concerning isomeric forms were raised in an acute form) but it was the best that could be done.

Then, in October 1937, Curie and Savitch³ discovered a tenth activity of about $3\frac{1}{2}$ hours period, and at once proceeded to investigate the chemical nature of the element to which it belonged. They showed that this radioelement did not separate with the platinum precipitate and soon discovered that it bore a close resemblance to lanthanum in chemical behaviour. At first the most plausible suggestion appeared to be that the new species was an isotope of actinium ($Z = 89$). Then two very disturbing facts were encountered. First, a body of the same period and almost identical properties was among the active products formed in the disintegration of thorium by neutrons, and, secondly, it was found possible to separate actinium almost completely from the new body by a lanthanum fractionation. In September 1938, Curie and Savitch⁴ wrote, "On the whole, the properties of $R\ 3.5$ h. are those of lanthanum, from which it appears that until now it has not been separated".

The work of Curie and Savitch immediately prompted a further search for activities belonging to elements of atomic number less than 92 produced in the uranium transformation, and, as a result, Hahn and Strassmann⁵ discovered two other lanthanum-like and three barium-like products. These workers believed that they had

demonstrated the production of each of the former species from one of the latter, but at that time they still inclined to the view that actinium and radium isotopes were really in question. However, in January of this year, they reported⁶ that fractionation of the new bodies with mesothorium and barium (or lanthanum) invariably concentrated the neutron-produced activity with the lighter carrier and resulted in a complete separation of mesothorium 1 (radium), or mesothorium 2 (actinium). The conclusion now appeared inescapable that active isotopes of barium and lanthanum were among the products of the bombardment of uranium with neutrons.

At this stage, Meitner and Frisch⁷ discussed the problem on the Bohr theory of heavy nuclei, making particular use of the essentially classical 'water-drop model' of the highly condensed system of particles of which such a nucleus is constituted. They concluded, "It seems therefore possible that the uranium nucleus has only small stability of form, and may, after neutron capture, divide itself into two nuclei of roughly equal size. . . . These two nuclei . . . should gain a total kinetic energy of c. 200 Mev. . . . This amount of energy may actually be expected to be available from the difference in packing fraction between uranium and the elements in the middle of the periodic system". Then Frisch⁸ obtained direct evidence for the projection of fission fragments with approximately the energy predicted, being able to detect the production of large bursts of ionization in a uranium-lined ionization chamber which was irradiated by neutrons. Similar results were obtained when thorium was substituted for uranium in the chamber, and it was concluded that some of the activities previously ascribed to isotopes of radium and actinium, in this case also resulted from fission of the nucleus under neutron bombardment.

The investigations begun by Meitner and Frisch were rapidly followed by many others in physical laboratories both in Europe and in the United States: the confirmation of the findings of Curie and Savitch by Hahn and Strassmann had indicated quite clearly to many workers that something new was involved. In Paris, in Berkeley, in Washington, New York and Baltimore, direct proof of the fission of uranium and thorium was obtained within the space of a few days. Now, some three and a half months after the original announcement, so much has been published that rigorous selection is necessary in any report on the subject. For the remainder of this survey, therefore, only the most interesting features of the new phenomenon can possibly be included.

Perhaps the first such feature concerns the radioelements of the platinum precipitate, of

which the previously supposed transuranic nature was now in question. Before the fission process was discovered, both in Berkeley and in Cambridge, projects had already been formed of investigating these elements for natural X-radiations, in the hope of being able to deduce the atomic number from the energy of the radiations (natural X-radiations) as determined by the method of critical absorption. This problem became much simpler once the presence of medium-heavy elements was suspected, since K-radiations could be looked for instead of the more complex radiations of the L-series. Almost at once, Abelson⁹ and Feather¹⁰ and Bretscher¹¹ found evidence for the natural K-radiations of iodine from the long-lived activity of the platinum precipitate, and, guided by this observation, were able to identify chemically a tellurium and iodine two products previously described as eka-iridium and eka-platinum, respectively. Then several workers found other of the so-called transuranic activities in the product collected by recoil from bombarded uranium. Observations concerning the rates of decay of these recoil activities¹²—and the results of chemical tests¹³—left little doubt that almost all the previous assignments had been seriously in error. At the present time, one might justly say that it cannot definitely be maintained, concerning any of the activities separable from uranium, that it does not arise in a process of fission of the uranium nucleus.

There is, however, one important activity, of 23 minutes half-value period, which is not separable from uranium and for which, in consequence, the fission process cannot be assumed to be responsible. This non-separable activity arises in a process of resonance capture of neutrons of about 25 ev energy, and the fact that negative electrons are involved must clearly indicate that a species for which $Z = 93$ is formed as the result of the disintegration. Yet, in spite of much careful investigation, no radioactivity of any kind has been discovered which is unquestionably due to the transformation of this species. Furthermore, in respect of the parent species (the uranium isotope for which $\tau = 23$ min.), this is clearly a quasi-stable modification of the body which undergoes fission in the majority of cases, and Meitner and Frisch and Bohr¹⁴ have discussed this aspect of the phenomenon. They have pointed out that there is nothing intrinsically incomprehensible in the occurrence of resonance capture (emission of γ radiation) rather than fission in certain circumstances. In any event, division of the nucleus into two fragments must be preceded by the concentration of the available energy in a type of nuclear motion of large deformation, and this concentration may be very unlikely if the original state of the system, after capture of the neutron, is one of

nsiderable symmetry. Or if, as Bohr has assumed, the effect of thermal neutrons in producing fission in the case of uranium (such neutrons are quite ineffective when thorium is bombarded) is ascribed to capture by the rare isotope ^{235}U , and the resonance effect and the fission process due to fast neutrons are ascribed to ^{238}U , it may even be that, at the resonance energy, the compound nucleus is not formed with sufficient energy of excitation for the neutralization of the small probability of form which it naturally possesses. As regards the whole of this question, more definite conclusions must clearly await further experiments: Joliot¹⁴ has reported a variation in the relative proportions of the different fission products as the energy of the neutrons is altered—and this might be held to favour the suggestions of Bohr—but Bjerge, Brostrom and Koch¹⁵ have failed to establish any difference in the decay of the products obtained with high-energy neutrons and thermal neutrons, respectively.

Hitherto, the process of fission has been spoken of without any precise statement regarding the nature of the fragments which result from the primary act of division of the nucleus, and in fact very little exact knowledge is as yet available on this point. Determinations of the range of the fission products provide some information. In the first place, they indicate that (with uranium and fast neutrons) the process occupies less than 1×10^{-12} sec. from the time of capture of the neutron (the forwards range is slightly greater than the backwards range, showing that very little of its original momentum is lost before the compound nucleus divides¹⁶), and, secondly, they appear to favour a very small number of competing primary processes, rather than a large number of possibilities¹⁷. On the other hand, chemical investigation reveals such a wealth of active products¹⁸ (with atomic numbers lying between 35 (Br) and 57 (La), if not more widely distributed) that some adequate explanation of their complexity must certainly be found. It would appear that the discovery that very frequently neutrons are emitted almost instantaneously by the original products of fission¹⁹ already provides a basis for such explanation (nuclei, first formed, presumably, in states of high excitation, emit either neutrons or quanta of radiation in passing to longer-lived states). Also, even after these states have decayed with β -emission, experiment shows that occasionally product nuclei result, still with sufficient energy of excitation for the 'evaporation' of neutrons to be a possible alternative to radiative transitions leading to more stable states. In this connexion, Roberts, Meyer, and Wang²⁰ and Booth, Dunning and Slack²¹ have reported delayed

neutron periods of about 12 sec. and 45 sec., when uranium is bombarded, whilst a similar feature has also been established in the case of thorium.

The frequency of the neutron-evaporation process accompanying fission, and the energies of the neutrons so produced, have been studied by many workers, but so far most exhaustively by Joliot²² and his colleagues, and by Fermi²³ and others in New York. The general result appears to be that, for each process of fission with uranium, at least two neutrons, having a mean energy of the order of 10^6 ev., eventually evaporate from the residual fragments. Since neutrons of less than this energy are still capable of producing fission on their own account (probably in ^{235}U , as already suggested), the possibility of a cumulative process of exothermic disintegration has to be considered. Clearly, if the probability of removal of neutrons in processes other than those which result in fission is sufficiently reduced, the latter process must eventually build up in any solid substance containing uranium. Direct experiments on this aspect of the matter have not yet been reported in the scientific literature, but at this stage it may be pointed out that, even in pure uranium, it is well known that a non-fission capture process takes place (*v. sup.*), whilst the unlimited generation of energy in the solid material would ultimately increase the energy of the 'thermal' neutrons until their efficiency as agents for fission was greatly reduced. Already several attempts have been made²⁴ to calculate the course of the phenomenon using existing data, but the assumptions upon which they have been based have generally been so severely idealized that no confidence in numerical values is at present likely to result.

¹ NATURE, 123, 898 (1934).

² J. Phys., 196, 249 (1937).

³ J. Phys., 8, 385 (1937).

⁴ J. Phys., 9, 355 (1938).

⁵ NATURE, 136, 755 (1938).

⁶ NATURE, 137, 11 (1939).

⁷ NATURE, 142, 239 (1939).

⁸ NATURE, 142, 276 (1939).

⁹ Phys. Rev., 55, 418 (1939).

¹⁰ NATURE, 142, 516 (1939).

¹¹ Meitner and Frisch, NATURE, 143, 471 (1939). Glasoe and Stogman, Bull. Amer. Phys. Soc., (3), 14, 20 (1939).

¹² Bretscher and Cook, NATURE, 142, 559 (1939).

¹³ Phys. Rev., 55, 418 (1939).

¹⁴ J. Phys., 10, 159 (1939).

¹⁵ NATURE, 142, 794 (1939).

¹⁶ Feather, NATURE, 142, 597 (1939).

¹⁷ McMillan, Phys. Rev., 55, 510 (1939).

¹⁸ Heyn, Aten and Bakker, NATURE, 142, 516 (1939). Abelson, Phys. Rev., 55, 670 (1939).

¹⁹ v. Halban, Joliot and Kowarski, NATURE, 142, 470 (1939).

²⁰ Phys. Rev., 55, 510 (1939).

²¹ Bull. Amer. Phys. Soc., (3), 14, 19 (1939).

²² v. Halban, Joliot and Kowarski, NATURE, 142, 680 (1939). Dodé, v. Halban, Joliot and Kowarski, C.R., 208, 906 (1939).

²³ Anderson, Fermi and Hanstein, Phys. Rev., 55, 797 (1939). Seillard and Elmi, Phys. Rev., 55, 790 (1939).

²⁴ For example, Perrin, C. R., 208, 1894 (1939).

The Concept of Instinct

By Dr. J. A. Loeser, formerly Professor of Psychology,
University of Berlin

WHEN a hen has laid eggs for the first time in her life she immediately sits on them. She does not know why she does this for she does not consciously know what an egg is, nor what incubation is, nor can she take any interest in the hatching of the future brood. Hitherto science has called this a typical example of animal instinct. Without any consciousness of the biological purpose, it is said the animal finds the right thing to do because it was born with a mysterious instinct, which is inherited from the experience gained by its ancestors in primeval times.

THE CONCEPT OF INSTINCT

What is the real truth of the matter? Careful investigation has proved that the animal certainly has personal motives for sitting, but they are not biological ones. Shortly before the beginning of hatching-time the animal's breast shows the so-called hatching spot. Here the feathers fall out and there is a bald spot which feels hot, as if from inflammation (probably caused by hormones). This evidently causes the animal pain, for it seeks cooling substances, which must necessarily have a curved shape to be effective. After the eggs have been laid, these offer what is required. But we may just as well give the hen stones or billiard balls to sit upon; she will 'hatch' them in exactly the same way, because all she wants is to soothe the discomfort of her body. It is also possible to soothe the 'hatching irritation' in an entirely different way, that is, by holding the animal's breast in cold water. These are experiments which even the peasant knows and often makes for practical reasons. Only a bird which has these 'spots' sits on the eggs, and with many species frequently it is the cock. Similarly, the bird takes no more interest in its own eggs than in those of another bird, if these are put into its nest soon enough to become familiar. There is, therefore, no such thing as purposeful hatching. The hen only sits on her eggs while the irritation from the 'hatching-spot' lasts. When the eggs have been hatched, others may be substituted, and she will continue to sit on them. But when the irritation has ceased, the hen does not continue to sit but forsakes the eggs, which decay.

Usually, however, this subjective conduct on the part of the bird serves a purpose, for the

consequence generally is that the eggs are hatched. The hen turns the eggs so that she may sit on the cool parts, and without meaning to do so she thus causes all parts of the egg to be equally warmed.

This example shows animal behaviour in an entirely new light. The conclusions to be drawn from it are the following:

(1) Every animal acts only in accordance with *personal* or *subjective impulses*; it only satisfies its personal needs. The hen merely wishes to soothe the pain of the 'hatching spot'.

(2) The *means* to do this may vary a great deal; they are *fundamentally variable*. It is a matter of indifference to the hen whether she sits on eggs or on other subjects, or whether cold water is used for satisfying her needs.

(3) Biological purposes are not aimed at either consciously or unconsciously, that is instinctively. The 'personally' motivated behaviour is often biologically useless or harmful. The hen is indifferent to the fate of the eggs. Frequently however, subjective (psychological) aims and objective (biological) purposes coincide.

The theory of the *psychological autonomy of action* in all living creatures, which I evolved on these lines a few years ago, cast doubt on all mechanistic conceptions of human and animal behaviour and therefore to the ancient conception of instinct, which had persisted for more than two thousand years. This conception had completely dominated the theory of organic behaviour. All actions were traced to fundamental instincts, even the actions of the apparently free will, for at long last the motives for these too were believed to consist in vital impulses.

In opposition to this conception, the new theory postulates the fundamental 'uniformity of all organic action' from the simplest reaction of the Protozoa to the voluntary action of man. The prototype of all reaction, indeed, is this *voluntary action*. Its principle is *variability* in the choice of the means to obtain its ends.

The aim of voluntary action is always a personal motive, a psychological experience, which represents the subjective reason for the reaction. The motives themselves may be of an inferior or of a superior nature, that is at present theoretically unimportant. Every organic action, therefore, is merely the satisfaction of an impulse, without

gard to the question as to how far self-preservation and race-preservation, the two impulses generally recognized in biology as the only influential ones, are guaranteed.

These two great unconscious motives in the theory of instinct and all biological psychology must be eliminated; they do not exist; they are either conscious nor unconscious impulses of organic behaviour. If then there is no instinct as the imaginary basis of action, neither is there instinctive action or reaction, in short no unconsciously suitable action (that is, no action for the purpose of self-preservation or race-preservation); there is no pre-formed reaction which intervenes, as an inherited factor, between the sensation and its expression.

Only in a certain percentage of cases do self-preservation and race-preservation occur in Nature as the *consequence* of purely individual action.

VOLUNTARY AND REFLECTIVE ACTION

The first and fundamental question here is the transition of ideas in the line which leads from true voluntary action (or action of the free will) by way of rigid instinct, occasionally modifiable, it is true, yet essentially and fundamentally invariable, to true *reflex action*. If this continuous line cannot be sharply divided, the result will always be: instinct is in the end a reflex-chain and the action of the will is only a relaxed action of the instinct; this was how it was described even in the most recent publications. Instinct is actually only an 'extended organ'—this was the rigid and materialistic conception of what is in truth free responsive action.

So we must first find a short and correct definition of reflex action. It is characterized by movement independent of the personal will, such as it can be found in the action of the internal organs of the body. Reflex action needs a nerve centre the existence of which has in many cases been proved. As it does not emanate from the ego, it is not directed towards the ego's purposes; how far it is biologically useful is another question. But this is not our concern for the moment.

In contrast to these *involuntary* processes all others appear as *voluntary actions*, modelled on the true action of the will. To these belong the voluntary closing of the eyelids or voluntary breathing, whereas involuntary breathing is a reflex. To these belong also, however, as I have proved by a number of examples, most of the so-called instinctive actions—not, it is true, taken as a whole (as described in the famous old alternative: conscious action of the will or unconscious action of the instinct), but analysed and broken up into a series of "small voluntary actions".

Thus every true action (action of the free will) is a natural product of all the circumstances, a product consisting of three main factors. That is, *psychological* and *physical* tendencies and abilities can only be effective in the animal's natural *surroundings*. In short, every living creature acts in any given situation so far as possible under the impulse of pleasure or pain.

SENSATION AND REACTION

Most investigators pay too little attention to the decisive factor, *sensation*, which they generally treat as of minor importance. Instinct is mostly defined as unconsciously purposive activity. But why should there be any sensations, pleasure or pain, and whence do they arise, if they do not cause a reaction and, moreover, a fitting reaction? Does not every living creature, as the simplest observation shows, act in a manner which leads, for example, to the satisfaction of the painful sensation of hunger? On these occasions biologically inexpedient activity frequently occurs, such as the eating of injurious food, only because it has a pleasant taste. It is only personal impulse, that primarily controls and guides action.

A striking example of instinct seems to be that of the *swallow*, the instinct of which appears to impel her to a sticking activity, even when there is no reason for it, when, for example, she has a perfect nest. The sticking is an instinctive impulse, it is said. But birds which build with saliva—swallows as well as nuthatches and salanganes—have special salivary glands, which swell during brooding-time and obviously drive them to secrete the salivary fluid, as is the case with all animal secretion. Alfred Brehm has pointed out that the pain caused by the swollen glands impels the animals to get rid of the secretion of these glands by pressing and rubbing movements. So here, too, there is no question of the irresistible beginning of a purposive instinct but of a subjective activity on the part of the bird, of a significant reaction to a painful stimulus, a reaction which may, however, be purposeless.

One of the chief examples of instinct, the piercing reaction of the lanneret (*Lanius collurio* L.) has since been proved, in complete agreement with my theory, to be the result of suitable actions according to the principle of trial and error, knowledge of the thorn being only acquired after long investigation (Lorenz). Another pillar of the instinct theory has therefore fallen.

A splendid new example of instinct analysis according to my theory is solving the famous problem of the *cuckoo's egg*. This was formerly a problem which evidently defied solution. How is it that the cuckoo's eggs found in other birds'

nests always correspond in colour to those of the owner of the nest? How can the cuckoo sometimes put bluish-green eggs, then again white ones with brown spots, or speckled or unspeckled ones into the strange nest? If the eggs differed from those of the host, they would, of course, be thrown out of the nest. But it is just these fundamental problems that have been solved quite naturally. Each cuckoo has been bred in a certain kind of nest and has been fed with a certain kind of food. This influences the colour of the eggs, for example, the bluish-green colour of the garden redstart's eggs. We now know almost for certain that for the purpose of laying her eggs, the cuckoo generally only chooses a nest like the one in which she herself has been reared and with which she is therefore familiar. This is easily explained. So her eggs are laid beside eggs of a different nature but of the same colour, and are therefore not thrown out by the host but hatched by her. In this way, a particularly complicated problem has been solved in a perfectly natural way in conformity with my theory, according to which purely physiological factors (the same colour resulting from the same food) generally co-operate in these complicated cases with psychologically motivated reactions (choice of the familiar kind of nest). Here, therefore, we have series of truly voluntary actions, and analysis has led to the solution of the problem.

It is therefore evident that there is always a *personal reason* for the action, and that nothing takes place *without* such a motive.

The second decisive point is the *reaction* to emotion. Every action is *always* and *only* the response to an emotion. Where the psychological basis is very narrow and slight and the physical possibilities very unmistakably re-formed, the response may be of an exceedingly stereotyped nature. In such cases the impression gained from superficial observation will be that the actions are really mechanical.

It is well known that ichneumon flies sting strange caterpillars or grubs which they find beneath the bark of a tree. The explanation of this mystery was found by means of an experiment which once more proved the exclusive effect of personal impulse. In this case, the impulse was provided by the smell of the victims. It was proved that the ichneumon flies also stung small paper cornets filled with the blood of the caterpillars or grubs, this blood providing the characteristic smell. If there were an instinct or some complete reaction unconsciously serving a vital purpose, it would necessarily *include* the strange insect as the *object* of the action, for without this insect as its object the action itself would be *useless*. It is therefore clear that here too the stimulus merely

leads to its own satisfaction irrespective of an object or purpose, whereupon a true inner organ reflex action takes place, which causes the laying apparatus to function.

The well-known experiment made in Germany a few years ago with *young storks* in order to subvert their instinct to an *experimentum crucis* ended in a real catastrophe for this conception. The bird which had been brought from east Prussia to the Rhine and which had not hitherto migrated should have moved in a south-easterly direction according to the instinct theory. This is usual with storks the home of which is in eastern Germany, a fact hitherto explained by the 'instinct of direction', that is a south-easterly instinct. The result, however, was that the storks scattered in all directions. Some were sighted in the Alps, some in France, but not a single one in the east. The reason for this is that all the storks in eastern Germany, being 'water-birds', must naturally move along the river valleys, etc., where they find their food, and finally in the direction of the Black Sea and the Bosphorus, whereas when taken to western Germany they pursue the opposite course, that is like the west-German storks, they fly along the Rhine-Rhone valley to the western Mediterranean and North Africa. In this case, however, the most natural thing was for them to scatter, as storks 'traditional flyers', mostly migrate under the leadership of old ones, and this leadership was lacking.

THE PROBLEM OF PURPOSE

In all these occurrences in Nature as well as in all experiments, we have repeated evidence of the uncertainty with which biological aims are achieved. A glance at 'fundamental instincts' will prove this; for example, the important and decisive *food instinct*, where the fundamental divergence between the significant reaction to stimuli (taste and smell) and the biological utility of this procedure is clearly evident. Every living creature, from the protozoan to man, directs its actions primarily and exclusively according to such subjective stimuli; only in the second place does the problem arise as to how far satisfaction of the stimulus is conducive to health. Even in the animal kingdom this problem may become a momentous one, as when certain tribes of ants cause the downfall of their community through excessive consumption of the intoxicating secretion of the plant-louse. It must be remembered that there is no question here of *abnormal behaviour*. On the contrary, it is in such extreme cases that the fundamental law is most clearly evident, the law of reaction to a sensation.

The frequently destructive behaviour in the animal's *care of its young* is perhaps the most

striking example of all. The fact that with many species the devouring of eggs and offspring is not an abnormality, but almost a normal procedure, with ants, bees, bumble-bees, also with some kinds of fish, is clearly in favour of the exclusive principle of the subjective satisfaction of impulse, a principle which rules even in opposition to elementary biological purposes.

On the other hand, I have already given a detailed description of cases in which 'genuine' care of the brood, that is the care of the young animal itself, as well as genuine friendship and love in animals, are found.

With regard to the problem of the so-called instinctive goal, *migration of birds* of passage is of special interest. It used to be said that the true migratory instinct determined both, the *passage* and its *destination*. But there is scarcely another instance which proves so unmistakably that all is variable. At most it can be said that the impulse of flying is constant, the impulse which is the fundamental phenomenon of the migration, and which I have already described in detail elsewhere. This impulse signifies the beginning or breaking forth of a *completely undirected* storm of motion—probably due to the action of hormones. In this storm the moving stimulus is once more recognizable, the stimulus to which all migration is the natural reaction. But the two factors essential to the instinct, that is, the *way* and the *goal*, are by no means pre-formed. On one hand, suitable adaptation to circumstances is again possible, leading to the only action which is biologically (relatively) expedient. On the other hand, the loss is naturally very great, due to the difficulties of the flight and to the inadequate intelligence of the birds, which are not able to gauge the difficulties that face them. Frequently they make fatal mistakes, as when the great flocks of singing birds fly over the Black Sea by night and perish in thousands, because their wings are frozen. The bird knows nothing, it neither recognizes its danger consciously, for it evidently does not even know that it is flying over a great expanse of water, nor does instinct guard it unconsciously, but all the more surely, from destruction.

RESULTS

So the nature of organic action proves to be quite different from what has always been assumed. For the assumption of instincts makes the living creature an automaton, which, if properly constructed, cannot make mistakes. (The famous struggle for existence constitutes only an apparent exception. For it is those individuals who have been most favourably predisposed from the beginning which automatically survive through the

process of selection. There can scarcely be any question of a real struggle.) The theory which I have propounded, that of the *risk* of organic life, is something fundamentally different. For every organism, from the lowest to the highest, acts in conformity with it, according to the same principle of adaptation to circumstances under the *egis* of subjective impulses and experiences. Thus we have genuine reflection and genuine risk. We also have error as a necessary ingredient of life, not as the abnormal breaking-down of an automatic machine. A real risk, and in consequence a real struggle worthy of the name, are only possible where there is that which in its highest sense is called free will. It always rests on the same principle—the possibility of *selection* among various reactions. What we term *psyche* or *consciousness* is needful, that is real psychological experience, the recollection and estimation of which leads to the corresponding action.

What becomes of organic purposiveness? The only thing we must state as an indisputable fact in Nature is the presence of a certain pre-formed harmony. Every living creature is born with an organism which enables it to exist within certain limits. Part of this constitution is a disposition to experience certain stimuli. The fact that sugar has a sweet taste and therefore a pleasant one rests on constitutional factors. But the behaviour which satisfies such pleasurable impulses and wards off painful ones is by no means, and cannot be, pre-formed, for the ever-changing circumstances of life necessitate a constantly renewed adaptation to them.

I must once more state emphatically that the instinct hypothesis is in direct contradiction to every result of the modern theory of heredity. It has been proved again and again that only a certain disposition to receive impressions on one hand, and to general emotional attitude and bent of mind on the other is inherited; for example, a profoundly emotional nature or a generally intelligent disposition. We have never known, especially in practical life, anything like an inborn impulse to action or hereditary knowledge. We may inherit a talent for languages, but not a knowledge of French. Neither can knowledge that an object is there for a special purpose be inherited; for example, the hen has not inherited the knowledge that sitting on an egg will hatch it. We see that man's knowledge and actions emanate from his mental and emotional disposition and as their result, but nothing more. There is no 'born murderer' as such, except in so far as a man is predisposed to murder by his general mental and emotional life. Instinct has been defined as 'inherited experience'. Science has proved that such a thing does not exist.

The Aurora Polaris and the Light of the Night Sky

THE relation of the aurora to the light of the night sky formed the topic of a Geophysical Discussion at the Royal Astronomical Society on May 19, under the chairmanship of Lord Rayleigh. Prof. S. Chapman opened the discussion.

Owing to its often striking appearance, the aurora polaris has long been studied. Dr. J. M. Stagg gave an account of its appearance and changes as observed at Fort Rae, near the auroral zone, during the second International Polar Year (1932/3); one remarkable feature he described was the occasional repetition, on two successive nights, of unusual and distinctive auroral appearances.

The situation of auroral arcs and rays and sheets and diffuse clouds has for many years been determined with considerable accuracy by the methods introduced by Prof. C. Störmer, whose long-continued and fruitful work was rewarded, not long since, by the discovery that the very high auroras, extending up to 600 km. or even more, are generally in the part of the atmosphere which, though visible from the ground after sunset or before sunrise, is still illumined by the sun's rays.

Naturally, the auroral light was also examined by the spectroscopist; the spectrum includes several bands, some of which have long been known to be the so-called negative bands emitted by excited positive molecular ions of nitrogen (N_2^+); in addition, it contains a bright yellow-green line.

A similar line was found to be present in the light of the night sky. But in other respects this light differs considerably from the auroral light, as was first clearly emphasized by Lord Rayleigh; it does not contain the N_2^+ bands: it is diffuse and formless, but always present, in all latitudes; its variations are much less rapid and less great than those of the aurora.

The wave-length of the green line in the night-sky spectrum was determined very accurately in 1923 by Babcock, using an interferometer; it is 5577.35, and its width is very small, only 0.030 Å. A few years ago, Harang and Vegard (who has been one of the most assiduous and successful workers on the auroral spectrum) determined the wave-length of the green auroral line in the same way, and thus proved that the line is the same in the two spectra. These interferometer measures show that the line is of atomic origin and not part of a molecular band. Harang and Vegard have also demonstrated the atomic character, and found the accurate wave-lengths, of two red lines, 6300 and 6364, in the auroral spectrum.

The same two lines, and also the yellow double of neutral atomic sodium, have been observed interferometrically in the night-sky spectrum: this was done in France, where several spectroscopists of the highest skill—Cabannes, Dufay, Gauzit and Bernard—are studying this light. The lines named above are the only ones in the auroral or night-sky spectra the atomic character of which has been established by use of the interferometer. The suspected presence of a line due to atomic nitrogen has not yet been confirmed or disproved by this method.

Recent years have seen a great advance in the accuracy with which the lines and bands in the two spectra are measured, and in the range of the spectrum observed. For the night sky, the observations have been extended far into the ultra-violet (notably by Gauzit) and into the infra-red (by Slipher). Gauzit has made the remarkable discovery that the night-sky spectrum extends to at least 2950 Å. in the ultra-violet; he suggests that this light comes from the lower part of the ozone layer, which would absorb such light if it came from above (as it absorbs the sunlight of the wave-length, during the day).

The origin of the green line 5577 long remained mysterious, and it was not produced in the laboratory until 1925, when McLennan, with Ireton, and others of his Toronto fellow-workers began a brilliant series of researches which, aided by other discoveries of the time, by Frerichs, Rubinowicz, and Bowen, established that the line is due to neutral atomic oxygen. The atomic transition involved is from the metastable ^1S state, with a mean life-time of about 1 second, to a ^1D state, lifetime about 100 seconds, these times having been calculated by Stevenson. Transitions from the latter state to the (multiple) ground state $^3P_{2,1}$ give the red lines 6300, 6364 already mentioned. Thus the nature of the atomic lines in the auroral and night-sky spectra is now definitely ascertained.

Kaplan's laboratory experiments on nitrogen mixed with oxygen have closely reproduced the two spectra, and in particular have led to the recognition and understanding of some of the principal (Vegard-Kaplan) bands in them. Though some important bands still remain unidentified, it seems likely that all the principal bands, in both spectra, are due to molecular nitrogen (neutral in the night-sky spectrum, and both neutral and ionized in the auroral spectrum). The two spectra differ greatly in the degree of excitation involved: that of the night-sky spectrum (about 7 volts

being much less than for the auroral spectrum (about 20 volts).

Dr. W. C. Price described the energy-level diagrams for nitrogen and oxygen, indicating the nature of the various nitrogen emission bands, and also explained how the oxygen molecules, but not the nitrogen molecules, become dissociated by sunlight in the high atmosphere; both also become partly ionized, the nitrogen in the *F* layer and the oxygen (O_2) in the *E* layer. The energy of the night-sky light probably comes from the recombination of some of the oxygen atoms throughout the night, and Chapman has outlined the processes by which this energy can be transformed into the observed light. The auroral light is probably due to the impact upon the molecules in the high atmosphere of fast-moving particles coming from the sun.

The temporal variations in the intensity of the night-sky light have been studied in a remarkable series of researches, carried on for eleven years under the exceptional difficulties of English skies, by Lord Rayleigh. He devised a simple instrument, which was described by the Astronomer Royal, containing a permanent weak comparison light-source (a radioactive uranium salt) and which by means of six simple colour filters enabled the intensity of the faint night-sky light, in three spectral regions, to be estimated within a range of no fewer than thirteen grades. Copies of this instru-

ment were used by other observers, and notably for about eight years at the Cape and Canberra Observatories, in a co-operative research organized by Lord Rayleigh. Variations of annual, semi-annual and eleven-year (sunspot) periods were observed, as well as irregular day-to-day changes. McLennan, and independently Lord Rayleigh, also found a variation during the night, with maximum at 12 or 1 p.m., which has since been confirmed also by Russian observers. In addition, Lord Rayleigh made the very difficult determination—of great theoretical interest—of the absolute photometric intensity of the green night-sky light (5577); this indicated that 1.8×10^{12} atomic oxygen transitions ($^1S_0$ to $^1D_2$) occurred per second in each square centimetre column of the atmosphere.

In Lord Rayleigh's own contribution to the discussion, he stressed the difficulty of work on the night-sky spectrum, owing to its faintness, which makes it impossible, in the ordinary way, to get luminous spectra with much dispersion, unless large and expensive prisms are used. He considered that his father's tube-spectroscope might find a useful application in this field; this instrument consists of a tube, with lenses at each end, which contains numerous, perhaps twenty, glass prisms in a liquid, carbon disulphide, of very similar refractive index; it can give great dispersion with little loss of light.

Obituary Notices

Sir Robert Bolam, O.B.E.

THE death of Sir Robert Bolam, which took place at his home in Newcastle-upon-Tyne on April 28, not only removes an outstanding personality of the medical profession from the north of England, but also one who by reason of his activities in larger spheres of medical interest had made a name known and respected in the profession all over Great Britain.

Bolam's name will always be connected with the two bodies to which he gave such long and valued service, the General Medical Council and the British Medical Association. He was first a member of the General Medical Council in 1920, being elected as a direct representative for England; then from 1928 until his death he represented the University of Durham. It was only natural that his acumen and capacity for attention to detail led ultimately to his appointment as Chairman of Business, and this no doubt, had he lived, would have been followed by yet higher honour in the Council.

In the British Medical Association, Bolam was an active member for forty years, and here again his administrative ability, shrewdness and clear thinking soon brought him into prominence. He became a

member of Council in 1915, acted as chairman of the Journal Committee and of the Hospitals Committee; finally in 1920 he became chairman of the Council. His energy and initiative were responsible for the transfer of the Association's headquarters in London from the Strand to its present site in Tavistock Square. In this move to what is now rapidly becoming the intellectual quarter of London, Bolam displayed foresight and faith which have since been justified abundantly.

In spite of the energy which Bolam expended in the services to the General Medical Council and the British Medical Association, either of which would have been an ample occupation for a man of normal activity and talents, he gave his best services over a long period of years and in many capacities to his old school, the University of Durham College of Medicine and the associated Royal Victoria Infirmary. The posts he held were various; in the College of Medicine he was in turn lecturer on physiology and pathology, joint lecturer on physiological physics and chemistry, professor of medical jurisprudence, sub-governor of the museum, while in the Infirmary he was assistant physician and pathologist. Later he

became the first honorary physician in charge of the Skin Department and held this position until his retirement from the Infirmary staff in 1931. The accompanying lectureship in dermatology in the College of Medicine he held from 1914 until 1937.

But as in London, so in Newcastle, Bolam was outstanding in his committee and administrative work. He was an active member of the senate of the University for many years and in 1931 was made pro-vice-chancellor, and was vice-chancellor in 1936-37. He acted as registrar of the College of Medicine in succession to Prof. R. Howden, and in 1934 was elected its president.

During the years following, Bolam's main object was to see the College rehoused on a site facing the Royal Victoria Infirmary, and to this task he applied himself with his customary vigour and enthusiasm.

Following the merging of the College of Medicine and Armstrong College into the present King's College in the University of Durham, Bolam continued as chairman of the Building Board, in which capacity he was able to see the realization of his dreams. In spite of periods of ill-health during the last six months, he was able to receive H.M. King George VI and H.M. the Queen and to conduct them around the finished building on the occasion of the official opening in February of this year.

An obituary of a man of such widespread activity as Sir Robert Bolam must necessarily tend to take the form of a catalogue of his services, in the recital of which the personal character is not given due weight. To those who knew him well, the memory of Bolam will be found not in a monument of brick or stone, not in the records of the minute books of the many committees on which he served or which he directed, but in the personal memory of the man himself. In this, his statesmanship, sincerity and directness of purpose will be remembered, but his never failing courtesy and kindness will above all be abiding to those who may claim to have been honoured by his friendship. R. B. GREEN.

Sir William Butler, Bart.

THE death on April 5 of Sir William Waters Butler, Bart., deprived Birmingham, its neighbourhood and its University, of one of their most generous philanthropists.

Educated at King Edward's School, Birmingham, Sir William entered his father's business, which later became Mitchells and Butlers, Ltd., brewers. Further studies in the sciences were pursued at the evening classes held at the Midland Institute, and he became a fellow of the Chemical Society. To the last he maintained an interest in the technology of his trade, and on more than one occasion told me that the most pleasant times in his routine week were spent in the brewery discussing technical matters on Sunday mornings when the distractions of workaday business activities could be temporarily banished.

The British School of Malting and Brewing at the University of Birmingham, set up by subscription from a number of brewing firms in 1899, was strongly

supported from the first by Sir William's firm. In 1919, he initiated the endowment of the Adria Brown chair of brewing, and in 1926 personally defrayed the entire cost of the new Department at the Edgbaston site. Without this donation, the erection of the new biology block there would have been virtually impossible. He also made repeated donations to various departments of the University; two of his most recent ones, £10,000 each, were respectively for the endowment of scholarships in science and commerce and for the University Medical School. In addition he had served since 1917 on the Council of the University, and was known to possess wide sympathies in all educational matters, and to be ever ready with business advice and help.

R. H. HOPKINS.

Mr. G. E. Blundell

THE National Museum of Wales has lost a good friend by the death of Mr. G. E. Blundell. For many years science master at Wellington College, Blundell retained his interest in scientific matters when he became lord of the manor at Newton Nottage near Porthcawl, paying special attention to chemistry and geology, and eventually to archaeology. He was a keen observer, always ready to bring new discoveries to the notice of those to whom the information was likely to be useful, with the result that although he seldom published the results of his own investigations, he contributed much that was of real value to the work of others.

It was this generous attitude that brought Blundell into contact with the National Museum of Wales. In 1922, when the Museum was preparing to open its doors for the first time, he became a member of the committee concerned with archaeological matters, and in 1926 he was elected to a seat on the Council.

As an example of Blundell's indirect contributions to archaeology we might take the discovery, made in association with his wife (a daughter of the late R. H. Tiddeman of the Geological Survey), of bronze objects and fragments of crucibles with adherent bronze, associated with fragments of iron and slag, pot-boilers and bones, in the sand dunes at Merthyr Mawr in Glamorgan. This proved to be the first Early Iron Age settlement to be found in Wales, and it was afterwards described by (Sir) Cyril Fox in "*Archaeologia Cambrensis*" in 1927.

To geology, Blundell rendered useful service by recording excavations made in the vicinity of his home, and by his interest in the early history of the subject. The latter is understandable since he was related to the descendants of William Buckland, and as a result of it, interesting manuscripts relating to Buckland's work in Wales have been deposited in the National Museum of Wales by Dr. Mervyn H. Gordon, one of the Dean's grandsons. F. J. N.

We regret to announce the death of Prof. S. L. Loney, professor of mathematics in the Royal Holloway College (University of London), from 1888 until 1920, on May 16, aged seventy-nine years.

News and Views

Dr. E. D. Merrill

THE Linnean Medal of the Linnean Society of London was presented to Dr. E. D. Merrill through a representative of the American Embassy on May 14. When in 1900 the new administration of the Philippines established a scientific service, Elmer Drew Merrill, then fresh from college, was one of those appointed. The botanical position there had been rendered difficult because of two fires; one in 1897 had destroyed the herbarium of the Forestry Bureau, Manila, and the other had destroyed the herbarium of the Guadalupe Convent during the Spanish-American War of 1898. Thus in the space of two years the work of Vidal and of the priests who had followed Blanco was largely obliterated. The problem facing young Merrill was one which would have daunted many much more experienced taxonomists, but he faced it with characteristic energy and common sense. To know what the older explorers had found and described necessitated visiting the same areas and making large collections. Thus not only did he collect in all parts of the Philippines as they became accessible, but also the extensive herbarium he built up contained specimens from all adjoining areas. His first administrative post was that of Director of the Bureau of Science, Philippine Islands, to which he was appointed in 1919. He rounded off his botanical work for the islands by the publication of "An Enumeration of Philippine Flowering Plants" (1925-26) in four volumes.

In his intensive studies of the Philippine flora, Dr. Merrill did not confine his attentions to Philippine plants but investigated also the neighbouring Indo-Malayan floras. Borneo, Amboina (where Rumphius had worked in pre-Linnean times), and Indo-China (where Loureiro had botanized) all received his attention. His "Bibliographie Enumeration of Bornean Plants" appeared in 1921, and at intervals between 1917 and 1935 he published his invaluable interpretations of the species of the earlier Asiatic botanists whose specimens, from one cause or another, had largely disappeared. In 1917 came his "Interpretation of Rumphius's Herbarium Amboinense", in the following year his "Species Blancoanae", in 1921 his "Review of the New Species of Plants Proposed by N. L. Burman in his Flora Indica", and in 1935 his commentary on Loureiro's "Flora Cochinchinensis". Since leaving the Philippines Merrill has filled arduous administrative posts, first as dean of the Faculty of Agriculture in the University of California, then as director of the New York Botanic Garden and now, as administrator of botanical collections of Harvard University. In all these he has worked with the same energy and success. At the same time he has contrived to do what many holders of high administrative posts find impossible: to continue his old scientific work. During this latter period he has turned his attention chiefly to the botany of south-eastern China, and in

collaboration with the enthusiastic young Chinese botanists has published numerous contributions on the flora of the region; and only a year ago he published, with E. H. Walker, a comprehensive "Bibliography of Eastern Asiatic Botany", of more than seven hundred pages.

Rev. E. O. James

THE Rev. Ernest Oliver James, professor of the history and philosophy of religion in the University of Leeds since 1933, has been appointed Wilde reader in natural and comparative religion in the University of Oxford for a period of three years as from October 1 next. Dr. James is well known for his studies in comparative religion in the school of Robertson Smith and Sir James Frazer. He was president of the Folk-lore Society in 1930-32, has edited *Folk-Lore* since 1932, and presided over the section of religions in the International Congress of Ethnological Sciences which met in London in 1934. In 1916-20 Dr. James acted as a secretary of the Anthropological Section of the British Association, and in 1928 was an extra-mural tutor in anthropology in the University of Cambridge. From 1911 until his appointment to a professorial chair, Dr. James was engaged in pastoral work in the Church, among the parishes of which he was incumbent being Limehouse in the East End of London, where between 1917 and 1921 his activities in eradicating the gross abuses prevalent among the Chinese population attracted no little public notice. He is the author of a considerable number of works on anthropological topics, among which may be mentioned "Primitive Ritual and Belief" (1917), "An Introduction to Anthropology" (1919), "The Stone Age" (1927), "The Origins of Sacrifice" (1933), "Christian Myth and Ritual" (1933), "The Old Testament in the Light of Anthropology" (1935) and "Introduction to the History of Religions" (1938).

U.S. National Academy of Sciences: Medal Awards

THE following medals of the National Academy of Sciences were presented at the annual dinner of the Academy on April 25: *Agassiz Medal*, for oceanography, awarded to Harald Ulrik Sverdrup, of the Scripps Institution of Oceanography of the University of California, La Jolla, for his personal oceanographic explorations in Arctic regions and his numerous contributions to physical oceanography and the inter-relations between the sea and the atmosphere; *Daniel Giraud Elliot Medal* for 1933, and accompanying honorarium of 200 dollars, awarded to Richard Swann Lull, of the Peabody Museum of Natural History, Yale University, in recognition of his work entitled: "A Revision of the Ceratopsia or Horned Dinosaurs", published in the *Memoirs* of the Peabody Museum of Natural History; *Daniel Giraud Elliot Medal* for 1934, and accompanying honorarium of 200 dollars, awarded to Theophilus Shickel Painter, of the University of Texas, in recognition of his work

on the chromosomes of the salivary glands in *Drosophila* in relation to the problems of mutation and genetics, published in *Genetics* and the *Journal of Heredity* in 1934; *John J. Carty Medal*, and award for the advancement of science, consisting of a gold medal, bronze replica, certificate and 3,000 dollars, awarded to Sir William Bragg, of the Royal Institution, London, for his fundamental work in X-ray crystal analysis; he has shown how to reveal the constitution of crystalline forms and accurately measure them, and his studies have given birth to a new tool which is bringing to light important facts regarding such complex structures as the larger organic molecules.

U.S. National Academy of Sciences: Elections

At the annual meeting of the National Academy of Sciences, Dr. Frank B. Jewett, president of the Bell Telephone Laboratories, was elected president for a term of four years, to succeed Dr. Frank R. Lillie, emeritus professor of zoology of the University of Chicago, who will retire on June 30. The following were elected members of the Academy: Gregory Breit, professor of physics, University of Wisconsin; Detlev Wulf Bronk, Johnson professor of biophysics and director of the Johnson Foundation, University of Pennsylvania; William Bosworth Castle, associate professor of medicine, Harvard Medical School, director of the Thorndike Memorial Laboratory, Boston City Hospital; Frederick Gardner Cottrell, president, Research Associates, Incorporated, Washington, D.C., consulting chemist, Bureau of Chemistry and Soils; Frederick Parker Gay, professor of pathology and bacteriology, College of Physicians and Surgeons, Columbia University; Albert Baird Hastings, Hamilton Kuhn professor of biochemistry, Harvard University; Vladimir Nikolaevich Ipatieff, research director of the Universal Oil Products Company, professor of chemistry, Northwestern University; Merkel Henry Jacobs, professor of general physiology, University of Pennsylvania; Zay Jeffries, General Electric Company, Cleveland, Ohio; Donald Forsha Jones, geneticist, Connecticut Agricultural Experiment Station, New Haven; George Bogdan Kistiakowsky, professor of chemistry, Harvard University; Warren Judson Mead, professor and head of the department of geology, Massachusetts Institute of Technology; Oscar Riddle, investigator, department of genetics, Station for Experimental Evolution, Carnegie Institution, Cold Spring Harbor, N.Y.; Adolph Hans Schultz, associate professor of physical anthropology, School of Medicine, the Johns Hopkins University; Philip Edward Smith, professor of anatomy, College of Physicians and Surgeons, Columbia University.

The following were elected foreign associates: Sir Joseph Barcroft, professor of physiology, University of Cambridge; Sir William Bragg, director, Royal Institution of Great Britain and Fullerian professor of chemistry and director of the Davy Faraday Research Laboratory; Dr. F. A. Vening Meines, professor of geodesy and cartography, the University of Utrecht.

Franklin Medals

FRANKLIN Medals have been awarded by the Franklin Institute, Philadelphia, Pa., as follows: Edwin Hubble, Mount Wilson Observatory, Carnegie Institution of Washington, Pasadena, "In recognition of his extensive study of the nebulae, particularly those outside our galaxy, as a result of which the dimensions of observed space have been greatly increased"; Albert Sauveur (posthumously), professor emeritus of metallurgy and metallography, Harvard University, "In recognition of his outstanding work in the science of metallography and of his many contributions to this branch of metallurgy which have been in a large measure responsible for changing the heat treatment of steel from an art to a science".

Rare Frankliniana

VISITORS to the recent exhibition of "Frankliniana" at New York City's Grolier Club (March 16-April 1) were impressed alike by the incomprehensible versatility of Benjamin Franklin's genius and by the fascinating rarity of many of the exhibits displayed. Printer, journalist, statesman, advocate of inoculation, inventor, and the most widely travelled American of his day, Franklin crossed the Atlantic Ocean eight times. That he was not unaware of the perils of travel is revealed by an obsolete will "written by my own hand while waiting for a passage to England" in 1757. By his classic kite experiment in 1748 he proved the identity of lightning and electricity, and his book "Experiments and Observations on Electricity", London, 1751, with a preface by his physician and friend Dr. John Fothergill, carried his fame over the civilized world. "Somerset Account of the Pennsylvania Hospital", Philadelphia 1754, recalls that Franklin was instrumental in founding what is regarded as the oldest hospital, in the modern sense of the term, in the present United States. He served as the first clerk to the board of management and later as president. "Proposals for Promoting useful Knowledge among the British Plantations", 1743, is believed to be the earliest suggestion in printed form for an American Philanthropic Society, to which the author offers his services as secretary. The pamphlet shown is described as one of two copies known. His first book "Dissertation on Liberty and Necessity, Pleasure and Pain", London, 1725, the young Franklin grew to dislike so violently that he destroyed all remaining copies except one. Other exhibits included a selection of his famous almanacs, so rare to-day, though originally issued in editions of 10,000 copies.

Chaston Chapman Gift to the University of Leeds

IN 1933 Mrs. Chaston Chapman presented to the University of Leeds her late husband's extensive working library of modern books on chemistry together with complete runs of a large number of periodicals. Mrs. Chaston Chapman has now presented his collection of works on alchemy to the University of Leeds, where they are housed in the Brotherton Library. There is a small section of French books and a more extensive section of

English books. Noteworthy among the latter are "The Mirror of Alchimy, Composed by the thrice-nous and learned Fryer, Roger Bacon", London, 177; the rare "Secrets Reveal'd: or, An open entrance to the Shut-Palace of the King: Containing the greatest Treasure in Chymistry, Never yet so fully Discovered", 1669; Plat, "The Jewel House of Art and Nature", 1653; and many other rare works. Translations into English include Geber, "The Works of Geber, the most famous Arabian chemist and philosopher", 1678; Beguin, "Tyroium Chymicum", 1669; Paracelsus, "The Chymical Transmutation of Metals", 1657; Glauber, "The Golden Ass Well Managed", 1670; Geener, "The newe Jewell of Health", 1576; Le Febvre, "A compleat Body of Chymistry", 1670; the 1677 and 1686 translations of Lemery, "A Course of Chymistry" and "New Curiosities in Art and Nature", 1711, by the same author.

Of large folios from the Chaston Chapman Collection there are good copies of the works of Agricola, Cardanus, Josephus, Lucretius, Manget, Paracelsus, Pettus, Petronius, Sennert, van Helmont, and others. There are some two hundred works by German and Dutch seventeenth-century authors. Becher and Stahl, the two founders of the phlogiston theory, are well represented. There are also certain editions of the strange work "De secretis", composed by Alexis of Piedmont, a narrative revelation to the world of the secret remedies that might have saved a patient's life. Special attention was also paid by Mr. Chaston Chapman to Black, Boerhaave, Boyle, Newton, and Priestley, and there is an interesting series of old and modern books on brewing and fermentation, commencing with "A Perfitte platforme of a Hoppearden", 1578. A whole case is devoted to the Royal Society, with the first, second, and fourth editions of Sprat's history of the Society. With the single exception of Lord Brotherton's books, this carefully selected library is the most valuable collection of rare books that the University has ever received.

Bledialoe Medal for Native Agriculture

In the recently issued report of the Rhodesia-Nyasaland Royal Commission (see NATURE, May 20, p. 829) stress is laid by members of the Commission on the expression of their individual views regarding certain matters, on the importance of the development of the native for the future of all three territories like. In this development, agriculture and native husbandry are assigned the foremost place, more specially in the two protectorates, of which the future prosperity can only be based upon agriculture. In the memorandum appended by the chairman, Lord Bledialoe, and Mr. P. A. Cooper, it is said that Education is a crying need of the African, but its foundation should, in his case, be knowledge of the land and its proper treatment on the one hand and of the basic principles of nutrition and hygiene on the other. These lessons are even more vital to his true welfare than reading and arithmetic, and should

take precedence of them." They go on to point out that they are inclined to the view that both land and labour are at present wasted, adding a caution against dogmatic pronouncement that large areas of territory are permanently unsuited to human occupation or economic utilization. In order to encourage the development of the native as agriculturist, Lord Bledialoe has now instituted a silver medal for presentation annually in appropriate numbers to the chiefs of the various tribes of Southern Rhodesia who have done most to induce their tribesmen to adopt improved methods of husbandry. The medal bears on its obverse the figure of a native Afrikaner bull with the inscription "Southern Rhodesia Mutungamiri Umtungameli", the Bantu and Sindabele terms for leader or guide. The reverse bears an ear of maize and the inscription "The Bledialoe Medal for the Advancement of Native Husbandry".

Treasure at Delphi

A DISCOVERY, which would seem to be remarkable even in the annals of Mediterranean archaeology for the quantity of objects of gold brought to light, is reported from Delphi, where excavations have been in progress under Prof. Delacotte on behalf of the French School of Archaeology at Athens during the past two years. A dispatch from the correspondent of *The Times* in the issue of May 10 states that in the course of raising and relaying the pavement of the Sacred Way from the eastern side of the Sanctuary in the direction of the Temple of Apollo in a search for inscriptions, a cavity has been found in the centre of the Stoa of the Athenians, in which was a mass of objects, covered with dust and ashes, and including a large number of gold articles. Of these the most important is the gold overlay of a chryselephantine statue, of which the ivory has been carbonized. The robe, diadem, ear-rings, bracelets, curls, heads and flowers, which formed the decorations of the robe, and the girdle, all in gold, have been recovered. A bronze statuette holding a receptacle for the burning of aromatic woods, which is complete and of remarkable workmanship, is dated at 500 B.C. In addition, there is a quantity of material in clay, copper and bronze. Expert opinion at present is that the finds show evidence of Oriental influence, possibly originating from the Greek cities of Asia Minor. A further discovery is a second cavity, found in working in a northerly direction from the Sacred Way, which was full of bronze and copper objects, all much encrusted, but otherwise in good preservation. Here also Eastern influence is discerned.

Television and the Provinces

MR. C. O. STANLEY, chairman of the Television Development Committee of the Radio Manufacturers Association, spoke at Manchester on May 13 outlining the great progress recently made with television. He pointed out that it is necessary to have a universal service for the whole of Great Britain in order to enable manufacturers to develop the export industry. The first step is to extend television to the provinces. While the mentality produced by experimental tele-

vision remains, the public will not purchase sets. Even if only one provincial station were started, it would show that television has been accepted and would give a tremendous stimulus to the industry. The United States has studied the possibilities of television and by next September there will be twenty stations in operation. If good progress had been made in Great Britain in providing provincial stations and services, manufacturers in this country could have produced sets in such quantities that the initiative could have been taken in the South American countries, in South Africa and in other places. Unless the rate at which we are now moving is accelerated, the stations to be provided in these places will be American stations, and if this were so, the sets now being produced in Great Britain would not work when connected to them.

Changes in Bird Population

In a civilized country, where social changes are rapid and often extensive, the wild population, whether of birds or other creatures, is undergoing constant readjustment. Much of the change passes unnoticed, and much, even if it be observed by local residents interested in natural history, goes unrecorded. The Royal Society for the Protection of Birds is doing good work in stimulating interest in the changing phases of bird population by offering the Medal of the Society and money prizes for the best paper on "Changes in the bird population of Britain during the present century, in a district or districts known to the writer, in regard to the increase or decrease of species named, what cause or causes can be assigned, and what (if any) effect has been observed". The causes which suggest themselves to the Society include—the universal use of the motor-car and the popularity of 'rambling', opening up hitherto secluded places; afforestation; road development; the disappearance of hedges; the invasion of the open country by factories; the replacement of open ditches by underground drains. There is also deliberate encouragement of birds to be reckoned with, by the creation of bird sanctuaries, the influence of the law's protection, and the altered outlook of the people towards the amenity of bird life generally. The competition should prove to be interesting and useful, although it is obvious that great care will have to be taken in sifting and adjudicating upon the causes alleged to be responsible for any change. The competition is referred to in the spring number (1939) of *Bird Notes and News*.

The National Physical Laboratory

THE report of the Laboratory for the year 1938 is a royal octavo pamphlet of 147 pages published by H.M. Stationery Office at 2s. 6d. The general report of the Executive Committee occupies 14 pages and is followed by reports of the superintendents of the separate Departments of Physics, Electricity, Radio, Metrology, Engineering, Metallurgy, Aerodynamics and Ship Propulsion, which enter into more detail, extending to 114 pages, and each concludes with a list of papers published by the Department

during the year. They seem remarkably free from obscure technical expressions and can in consequence be read with ease by the general public. The changes of staff have been more important than usual. Three directors have been in charge during the year as one superintendent has become director of research in another Government department, while industrial and Government departments have absorbed other members of the staff. Lectures on the work of the Laboratory have again been given in large industrial centres (17), and as usual a large number of requests for scientific information on points arising in industrial work have been answered by the Laboratory without charge.

Utilizing Sunshine

DR. C. G. ABBOT, the secretary of the Smithsonian Institution, has published a description of recent devices he has used in converting sunshine into power (*Smithsonian Misc. Coll.*, 98, No. 1, March 30, 1939). In general, the sun's rays are focused by a cylindrical mirror on to an axial glass tube through which, for the distillation of water, the generation of steam, water flows, and for cooking purposes a black liquid of boiling point above 350° C. The mirror is now made of flexible sheet known as 'Aloe' and the axial tube is surrounded by a concentric vacuum tube. While coal is cheap, Dr. Abbot does not expect extensive use of such device but under favourable conditions small units up to five horse-power with an efficiency of conversion of solar to mechanical energy of the order of 15 per cent and a cost of a farthing per horse-power hour may be possible. At present the initial cost of the apparatus is high, but when thousands are required prices will fall.

Books on International Relations

A "SHORT List of Books on International Relations" recommended by the Education Committee of the League of Nations Union (15, Grosvenor Crescent, S.W.1) includes 141 titles arranged in two lists, the first consisting of books for boys and girls and the second of books for students and teachers. The latter is arranged in six sections dealing with the League of Nations, with education, with international relations, with special problems, with collective security and peaceful change and with colonies and raw materials, respectively. The majority of the books are of the descriptive type, but a number of constructive critical works are included, mostly from rather a Left Wing point of view. In addition, the list gives the titles of a number of songs and celebrations as well as of maps and periodicals, and forms on the whole a useful introduction to the study of international relations.

A Mosquito Invasion of South America

THE possibility of the introduction of a disease into a country at present free from it by air-transport of the infected insect-vector has long been recognized for example, yellow fever by its infected mosquito carrier. That this menace is real and not hypothetical

is demonstrated by the fact that an African species of malaria-carrying mosquito, *Anopheles gambiae*, has become established in South America. According to the Service, this mosquito has been found at Natal, Brazil, and in localities two hundred miles west and north of Natal, and has already caused several outbreaks of malaria. This mosquito was probably introduced as a stowaway on one of the aeroplanes of the French airline between Dakar in West Africa and Natal in Brazil.

Cadmium Pigments

We have received from Messrs. Johnson and Matthey, Hatton Garden, London, E.C.1, a copy of a booklet on cadmium pigments. These have cadmium sulphide as a basis, and the sulphide itself can be obtained in any colour from pale yellow to orange. Redder shades are obtained by the incorporation of selenium, so that it is possible to get a complete range from pale yellow, through orange and red, to deep maroon. Cadmium lithopones are also available. The properties of the pigments are described.

High Vacuum Distillation

THE *Transactions of the Society of Chemical Industry* (58, No. 2; 1939) contain several papers presented last November to a meeting of the Chemical Engineering Group which dealt with the industrial applications of high-vacuum distillation. Pressures of the order of 10^{-6} mm. are concerned and the technical apparatus is described with drawings. One important application of the technique is to the concentration of vitamins from oils.

Earthquake in Solomon Islands of April 30, 1939

FURTHER news has come to hand concerning this shock. According to the Bureau central seismologique de Strasbourg, from reports received from thirty seismological stations the epicentre of the most severe shock was at 7.5° S., 159.6° E., depth of focus probably 100 km. and starting time 2h. 55m. 35s. G.C.T. According to reports from the islands, the shock and after-shocks lasted for several days. One of the islands most seriously affected was Guadalcanar, where a number of buildings were wrecked, and where a wave following the shock swamped a number of native villages. On Yasabel Island houses were damaged, and in the Cape Marsh district of the Russell Islands wharves and houses were wrecked. In the island of Savo, surface faults were visible, but there was no loss of life. Altogether nine children and three adults of the indigenous population were drowned.

Earthquake near Japan

Using reports from the seismological stations at Honolulu, Victoria, Tucson, Manila, Huancayo, Zikawei, Burlington and Philadelphia, the United States Coast and Geodetic Survey has made a preliminary determination of the epicentre and initial time as follows: lat. 37° N., long. 142° E., November 30, 2 h. 29 m. 52 s. G.C.T. The epicentre is under the ocean bed to the north-east of the coast of the

main island of Japan, and is the same as that for the earthquake of November 22, 1h. 14.1m. G.C.T. No effects of this shock have been reported from land.

Commonwealth Fund Fellowships Awards

THE Committee of Award of the Commonwealth Fund fellowships has made the following appointments, among others, to fellowships tenable by British graduates in American universities for the two years beginning September 1939: C. A. U. Craven, Imperial College of Science and Technology, University of London, to Harvard University, in geology; Dr. B. M. Crowther, Clare College, Cambridge, to the Massachusetts Institute of Technology, in physics; G. M. Henderson, University of Edinburgh, to Princeton University, in chemistry; P. B. Hunt, Christ Church, Oxford, to Columbia University, in economics; G. O. Jones, Emmanuel College, Cambridge, to the Massachusetts Institute of Technology, in engineering; J. P. Keane, University of Wales and University of London, to the University of Michigan, in economics; Edward Lee, University of Manchester, and University of Cambridge, to the University of Michigan, in physics; Nicholas Miller, Imperial College of Science and Technology, University of London, to the University of California, in engineering; D. G. Northcott, St. John's College, Cambridge, to Princeton University, in mathematics; G. W. Parnell, University of Bristol, to the University of California, in zoology; J. H. Read, University of St. Andrews, and Emmanuel College, Cambridge, to Columbia University and the American Film Center, New York, in cinematography; J. A. Scott, Trinity College, Oxford, to the University of Pennsylvania, in economics; Dr. E. V. Watson, University of Edinburgh, to Harvard University, in botany; E. R. Winton, University of St. Andrews, to the Massachusetts Institute of Technology, in engineering; N. A. Wylie, Oriel College, Oxford, to Yale University, in forestry.

THE following have been appointed to fellowships tenable by candidates from the British Dominions: H. C. Corben, University of Melbourne, and Trinity College, Cambridge, to the University of California, in physics; Dr. A. P. Guinand, University of Adelaide, New College, Oxford, to Princeton University, in mathematics. The following have been appointed to fellowships tenable by candidates holding appointments in Government service overseas: H. L. Hume, University of New Zealand, of the Public Works Department, Government of New Zealand, to the University of California, in engineering; M. R. Jacobs, University of Adelaide, and St. Catherine's Society, Oxford, of the Department of the Interior, Government of Australia, to Yale University, in forestry; C. S. Kelly, Balliol College, Oxford, of the Indian Civil Service, Government of Burma, to Yale University, in anthropology; S. L. Macindoe, University of Sydney, of the Department of Agriculture, Government of New South Wales, to the University of Minnesota, in agriculture. The following have been appointed to fellowships tenable

by candidates holding appointments in the Home Civil Service: J. G. M. Alcock, Jesus College, Cambridge, of the Board of Education; C. H. W. Murphy, Selwyn College, Cambridge, of the Unemployment Assistance Board; J. B. Williams, McGill University, and University of Cambridge, of the Colonial Office.

The Night Sky in June

THE short nights round about the summer solstice on June 22 are less than $7\frac{1}{2}$ hours in length according to the sun's setting and rising in the latitude of London, and a little more than 3 hours if nautical twilight be reckoned. The moon is full on June 2 and new on June 17. A notable occultation occurring on June 25 is that of the first magnitude star Spica (α Virginis) when the moon is 8.2 days old. At Greenwich the disappearance takes place at 16h. 12.6m. at position angle 142° from the north point and the reappearance at 17h. 14.0m. at 285° . At Edinburgh, the corresponding times and position angles are 16h. 11.3m. (133°) and 17h. 14.5m. (272°). Lunar conjunctions with the planets take place as follows: on June 6 with Mars, on June 11 with Jupiter, on June 13 with Saturn, on June 15 with Venus. In the latter part of the month, Mercury may be seen in the evening twilight, low down in the direction north of west. Venus rises in the dawn, preceded by Saturn some two hours earlier. Mars is growing brighter (-1.2 m. to -2.0 m.) and rises before midnight. Jupiter, also increasing in brightness (-1.8 m. to -2.0 m.), rises after midnight. There are close groupings of the four inner satellites about Jupiter at 2 $\frac{1}{2}$ h. on June 5, 22 and 30. On June 17 at the same hour only two of the satellites (3rd and 4th) are visible, the first two being in transit. At the beginning of June the faint comet Pons-Winnecke is near β Boötis and by mid-June near β Coronae Borealis. Comet Juriol-Ackmarof-Hassel is being lost in the sunset. On June 1 it will be about 5° north of γ Geminorum, and by June 30 about midway between Procyon (α Canis Minoris) and γ Geminorum. In mid-June at 22h., Arcturus has already southed; Antares, low down in the south, is approaching meridian passage; Vega is 3 hours before the meridian. The small beautiful constellation Corona Borealis is on the meridian. At midnight, 24h. U.T. (all times being thus expressed: add 1h. to convert to Summer Time), the star γ Draconis passes within $1\frac{1}{4}'$ of the zenith at Greenwich. Observation of this star in 1725-26, for any sign of annual parallax, led to the discoveries by Bradley of the aberration of light and, later, of the nutation of the earth's axis.

Announcements

PROF. EMMANUEL TEODORESCO, of the University of Bucharest, has been elected *correspondent* of the Section of Botany of the Paris Academy of Sciences.

THE two lectures which were to have been delivered by Dr. A. Hrdlička at University College, London, in April but which were postponed, will be delivered on May 31 and June 1 at 5 p.m. The subject of the first lecture will be "The Present Status of our Views

on Human Evolution", and that of the second "The Racial Fallacies and Realities of European Peoples". The lectures are open to the public.

THE Gresham lectures on astronomy will be delivered on May 30, 31, June 1 and 2 at Gresham College, Basinghall Street, E.C.2, at 6 p.m. by Mr. Arthur R. Hinks. The subject of the course is "Recent Discoveries of Special Interest". The lectures are open to the public.

At the anniversary meeting of the Linnean Society of London held on May 24, the following officers were elected for the year 1939-40: *President*, Dr. John Ramsbottom; *Treasurer*, Mr. Francis Druce; *Secretaries*, Mr. Isaac H. Burkill (botany) and Dr. Malcolm A. Smith (zoology); *New Members of Council*, Prof. T. M. Harris, Mr. H. R. Hewer, Prof. T. G. B. Osborn, Mr. H. W. Parker and Dr. Malcolm A. Smith.

At the annual general meeting of the Institute of Physics held on May 17, the following were elected to take office on October 1, 1939: *President*, Prof. W. L. Bragg; *Vice-President*, Prof. A. Ferguson; *Honorary Treasurer*, Major C. E. S. Phillips; *Honorary Secretary*, Prof. J. A. Crowther; *New Members of the Board*, Dr. H. Lowery and Mr. R. S. Whipple; and Mr. J. H. Awbery (appointed by the Physical Society).

THE Medical Research Council has appointed the following committee to advise and assist in promoting investigations into problems of preventive medicine: Sir W. Wilson Jameson, dean of the London School of Hygiene and Tropical Medicine (chairman); J. H. Brincker; J. Fenton; J. Ferguson; W. M. Fraser; L. H. R. Harries; A. Bradford Hill; W. D. Hood; J. R. Hutchinson; R. A. McCance; A. S. M. MacGregor; R. H. Parry; Prof. R. M. F. Picken; W. M. Scott; J. C. Spence; Prof. W. W. C. Topley; D. K. M. Chalmers, of the National Institute for Medical Research (secretary).

THE thirtieth annual Conference of the Association of Teachers in Technical Institutions will be held at Southport during May 27-30, under the presidency of Dr. E. A. Seeley of the Municipal College, Bournemouth. Further information can be obtained from the Secretary at 29 Gordon Square, London, W.C.1.

UNDER the auspices of the French Zoological Society, the thirteenth International Congress of Zoology will be held in Paris in July 1940, the actual date not having so far been fixed. Further information can be obtained from the Secretary-General, Société Zoologique de France, Institut Océanographique, 195 rue St-Jacques, Paris, V^e.

THE bicentenary of the foundation of the Royal Academy of Sciences of Sweden will be celebrated on September 23-25.

ERRATUM. In NATURE of May 20, p. 844, column 1, under "Prominences through Colour Filters" and under "Movements of Prominences", "for H λ " read "H α ".

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 901.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Reflection of Atmospherics from the Ionosphere

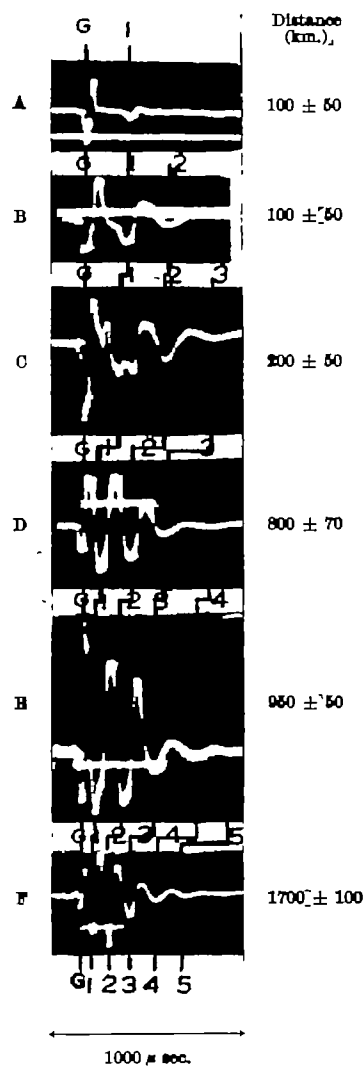
THE details of the structure of the 'oscillatory' portion of the wave-form of an atmospheric have been the subject of several investigations¹. Prof. J. H. Laby and his co-workers of the Australian Radio Research Board have made the remarkable suggestion that the observed complicated structure can be interpreted in terms of a series of reflections from an ionospheric layer of the simpler primary disturbance due to lightning. Their analysis places its height at 59-88 km.

We have worked on this question since November 1937 in conjunction with a direction-finding network which fixes independently the distance from receiver to parent thunderstorm, and arrangements have been made whereby the wave-form oscillogram corresponding to a source at a known distance is automatically marked. The height of the layer is then the only unknown quantity to be determined from the wave-form record. Several thousand oscillograms of atmospherics which have travelled from 50 km. to 2,800 km. have been examined.

A study of these records strongly supports the view of the Australian workers that the structure arises from repeated reflections, but brings to light a new feature which can be interpreted as a pronounced lowering of the effective height of the layer, h , in the neighbourhood of the parent storm. Thus we find: (1) h determined from the singly reflected sky wave is equal to 85 ± 5 km. for all direct distances between 2,800 km. and 600 km., that is, at all points of reflection from 1,400 km. to 300 km. from the source. (2) h determined from multiply-reflected sky waves is also equal to 85 ± 5 km. provided that no component reflection takes place within a distance less than 300 km. from the source. (3) For cases where reflection occurs one or more times within this critical distance of 300 km., h falls from 85 km. at 300 km. distance to 50 km. directly above the source. By examining the multiple reflections at one distance only, a model of the layer can be constructed which satisfactorily accounts for all reflections at all distances examined.

This evidence indicates that there is a real lowering of the effective height of reflection for long waves in the neighbourhood of a thunderstorm. Evidence for abnormal ionization of the layer under these conditions has already been found by many workers on short-wave pulse-sounding.

The accompanying reproduction illustrates how the first pulse of the ground-wave G is related in time and amplitude to the corresponding sky waves 1, 2, 3, 4, 5 after the atmospheric has travelled various distances. At small distances (A, B) the reflected waves are separated from the ground-wave (a single complete period of disturbance) by a quiet interval. Farther away (C to F) they form an apparently continuous damped oscillation. It can



WAVE FORMS OF ATMOSPHERICS. G , FIRST PULSE OF GROUND WAVE; 1, 2, 3, 4, 5, CORRESPONDING PULSES REFLECTED 1, 2, 3, 4, 5 TIMES BY LAYER.

be shown that this continuity is due to an effective increase in 'wave-length' of a single long-period transient on reflection, and arises if the properties of the layer vary appreciably over a distance of the order of a wave-length. The reproduction illustrates how the time-interval between successive reflections decreases with distance and can be used for the conclusions listed under (1), (2) and (3) above. In deriving h from these results, it is necessary to consider the curvature of the earth and the layer.

The relative amplitudes of the first ground-pulse G and its reflections 1, 2, 3, 4 and 5 alter noticeably with distance. At moderate distances, as would be expected, G is the largest (A, B, C). Farther out (D, E), attenuation of the ground-wave reduces its amplitude below that of the first sky wave. Still farther away from the parent storm (F) the first sky wave must graze the earth before reaching the receiver and becomes attenuated from this cause also, so that the second sky wave has the maximum amplitude.

The atmospherics which exhibit the clear evidence of reflection here discussed are all due to flashes to ground. As has been pointed out elsewhere, discharges within the thundercloud produce effects which are weaker in intensity and more complex in form.

We have to thank Mr. I. Kats, Prof. D. B. Hodges and Mr. Phillips of Howard College, Durban, and Mr. R. A. Jubb of the Meteorological Department, Southern Rhodesia, for operating the direction-finders used in locating thunderstorms.

B. F. J. SCHONLAND.
J. S. ELDER.
J. W. VAN WYK.
G. A. CRUICKSHANK.

Bernard Price Institute,
University of the Witwatersrand,
Johannesburg.

Watson Watt, R. A. Hurd, F. F., and Lutkin, F. M., *Proc. Roy. Soc., A*, 168, 237 (1937). Appleton, M. V., and Chapman, F. W., *Proc. Roy. Soc., A*, 163, 1 (1937). Laby, T. H., Nicholls, F. G., Nickson, A., and Webster, H., *NATURE*, 136, 837 (1937). Laby, T. H., Nicholls, F. G., Nickson, A. F. B., and McNeill, J. J., *NATURE*, 140, 253 (1938).

Disintegration of Nitrogen by Fast Neutrons

ACCORDING to researches published up to the present time, bombarding nitrogen with fast neutrons produces the two following nuclear reactions:

- (i) $^{14}\text{N} + {}^1_0\text{n} = {}^{12}\text{B} + {}^2_1\text{H}$
- (ii) $^{14}\text{N} + {}^1_0\text{n} = {}^{14}\text{C} + {}^1_1\text{H}$

The present paper deals with the determination of the cross-sections σ for these two processes and the total energy Q evolved in reaction (i).

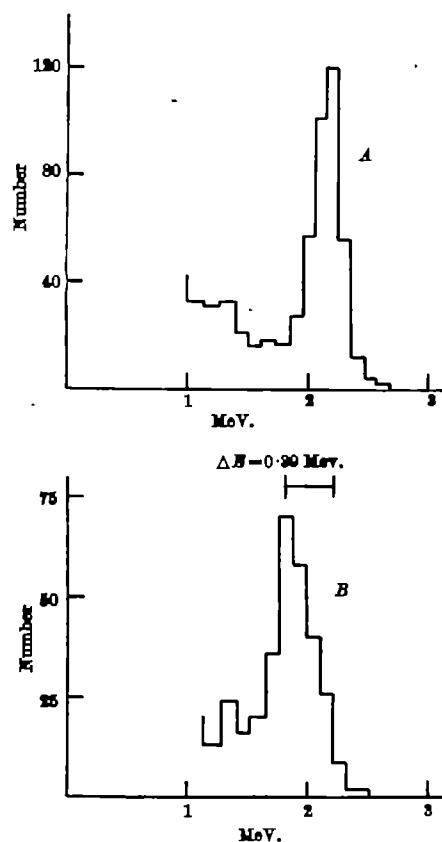
An ionization chamber filled with nitrogen was bombarded with fast neutrons obtained by the reaction ${}^2\text{D}({}^2\text{D}, {}^1_0\text{n}){}^3\text{He}$. The products of transformation were detected with the help of a linear amplifier and of an oscillograph. Both neutron source and amplifier have been described in detail in a former paper¹.

In the accompanying figures are plotted two statistics for the process $^{14}\text{N}({}^1_0\text{n}, {}^4_2\text{He}){}^{12}\text{B}$. Curve A corresponds to an angle of observation of 0° (neutronic energy 2.8 Mev.) and Curve B to an angle of 90° (neutronic energy 2.36 Mev.). By 'angle of observation' we understand the angle between the direction of the incident deuterons and the direction of observation of the emitted neutrons. The cross-section σ and the reaction energy Q for the process $^{14}\text{N}({}^1_0\text{n}, {}^4_2\text{He}){}^{12}\text{B}$ can be determined, since the intensity of the neutron source and the energy of the emitted neutrons are known. The study of a thousand of such processes gave the following results:

$$\sigma = 1.63 \times 10^{-28} \text{ cm.}^2. \quad Q = -0.43 \text{ Mev.}$$

From corresponding measurements for the process $^{14}\text{N}({}^1_0\text{n}, {}^1_1\text{H}){}^{14}\text{C}$ we found a cross-section equal to $\sigma = 0.4 \times 10^{-28} \text{ cm.}^2$.

The difference between the neutronic energies corresponding to the two angles 0° and 90° can be



OSCILLOGRAPH DEFLECTIONS AS A FUNCTION OF THE CORRESPONDING ENERGY

calculated by means of the theorems of conservation of energy and momentum. If the deuterons are accelerated by 140 kv., this energy difference is equal to 0.44 Mev. The observed difference, 0.39 Mev., is, within the limits of possible errors, in agreement with the calculated value.

A complete account of the experiments will be published in the *Helv. phys. Acta*.

E. BALDINGER.
P. HUBER.

Physical Institute,
Federal Technical College,
Zurich.
April 1.

¹ Baldinger, Huber and Staub, *Helv. phys. Acta*, 11, 245 (1938).

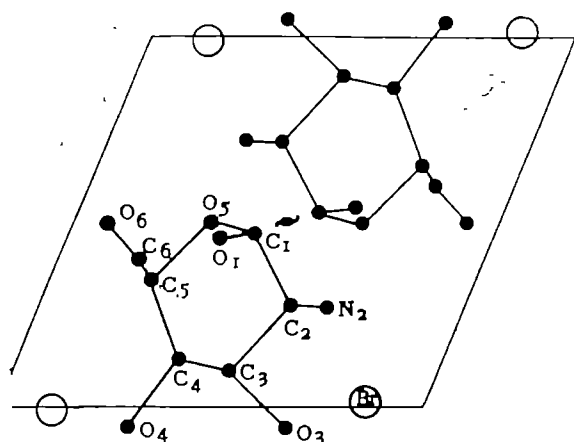
Crystal Structure of Glucosamine Hydrobromide

PROGRESS in the detailed analysis of carbohydrate crystal structures has hitherto been slow, on account of the lack of guidance from physical (optical and magnetic) properties of the crystals, the wide choice of molecular conformations on which 'trial and error' calculations might be based, the absence of outstandingly strong reflection intensities, and the asymmetry of the compounds concerned. The isomorphism of α -chitosamine hydrochloride and hydrobromide has now enabled us to determine the positions of all the atoms (other than hydrogen) in the crystal lattices of these substances by synthetic methods alone, no stereochemical assumptions being necessary.

α -Chitosamine hydrobromide and hydrochloride are monoclinic sphenoidal, space-group $P2_1$, with two molecules in the unit cell, the dimensions of which are as follows:

Hydrochloride ¹	Hydrobromide
$a = 7.06 \text{ \AA.}$	$a = 7.06 \text{ \AA.}$
$b = 9.18$	$b = 9.20$
$c = 7.11$	$c = 7.18$
$\beta = 115^\circ 25'$	$\beta = 115^\circ 35'$

About 900 reflection intensities (Cu radiation) were measured for each salt, and the structure amplitudes derived from them were employed in three-dimensional Patterson (F^2) syntheses, and two- and three-dimensional Bragg (F) syntheses. The phase angles necessary for the latter were obtained by comparison of corresponding F -values for chloride and bromide. In this way we have arrived at the structure which is shown projected on the (010) plane in the diagram.



and more precisely described by the accompanying table of atomic co-ordinates; these are accurate to about 0.01, that is, about 0.08 $\text{\AA.}$, with the exception of those for the primary alcohol oxygen atom, the position of which has not emerged quite so definitely from the Fourier syntheses, possibly because it is oscillating over an appreciable angle, as appears not improbable from its environment in the lattice. There is no doubt, however, that this atom is attached to the sixth carbon atom. The general accuracy of the analysis is vouched for by the fact that in the numerous F -syntheses performed, there occur no negative electron densities comparable in magnitude with the positive values in the atomic peaks.

Atom	x	y	z	Atom	x	y	z
Br	0.143	0	0.018	O ₁	0.55	0.50	0.48
C ₁	0.56	0.35	0.47	N ₁	0.33	0.47	0.27
C ₂	0.41	0.33	0.27	O ₂	0.30	0.30	-0.06
C ₃	0.49	0.33	0.10	O ₃	0.67	0.17	-0.06
C ₄	0.02	0.20	0.13	O ₄	0.06	0.24	0.50
C ₅	0.76	0.20	0.35	O ₅	-0.91	-0.02	-0.50
C ₆	0.81	0.04	0.40				

We are now engaged in refining this structure by utilizing structure amplitudes the phase angles of which were originally uncertain, together with others obtained with molybdenum radiation, and also by 'trial and error' methods. Meanwhile, it may be of interest to point out that the accuracy of the analysis as it stands is adequate, without the assistance of any stereochemical data, to justify the following statements:

(a) For the first time the configuration of a carbon compound containing several asymmetric centres has been confirmed by direct determination of atomic positions. In this particular case, chitosamine is shown to be a derivative of glucose and not of mannose (cf. the recent work of Haworth, Lake and Peat²).

(b) The pyranose (six atom) ring has a real existence in a crystalline sugar. (It should be observed that the chemical evidence for pyranose structures applies strictly to glucosides and only by inference to sugars.)

(c) In the α -form of a d -glucose derivative (that is, that which possesses the higher [positive] rotation) the oxygen atoms on the first and second carbon atoms are in *cis* positions.

The analysis is not yet sufficiently refined to distinguish between a nitrogen and an oxygen atom, so that we cannot at present confirm that in chitosamine the nitrogen atom is attached to the second carbon atom; this, however, is completely certain from its mode of synthesis. The pyranose ring is definitely not Sachse *cis* (boat-shaped), but is either Sachse *trans* or some partially flattened form of it³.

E. G. COX.

G. A. JEFFREY.

Chemistry Department,
The University,
Edgbaston,
Birmingham, 15.
March 29.

¹ Cox, E. G., and Goodwin, T. H., *Z. Krist.*, **86**, 462 (1933).

² *J. Chem. Soc.*, 271 (1936).

³ Cf. Cox, E. G., Goodwin, T. H., and Wagstaff, A. I., *J. Chem. Soc.*, 1495 (1935).

Absorption Spectra of Proteins

In a recent communication¹, Prof. F. Haurowitz and Dr. T. Astrup describe observations of absorption spectra on solutions of native and digested serum globulin, which are said to be in better accord with the classical theory of the structure of proteins than with the cyclol hypothesis. They reason that because, after digestion of serum globulin with trypsin to a stage at which only a fine opalescence is given with sulphosalicylic acid, there is no increased absorption at λ 240 m μ , there has therefore been no formation of CO groups from $>O(OH) - N <$ groups which are required by the cyclol hypothesis.

Haurowitz and Astrup state that CO groups absorb strongly at λ 240 m μ . This is contrary to observations made here and elsewhere on amino-acids and peptides. For example, at this wave-length the molecular extinction coefficient of glycyl-leucine is only 10. At λ 240 m μ the contribution of CO groups to the absorption of serum globulin is small compared with that of the nuclei of the aromatic amino-acids. The former can be calculated from average amino-acid composition figures for serum globulin and known extinction coefficient values for the aromatic amino-acids at λ 240 m μ to be about 17 per cent of the total.

The change of absorption of the globulin on digestion can be seen to be mainly a shift of the whole band to shorter wave-lengths with a filling up of the trough. That this shift is due to change in absorption of tyrosine and tryptophane has been shown in experiments to be published. This shift in itself causes a fall in absorption at λ 240 m μ large enough to mask a large increase of the kind for which Haurowitz and Astrup were looking. It would be

necessary to distinguish change of absorption of the aromatic amino-acids from appearance of new absorbing centres (CO groups) before such observations could be used as arguments for or against the cyclol hypothesis.

The question will be discussed more fully in a paper to be published shortly.

ENSOR HOLIDAY.

Research Laboratories,
London Hospital,
E.1.

¹ Haurowitz and Astrup, *NATURE*, 142, 119 (1939).

Protein Stability as Revealed by Ultracentrifugal Analysis

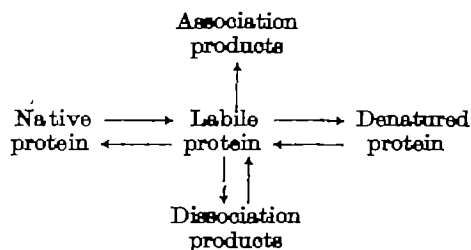
IN the course of sedimentation velocity studies with serum protein mixtures, it has been noted from time to time that the concentrations of the different molecules calculated from the sedimentation diagram differ from those determined analytically¹. The substance sedimenting at the higher rate decreases in amount to form units of a lower apparent sedimentation constant, even though it has appeared to be perfectly stable under the same conditions when it is present alone. It has been concluded that these changes are caused by some medium effect produced by the action of one protein upon the other. It was then reasoned that it should be possible to produce this effect by means of such lower molecular substances as amides, amino-acids, polypeptides, and protamines. The action of such 'dissociating compounds' is found to be highly specific. Thus an amino-acid which acts strongly upon a certain protein may have no effect upon another, and *vice versa*, and the effect may depend upon the presence or absence of salt^{2,3}.

Naturally it is important to understand such effects of proteins upon each other and of smaller molecules upon proteins. In some quarters it is believed the effect is due to a real dissociation of the faster sedimenting unit, but it must be recognized that in some cases the modification of the sedimentation rate may arise from a change in the shape of the molecule or even from hydration effects. It

appears that final answer to this question will have to come from the results of parallel osmotic pressure determinations.

It has now been found that changes in sedimentation behaviour of the type mentioned above can be produced, at least in solutions of the uniform protein now being investigated in this Laboratory (antitox (diphtheria) pseudoglobulin, thyroglobulin⁴, thymus nucleohistone), by the simple expedient of increasing the protein concentration in the solution and reducing the electrolyte content. In other words, the effect is produced without the addition of any reagent. Typical sedimentation diagrams are shown in the accompanying figure. There are many reasons for believing this is a quite general property of protein systems.

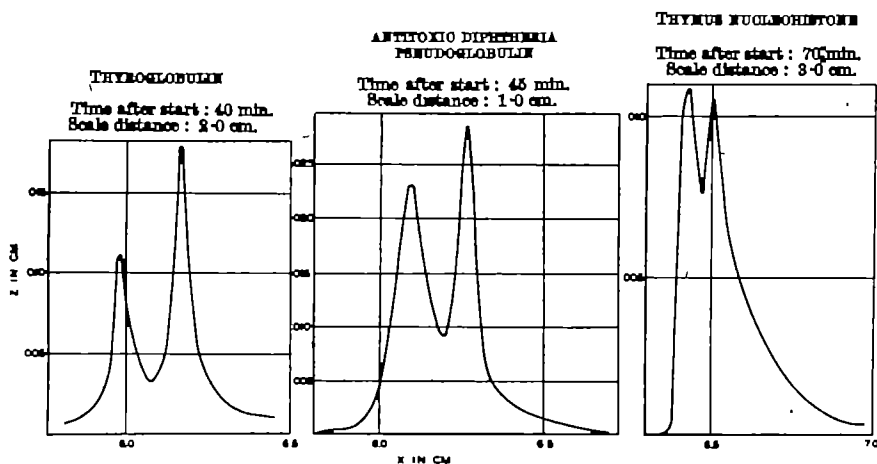
The observations can be described by means of the following scheme:



The formation of the labile state, probably due to an unfolding of native protein, appears not to involve any reaction between molecules, but is essentially a slow, intramolecular change involving an equilibrium the rate of establishment of which depends upon protein and hydrogen ion concentration of the solution and temperature. An increase in protein concentration and the removal of electrolyte from the solution favour the formation of the labile form. Any subsequent formation of denatured protein, dissociation or association products depends upon the presence of such reagents as urea, salicylate, hydrogen ion concentration of the solution, heat, ultra-violet light, and other factors.

Inasmuch as the presence of certain proteins, amino-acids or other substances favours the establishment of this equilibrium or may cause complete denaturation or change in molecular size even in the presence of salt, we believe this equilibrium between native and labile protein to form the basis of effects noticed by McFarlane, Pedersen, and others.

HAROLD P. LUNDGREN,
Laboratory of
Physical Chemistry,
University of Wisconsin,
Madison.
April 4.



ULTRACENTRIFUGAL SEDIMENTATION DIAGRAMS.

From left to right in each diagram, labile and native components. Concentration and pH for each protein as follows: thyroglobulin, 4.3%, pH 6.1; antitoxic diphtheria pseudoglobulin, 5.5%, pH 7.6; thymus nucleohistone, 1.2%, pH 6.0.

⁴ McFarlane, *Biochem. J.*, 20, 407 (1935).

² Pedersen, *NATURE*, 138, 363 (1936).

³ Svedberg, *Ind. Eng. Chem., Anal. Ed.*, 10, 119 (1938).

⁴ Lundgren, *J. Chem. Phys.*, 6, 17 (1938).

X-Rays and the Cyclol Hypothesis

THE purpose of the vector map described by Fankuchen and Riley¹ to which Dr. Wrinch has taken exception in her recent letter² was merely to show that the cyclol C₁ skeleton does not contribute anything to the specific character of the observed X-ray reflections from crystalline insulin. No one imagines that insulin contains only (CON) groups, but these are the only atoms of which the positions have been definitely stated by Dr. Wrinch, and therefore the only ones amenable to exact computation. Dr. Wrinch is, of course, at liberty to place other concentrations of density wherever she likes, but she cannot logically claim in this case that the structure arrived at in this way offers any confirmation of the cyclol hypothesis. Moreover, as has been shown already³, Dr. Wrinch's construction of the vector map from such concentrations⁴ has been incorrectly carried out, and therefore cannot confirm her proposed model of the insulin structure. Finally, the shape and size of the cyclol molecule do not offer particularly convincing fit into the cell of insulin. Any spherical molecule of approximately the right molecular weight would fit the cell equally well. The only positive agreement is in the presence of a trigonal axis of symmetry, which can scarcely be claimed to justify the acceptance of such an elaborate construction.

We feel, therefore, that no case whatever has been made out for the acceptance of the cyclol model on X-ray grounds; indeed so far as it goes, the X-ray evidence is definitely against the model and in favour of one composed not of a cage but of more or less discrete sub-units, although it is admitted⁵ that no model has yet been proposed that will fit existing experimental evidence. The arguments against the cyclol molecule on X-ray grounds have now been fully stated⁶, and it seems to us unprofitable to continue the discussion until fresh evidence or new interpretations are provided.

J. D. BERNAL.

I. FANKUCHEN.

D. RILEY.

Birkbeck College,
London, E.C.4.Department of Mineralogy,
Oxford.
May 9.¹ NATURE, 142, 648 (1939).² NATURE, 143, 763 (1939).³ Bernal, NATURE, 143, 74 (1939).⁴ Wrinch and Langmuir, J. Amer. Chem. Soc., 60, 2247 (1938).⁵ Physical Society, discussion of paper of Langmuir, Dec. 20, 1938 (in course of publication).⁶ cf. 1 and 5, Bernal, Proc. Roy. Soc., A, 170, 75 (1939); Bernal, NATURE, 143, 663 (1939).

Rapid Calculation of Relative Humidity from Readings of the Sling Hygrometer

At the recent Institute of Physics Conference at Leeds, I communicated a rule which I have found useful for calculating the relative humidity direct from readings of the ventilated wet- and dry-bulb hygrometer. Expressed so as to facilitate rapid mental calculation, it is as follows: to calculate the percentage relative humidity, express three times the wet-bulb depression ($^{\circ}$ F.) as a percentage of the dry-bulb reading, and subtract from 100; or symbolically:

$$\text{R.H. (\%)} = 100 - 3\left(\frac{t - t'}{t}\right) \times 100,$$
where t = dry-bulb temperature ($^{\circ}$ F.) t' = wet-bulb temperature ($^{\circ}$ F.).

The same formula applies when centigrade thermometers are used, except that the wet-bulb depression must then be expressed as a percentage of the dry-bulb temperature plus 18.

The rule applies only to the readings of a ventilated hygrometer, and breaks down at relative humidities below 30 per cent; but it applies very closely from 30 to 100 per cent relative humidity, and over an air-temperature range of 20° to 140° F. The degree of accuracy of the formula over these ranges can be checked by comparing calculated values with the corresponding values given in "Psychrometric Tables for Obtaining the Vapour Pressure, Relative Humidity, and Temperature of the Dew Point" by C. F. Marvin, U.S. Dept. of Agriculture Weather Bureau, 1937. It will be found that the average difference between the calculated and tabulated values is less than 2 per cent R.H., whilst the maximum difference under extreme conditions within the ranges mentioned is ± 4 per cent R.H. For example, according to the formula, a wet-bulb depression of 5° F. at temperatures of 20° , 40° , 60° and 100° F. corresponds to relative humidities of 25, 63, 75 and 85 per cent respectively, whilst the tabulated values are 28, 60, 73 and 83 per cent R.H.

If the practical interest is confined to the more restricted ranges between 50 and 90 per cent R.H., and 40° F. to 120° F., the calculated relative humidity is in general higher than the tabulated by 2 per cent, and when this correction is made the error does not exceed 1 per cent R.H.

A. J. TURNER.

Shirley Institute,
Didsbury,
Manchester.
April 14.

Rapid Graphical Analysis of Circuit Performance by the Use of Logarithmic Charts

In connexion with some recent work, use has been made of charts with $\log (| \text{impedance} |)$ and $\log (\text{frequency})$ as axes, and the properties of this plane have been found to lend themselves to graphical use. The chief properties are:

The impedances of the three circuit elements (resistance, capacity and inductance) are represented by straight lines.

The impedance for all frequencies of any two elements in series is exactly represented by one of two curves the shape of which does not depend upon the value of the elements; these can therefore be made in the form of templates.

Since $\log \frac{1}{|Z|} = -\log |Z|$, operations upon

impedances in series and parallel are equally simple, and the same two curves apply to elements in parallel as in series.

Since the ratio of the voltage (E_2) across one (Z_1) of two impedances (Z_1, Z_2) in series, to the total voltage E is

$$\frac{|Z_1|}{|Z_1 + Z_2|}$$

and

$$\log \frac{|Z_1|}{|Z_1 + Z_2|} = \log |Z_1| - \log |Z_1 + Z_2|,$$

and the attenuation in decibels is $\left[20 \log_{10} \frac{E_1}{E} \right]$, distances in the vertical direction give attenuations directly.

The use of charts of this plane, together with the two elementary curves mentioned above, enable the rapid graphical analysis of the behaviour of many circuits, also the synthesis of networks with desired frequency characteristics and the determination of equivalent circuits.

An accuracy to 5 per cent in frequency or impedance and 0.5 decibel in attenuation can readily be obtained. The method has been found both rapid and convenient in application to various aspects of radio receiver design.

Acknowledgment is due to Murphy Radio, Ltd., for permission to publish this information.

D. N. TRUSCOTT.

Murphy Radio, Ltd.,
Welwyn Garden City,
Herts.
March 28.

Structural Geology of the Bermuda Islands

IN conjunction with investigations for the development of a technique for deep-sea seismic measurements that will permit the obtaining of positive geological information on the structure of the ocean basins, we have investigated the structural geology of the Bermuda Islands.

Of especial interest is the fact that contours around the Bermuda area based upon recently published sounding data¹ and unpublished soundings secured by the ketch *Atlantis* of the Woods Hole Oceanographic Institute suggest that the islands consist of four main volcanic cones with several minor ones on the flanks of the main structures, and also that the island mass is surrounded by a series of concentric folds which die out in amplitude with distance from the islands. In order to verify this latter indication, we have arranged for several lines of continuous soundings to be made in the near future.

Two seismic refractions depth profiles made in the island area show the top of the volcanics to lie at depths of 273 feet and 243 feet below sea-level. These determinations are in excellent agreement with the depth reported for the top of the volcanics in a deep well in the islands, 245 feet below sea-level. The volcanics were characterized by a velocity of 16,000 ft./sec., whereas the overlying calcareous eolianite composing the visible portion of the islands had a velocity of 8,800 ft./sec.

An examination of existing magnetic data which comprise a fairly complete isogonic survey² and localized studies of the variation in the horizontal component of the earth's field³ show that the islands are characterized by local areas of low magnetic susceptibility. Further, that the depths of the disturbance are all about the same and less than 1,200 feet in depth. To elaborate the magnetic indications further, we have made a series of observations on the vertical component of the earth's field and find very high local disturbances both positive and negative in character. This work is still too incomplete to permit any conclusions to be reached as to the nature of the disturbances. They are near surface, and it is believed cannot be attributed to artificial causes.

Of significance in this connexion is the discovery of a calcareous sandstone heavily impregnated along dark bands with magnetite, ilmenite and andradite garnet. There are no surface exposures of this rock, and it was brought up from twenty feet below water

in constructing a bridge pier. Also believed of significance is a coarse limestone conglomerate cemented in a very dense calcite matrix which occurs at about the same depth in several localities. In the formation we have found a weathered volcanic pebble four inches in diameter, but so fine only one.

From the evidence presented it is seen that various conflicting conclusions might be drawn, but it is hoped by extending the seismic measurements, the magnetic studies, and geological studies of the low dense limestone formation to reach a structural interpretation that will satisfy all the observed conditions. The nature of the exposed surface geology, cross-bedded eolianites, makes orthodox methods of structural geological investigation of little use in the area.

GEORGE P. WOOLARD.
MAURICE EWING.

Bermuda Biological Station for Research,
St. George's, W.
Bermuda.
April 13.

¹ Admiralty Chart, No. 360 (1938).

² Cole, J. F., *Terr. Mag. Atom. Elec.*, 13, 49 (1908).

³ Flak, H. W., 8p. Rpt. 339, Carnegie Inst. Wash., pp. 353-357.

Microphonic Potentials from the Utricle

Stevens and Davis¹ have put forward the view that the generation of potential differences in the cochlea when sound is incident on the ear is due to the 'piezoelectric' properties of the hair-cells themselves.

The principal item of evidence for this view is the similarity of the threshold curves for the microphonic effect determined oscillographically in the guinea pig and for sound perception in man. By implication, therefore, the microphonic effect is an integral part of the receptive process. Their argument is supported by the work of Adrian, Craik and Sturdy², who have demonstrated microphonic potentials in the ears of lower vertebrates (eel, frog, tortoise), which, though they do not possess a cochlea, yet have hair-cells in the maculae of the labyrinth closely resembling those of Corti's organ. These observations were confined to the inferior part of the labyrinth, in particular the sacculus, which in these animals has an auditory function. This evidence therefore tends to confirm the belief that such microphonic potentials might be intimately connected with the reception of sound.

I have obtained similar microphonic potentials from the labyrinth of perch, tench and roach in response both to loud air-borne sounds and to vibrations transmitted through the bench. By exploration with concentric electrodes, it was possible to show that they were derived not only from the sacculus (and perhaps the lagena) but also from the utricle. Indeed they could be obtained equally well from the latter after complete bilateral extirpation of sacculus and lagena, which in these bony fishes are widely separated from the upper non-auditory part of the labyrinth. Von Frisch³ has demonstrated that in fish, as in higher vertebrates the utricle plays no part in hearing. It is clear therefore that the generation of microphonic potentials in a sense organ is not in itself a sufficient

dication of the reception of acoustic or vibratory stimuli. Consequently it is not legitimate to regard the magnitude of the microphonic response as a measure of the sensitivity of an auditory organ.

R. J. PUMPHREY.

(Beit Memorial Research Fellow)

Department of Zoology,
Cambridge.
April 28.

Keaven and Davis, "Hearing" (New York: Wiley, 1938).
Addian, Craik and Sturdy, *Proc. Roy. Soc., B*, 125, 435 (1938).
von Frisch, *Biol. Rev.*, 11, 210 (1936).

Microspores in Diatoms

THE occurrence of microspores in centric diatoms and their possible nature have been the objects of great discussion. Recently, Gross¹, on the basis of cultures of *Chaetoceros pseudocrinatus* and *Ch. didymus*, concluded that "there is no evidence whatever that these microspore-like bodies found in the cultures of *Ch. pseudocrinatus* acted as reproductive cells. They are never liberated or at any rate never found outside the parental cells, and flagellate-like cells were never found in the cultures where their formation had taken place". He tentatively put forward the view that "what have been described as microspores are either abnormal products of the diatom cell or alien flagellates, neither participating in the life cycle of the diatoms".

Culture work with plankton diatoms has suggested a different conclusion. In cultures of *Chaetoceros* species obtained by isolation of single cells or chains by means of capillaries and cultivated according to Allen's method², two species formed microspores, namely, *Ch. constrictus* and *Ch. decipiens*. The formation of the spores took place in much the same way: the cell content first divided into two, then into four parts by constrictions parallel to the valves. Each part then divided into two by constrictions perpendicular to the valve, so eight spores were formed in each cell. The spores were not all strictly of the same size; but all contained one or more chromatophores. Being fully developed, the spores had one rather solid cilium, several times as long as the spore, lying coiled around the spore. The liberation of the spores from the cells was observed. They were lively and motile and the culture fluid was crowded with them. Among the free-swimming microspores several were larger than the others and had two cilia. Fusion between two single-ciliate ones was, however, not observed. The formation of microspores took place in cultures without usual signs of crowding.

Transference of *Ch. decipiens* microspores by means of capillaries from a culture to a drop of pasteurized Allen sea-water³ and again to a flask with the same fluid in such a way that no regular *Chaetoceros* cells might by chance be brought along, gave in several cases luxuriant cultures of regular *Ch. decipiens* cells. In some cases two microspores or more were transferred, in other cases only one. Growth occurred in some cultures of both categories, but the number of isolations are yet too small to allow any conclusion as to the possible necessity of two microspores for obtaining ordinary vegetative *Chaetoceros* cells from microspores.

The development of regular *Chaetoceros* cells from microspores seems to give conclusive proof that these spores represent a mode of reproduction in *Chaetoceros*.

Their part in the life-cycle of the plant has to be determined by further studies, also of the cytological features of microspore formation.

Botanical Laboratory,

The University,

Blindern,

Oslo.

April 21.

TRYGVE BRAABUD.

¹ Gross, F., "The Life History of some Marine Plankton Diatoms", *Phil. Trans. Roy. Soc., B*, No. 548 (1937).

² Allen, E. J., and Nelson, E. W., "On the Artificial Culture of Marine Plankton Organisms", *J. Mar. Biol. Assoc.*, 8 (1910).

Cultivation of Rabies Virus in the Developing Chick Embryo

IN a recent publication we reported that fixed rabies virus can be recovered from an infected chick embryo, that the virus tends to be localized in the brain of the embryo, but that serial passage was irregular and uncertain¹.

The continuation of these studies has led to successful serial passage of the virus in the developing chick embryo. In one series the virus has been carried through nine, and in a second, through six successive passages without loss of virulence of the virus to mice and rabbits when infected intracerebrally. The virus is present both in the allantois and in the embryo brain, but always in higher concentration in the latter. Both series are being continued.

The successful cultivation of the virus in the developing chick embryo depends, apparently, on the age of the embryo at the time of infection, as well as at the time of passage. A large series of experiments showed that embryos of eight days or more are only irregularly infected and that passages are, as a rule, negative. On the other hand, embryos 5-6 days old are readily infected and serial passages can be maintained without any difficulty if they are made 9-10 days after infection. The eggs have been kept at a temperature range of 37.0-38.5° C.

The following experiments are illustrative of this:

(a) Embryos eight days old were infected with 0.1 c.c. of a 1:10 emulsion of infected mouse brain; eggs opened nine days later: the embryo brain infected mice injected intracerebrally with a dilution of 1:10, the allantois failed to infect; in another case the embryo was removed after twelve days and both brain and allantois infected mice in dilutions of 1:100.

(b) Embryos five days old were infected as above; embryos removed nine days later, and both brain and allantois were infective for mice in dilutions of 1:10,000; embryos removed after thirteen days, the brain was infective in a dilution of 1:1,000 and the allantois in a dilution of 1:100.

In all passages thus far, the embryo brain removed 9-10 days after the infection was infective for mice in dilutions of 1:1,000 to 1:10,000. Passages from embryo to embryo can be made with emulsions of either allantois or embryo brain, provided that young embryos are infected and that passages are made not later than 10 days after the infection. Embryos removed more than ten days after infection have shown lower concentration of virus; in one case (passage 4) an embryo tested fifteen days after infection failed to infect mice in any dilution. It is of interest that this specific neuro-virus can be cultivated in the chick embryo provided the infection is made at the earliest possible stage of its development.

The embryo brain of the passage virus of the sixth passage was still virulent for mice when injected intraperitoneally. Studies of the pathogenicity of the virus for chick embryos and on the virulence and immunizing properties of later passages of the embryo culture virus for mammals are being continued.

This work has been assisted by a grant from the Ella Sachs Plotz Foundation.

I. J. KLIGLER.
H. BERNKOPF.

Dept. of Hygiene and Bacteriology,
Hebrew University,
Jerusalem.

April 20.

Kligler, I. J., and Bernkopf, H., *Proc. Soc. Exp. Biol. and Med.*,
50, 112.

Oestrous Cycle in the Cat

THE problem of reproduction among cats was studied so far back as 1784 by Spalanzani. Longley¹, van der Stricht², Hill and Tribe³, Courrier and Gros⁴, Greulich⁵, and Foster and Hisaw⁶ have made more recent studies of this question, with somewhat contradictory results.

About seventy cats kept and bred in this Institute have been, during two years, observed and dissected. The results obtained are as follows:

The cat is a dioestrous animal, that is, one in which oestrus appears twice a year. The first cycle occurs in the spring, the second one in early autumn. In this respect, together with the other factors (change of habitation, for example), climate has a great influence. It may happen that these two cycles overlap during the summer months, whereas winter is mostly a period of complete rest from sexual activity. More frequent oestrus than twice a year has sometimes been observed by breeders of Angora cats. That is probably connected with advanced domestication. Normally oestrus lasts 3-5 days. By lack of service it may be prolonged to 10 days or more.

Numerous experiments have proved that ovulation invariably takes place after coitus. That is identical with the rabbit and the ferret. Up to this time, authors differed on this subject. It is interesting to note that a great number of interstitial cells appear in the ovaries of these animals in contrast with other mammals, including women, in which such cells are found either in very small numbers, or not at all. That would be a further confirmation of Ansel's and Bouin's⁷ hypothesis, that the interstitial cells are connected with the above-mentioned symptom and have a restraining influence upon it. An extra nervous stimulus as is given by coitus is thus necessary for its accomplishment. Judging by the numerous interstitial cells which can be found in the ovaries of the above-mentioned three species of mammals, the hare and perhaps the mole ought also to be classified among animals with copulative ovulation.

In the female cat, ovulation occurs about forty to fifty-four hours after copulation. Graafian follicles which do not disrupt undergo an atresia; the granulous cells are partly subject to changes: cells of connective tissue grow out of the theca, interstitial cells undergo strong hypertrophy and grow towards the centre. Only a nucleus of connective tissue remains in the centre of the follicle. At first sight, this formation reminds one of the corpus luteum. Differences consist in their way of staining. The follicles undergo a process of atresia in all stages of development, already beginning at the period

which precedes sexual maturity. As in the rabbit or ferret, a female cat served by a vasectomized male shows the phenomenon of pseudo-pregnancy, which lasts about thirty-six days.

The corpus luteum of pseudo-pregnancy is formed in the first instance of granulosa cells. The blossoming of the corpus luteum takes place after thirteen days and twenty-eight days after copulation it undergoes a reduction simultaneously with the appearance of the growing Graafian follicles of the new cycle.

During the different phases of the oestrous cycle considerable changes occur in the genital tract.

The histological aspect is analogous. During anoestrus, the tube presents a cylindrical epithelium without cilia, whereas on the contrary during oestrus the tube becomes enlarged, it is ciliated and produces a mucus which contains, according to some authors, nourishment for the eggs which traverse the tube after ovulation. Even more prominent changes occur in the uterus. When in anoestrus, we observe flattened, single-layered epithelium and small inactive glands; during oestrus, on the contrary, the epithelium becomes cylindrical, though deprived of cilia, the glands attain a high degree of development and grow deeply into the endometrium. During pseudo-pregnancy, the development of the glands is still stronger and the endometrium grows out into large folds towards the lumen of the uterus. Lastly the vagina also shows marked changes during the cycle: the epithelium thickens many times during oestrus, at the same time the superficial layer flattens considerably, becomes cornified, loses their nuclei and become thrown out of the lumen separately or in flakes.

Further work is in progress.

H. LICHE.

Department of Anatomy,
College of Agriculture,
Warsaw. March 31.

¹ *Amer. J. Anat.*, 12 (1911)

² *Arch. Biol.*, 26 (1911).

³ *Quart. J. Micro Sci.*, 68 (1924).

⁴ *C.R. Soc. Biol.*, 114 (1933)

⁵ *Anat. Rec.*, 58 (1934).

⁶ *Anat. Rec.*, 62 (1935).

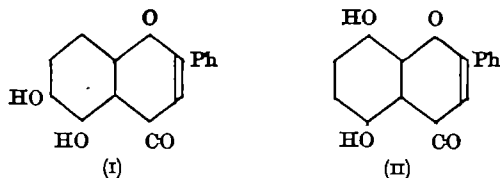
⁷ *C.R. Soc. Biol.*, 58 (1909).

Synthesis of 5:6-Dihydroxyflavone and the Structure of Primetin

PRIMETIN, $C_{15}H_{10}O_4$, isolated from the leaves of *Primula modesta*¹, has hitherto been regarded as 5:6-dihydroxyflavone (I), and several attempts have been made to prepare this compound². An unambiguous synthesis of 5:6-dimethoxyflavone has now been carried out via the stages 2:6-dihydroxyacetophenone, 2-hydroxy-6-methoxyacetophenone, 2:5-dihydroxy-6-methoxyacetophenone, 2-hydroxy-5:6-dimethoxyacetophenone, 2-benzoyloxy-5:6-dimethoxyacetophenone, and 2-hydroxy-5:6-dimethoxydibenzoylmethane.

Demethylation gave a dihydroxyflavone, which because it regenerated 5:6-dimethoxyflavone or methylation and for other reasons, must be regarded as 5:6-dihydroxyflavone (I), and not the alternative 5:8-dihydroxyflavone (II), which might be produced by opening of the pyrone ring and closure in the alternative direction.³ This substance and its derivatives differ widely from primetin and corresponding derived compounds, and a revision of the structure of primetin is therefore necessary.

It is of interest that Sugawara³ actually succeeded in preparing two derivatives of 5:8-dihydroxyflavone and even a crude specimen of 5:8-dihydroxyflavone itself, but, because the compounds were not identical with primetin and derivatives, he erroneously assumed that they were derived from 5:8-dihydroxyflavone (II).



A review of the available evidence leads to the conclusion that primetin is a dihydroxyflavone derived from hydroxyquinol, and must be regarded

as 5:8-dihydroxyflavone (II). It is probable that another flavone of this type occurs naturally; this is the 4'-methoxy derivative of (II) isolated from the leaves of *Ginkgo biloba* L. by Furukawa⁴. The synthesis of these 5:8-dihydroxyflavones is in progress. A detailed account of this work will shortly be published elsewhere.

WILSON BAKER.

Dyson Perrins Laboratory,
University of Oxford.
April 8.

¹ Hattori, S., and Nagai, W., *J. Chem. Soc. Japan*, 51, 162 (1930); *Acta phytochem.*, 5, 1 (1930).

² Sugawara, S., *J. Chem. Soc.*, 1621 (1933); *J. Pharm. Soc. Japan*, 53, 106 (1936); Baker, W., *J. Chem. Soc.*, 1963 (1934); Mahal, H. S., and Venkataraman, K., *Current Science*, 6, 450 (1938).

³ See Shah, B. C., Mohita, C. R., and Wheeler, T. S., *J. Chem. Soc.*, 1555 (1938).

⁴ Furukawa, S., *Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 19, 27, 39 (1932); 51, 278 (1933).

Points from Foregoing Letters

B. F. J. Schonland and his associates present evidence supporting the view of Australian workers that the oscillatory structure of atmospheres arises from multiple reflections from the E-layer of the ionosphere. They find that the effective height of reflection is approximately constant (85 km.) except in the neighbourhood of the thunderstorm producing the atmospheric wave, where it decreases from 85 km. at 300 m. distance to 50 km. immediately above the storm.

The cross-sections for the transformation of nitrogen (¹⁴N), when bombarded by fast neutrons, into boron (¹⁰B) or carbon (¹²C) are found by E. Baldinger and P. Huber to have the values 1.63 and 0.4×10^{-28} cm.² respectively. The reaction energy for the nitrogen-neutron transformation is -0.43 Mev.

The crystal structure of α -chitosamine hydrochloride and hydrobromide has been determined by L. G. Cox and G. A. Jeffrey without the assistance of stereochemical data. The authors state that it proves the correctness of the configuration assigned to glucose derivatives, and in particular shows that chitosamine is definitely a derivative of glucose. The results also demonstrate the existence of the pyranose sugar ring and show that in α -glucose derivatives the groups attached to the first and second carbon atoms are in cis positions.

E. Holiday states that deductions from observation of change of absorption at λ 240 m μ as to whether CO groups are formed during enzymic digestion of a protein are not possible until account has been taken of the large masking effect due to accompanying change in absorption of the aromatic amino-acids.

Sedimentation curves for several proteins (thyroglobulin, antitoxic diphtheria pseudoglobulin and thymus nucleohistone) are submitted by H. P. Lundgren, indicating the formation of 'labile' components with lower sedimentation constants; this may be brought about by the simple expedient of increasing the protein concentration and reducing the electrolyte content of the solution.

A. J. Turner communicates a simple formula for calculating the relative humidity directly from readings of a ventilated wet- and dry-bulb hygrometer; the formula gives results accurate to 1 per cent relative humidity between 50 per cent and 90 per cent R.H., from 40° F. to 120° F.

D. N. Truscott reports a graphical method of circuit analysis and synthesis, based on the use of charts with logarithmic scales of impedance and frequency; this has been used in radio receiver design.

A survey of the structure of the Bermuda Islands by means of sound-velocity technique indicates, according to G. P. Woolard and M. Ewing, that the islands consist of four main volcanic cones with several minor ones, and are surrounded by a series of concentric folds which die out in amplitude with distance from the islands. Sound refraction measurements show the tops of two of the volcanoes to be at a depth of about 250 ft.

R. J. Pumphrey has recorded microphonic potentials in response to sound from the non-auditory part of the labyrinth of teleost fish. Such potentials are therefore not an absolute indication of the reception of acoustic or vibratory stimuli.

By isolating single cells of plankton diatoms (*Chaetoceros*) and cultivating them in suitable media, T. Braarud has been able to follow the formation of ciliate microspores and to show that such spores represent a mode of reproduction in *Chaetoceros*.

I. J. Kligler and H. Bernkopf describe experiments showing that it is possible to cultivate fixed rabies virus in the developing chick embryo provided that (a) the allantois of embryos 5 to 6 days old are infected, and (b) passages are made 9 to 10 days after the infection. Passages from embryo to embryo can be made with emulsions of either allantois or embryo brain.

H. Liche confirms the existence of copulative ovulation in the female cat and suggests that it is conditioned by the presence of numerous interstitial cells in the ovary. He describes the pseudo-pregnancy and anatomical as well as the histological changes which occur during the different stages of the oestrous cycle.

Primetin, isolated from *Primula modesta*, has previously been regarded as 5:8-dihydroxyflavone. This substance has now been synthesized by W. Baker, who finds that it is not identical with primetin. There can be little doubt that primetin is 5:8-dihydroxyflavone.

Research Items

Nuer Time-Reckoning

IN a study of Nuer time-reckoning by Dr. E. E. Evans-Pritchard (*Africa*, 12, 2; 1939), it is pointed out that the Nuer have a sense of time different from ours, not merely owing to the fact that a system of time-reckoning in mathematical symbols differs from a verbal system not so reckoned, but also because both European and Nuer alike speak of time in terms of social activities and relationships, which in the two systems differ fundamentally. In Nuer concepts of time we may distinguish between those which reflect their relation to the environment, 'ecological' time, and those relating to the social structure, 'structural' time. The ecological cycle is a year of two main seasons, each divided into six months, one season, broadly, the wet, and the other the dry. The wet season is that of residence in villages, with appropriate occupational activities, and the dry that of residence in camps. The concepts of time are based primarily on the social rhythm, of which the outstanding quality is the movement from village to camp and back again. It is by reference to the changes in the character of their activities that they reckon time, and on them they base their calendar. Years are recalled generally by reference to the places at which their camps were made and the circumstances which arose during their stay there. Hence there is no accurate, or general, system of dating years. Each division of the Nuer has its own system of reference. A habitual method of dating an epoch, or certain events, is by reference to the age of certain persons, and this not by counting years, but by their relation with certain groups of persons. The interval between events is measured by the relation between the persons of one age group and those of another. Time can also be measured by employment of the genealogical method. Events integrate at a certain point in the clan system, and thus each person in the genealogy constitutes a significant point of reference.

Tahimahan Clan Relationships

THE clan relationships of members of nine tribes now resident at Port Simpson, British Columbia, were investigated by Viola E. Garfield in field work carried out in the summers of 1932, 1935 and 1937, with the purpose of defining more clearly the functioning relationships of Tahimahan individuals to each other as determined by their clan and tribal affiliations (*Univ. Washington Pub. in Anthropology*, 7, 3; 1939). In summarizing these relationships, those which are old and still functioning are differentiated from those which are now obsolescent, or those which have grown out of white impact. Closest contacts were with members of the father's and mother's lineages. Children usually lived with the mother in a household composed largely of the father's relatives; but they were taught that their homes were with their maternal uncles, with whom the boys went to live at adolescence. At the present day, however, children grow up under the father's care, and are less influenced by lineage relations. The duties of a father and his lineage towards his child are well formulated. The father's brother and sister are privileged to perform the first services to the child at birth. The father's brother provides the

cradle, while his sister acts as midwife—services now obsolete, owing largely to the provision of hospitals. At the giving of the first name, the maternal uncle gave the name, but it was proclaimed by the father's brother; and in the first power ceremony the father's sister acted as the child's assistant. No power ceremonies now take place. The ear, lip, and nose piercings were performed by a woman of the father's lineage. A paternal aunt assisted in the wedding preparations and the father's sister was the bride's chief attendant. The father's sister cared for the body of the deceased after death, being compensated by the clan relations, while the father's brother provided the coffin.

Metabolism and Castration

M. Sandberg, D. Perla and O. M. Holly (*Endocrinology*, 24, 503; 1939) studied the effect of castration in male and female albino rats on nitrogen sulphur, chloride, sodium and potassium metabolism and on changes in weight and food intake. They found that if the gonads were removed after puberty nitrogen, sulphur, chloride, sodium and potassium metabolism either decreased slightly or remained unchanged. If castration occurred before puberty urinary nitrogen excretion increased considerably urea nitrogen accounting for the increase. Ammonia nitrogen, uric acid, creatine, creatinine and faecal nitrogen excretion remained unchanged. Exogenous as well as endogenous sulphur metabolism was disturbed. Total sulphur excretion rose as well as that of neutral sulphur. After a period of seven months endogenous sulphur metabolism began to return to normal. Chloride, sodium and potassium retention was decreased. The weight curves and food intake of male and female rats which had been castrated before puberty were similar to those of normal animals. The weight curves of male rats which had been castrated after puberty were similar to those of normal animals up to the age of 30 weeks. Then the curves of the castrates flattened out and at 40 weeks of age the controls weighed 10 per cent more. Food intake expressed in gm. per 100 gm. body weight was somewhat higher in normal animals up to a weight of 370 gm. Afterwards it was the same for both groups. The weight curves of female rats which had been castrated after puberty showed a gain in weight over the controls in spite of the fact that their food intake expressed in gm. per 100 gm. body weight was less.

Synthesis of Cystine in Rats

E. F. Beach and A. White (*J. Biol. Chem.*, 127, 87; 1939) placed a group of male rats on a diet of the following composition: cystine-free casein hydrolysate 14.7, tryptophane 0.3, crisco 21, cod liver oil 5 Osborne and Mendel salt mixture 4, and starch 54 per cent. Each rat received in addition a daily supplement of 100 mgm. of ryzamin B and 50 mgm. of liver extract, which provided sufficient water-soluble vitamin to permit a fair rate of growth. This vitamin supplement represented the only possible dietary source of cystine, inasmuch as the casein hydrolysate used in the diet was cystine-free. Moreover, analysis of the animals showed that young rats restricted to this diet for a period of approximately six weeks

usually deposited a quantity of cystine which was considerably in excess of the amount present at the start of the experiment plus the small amount possibly present in the vitamin supplement. The authors include that cystine *per se* is not a dietary essential, but may be synthesized from methionine.

Migrations of Pacific Mackerel

The range of the Pacific mackerel, *Pseudophoxinus*, covers nearly 2,000 miles from Vancouver land to Lower California. Since 1928, the fish has been extensively used for canning, and the opportunity has been taken to mark large numbers so that questions of spawning and other movements may be elucidated (Donald H. Fry, jun., and Phil. M. Roedel *California Fish and Game*, 25, 2; 1939). From 1935, when the marking programme was launched, to 1938, 16,848 had been tagged by metal tags which were either clamped on a gill-cover (an unsuccessful method because the tags do not stay in place), or were inserted through a tiny slit into the body cavity. The tags are recovered by magnets during the processes preparatory to canning, or are sent in by fishermen for a small monetary reward. In order to determine relative movements of different shoals, 403 mackerel were marked at Monterey, 10,184 in southern California, and 1,261 in Lower California. The tag returns seem to be disappointingly few, in all only 412 (out of 16,848), and of these 233 were taken within ten miles of the place of release; 130 were recovered by cannery magnets in the same general area in which they were marked, and 49 were found more than ten miles from the place of release. The recoveries show that there is an interchange of fish between Monterey and southern California and a mingling of fish from different parts of the southern Californian area. The time which has elapsed between tagging and recovery has been as long as two years, and some of the more rapid rates of movement shown by marked fish are 21 miles in twenty hours, and 200 miles in thirty-four days.

Corpuscles in Body Fluids of Invertebrates

SINCE 1924, Toshio Ohno has been conducting a series of investigations into the characteristics of the corpuscles to be found in the body fluids of invertebrates. The findings of eleven of these inquiries have already been published in the Science Reports of the Tôhoku Imperial University. In the issue of the *Journal* for December 1938, the author summarizes the previous work and sets forth his general conclusions. The investigations cover forty-four invertebrate animals belonging to six phyla. The author considers that there is no fundamental hiatus between the erythrocytes of invertebrates and those of vertebrates. Those of invertebrates constantly contain inclusions which are of a substance analogous with that found in the granules included in the leucocytes. Thus the erythrocytes can be regarded as modified leucocytes. Thus the lymphocyte may be regarded as a pluripotential element capable of differentiation along several lines, the particular one followed being dependent upon the individual environmental requirements. The invertebrate blood is characterized by the presence of many and variously pigmented leucocytes.

Sterility in Plums

CONTINUING their studies on incompatibility of fruit trees, M. B. Crane and A. G. Brown (*J. Pom.*, 17, 51-66; 1939) show that self-incompatibility,

cross-incompatibility and partial incompatibility exist in the plums. The existence of self-compatible varieties together with the complex behaviour in respect of intervarietal compatibility is due in large measure to the hexaploid constitution of the plum. The authors show that the old greengage variety exists as a population of different strains which are intercompatible. These strains have several distinct morphological features and they may be either seedlings of one parent or bud sports from one plant. The application of the experimental results to economic practice is discussed.

Earthquake in Chile, January 24, 1939

A SHORT article on this earthquake, written by Julio Bustos Navarrete, director of the Salto Observatory, Santiago, has recently appeared (*Rev. pour l'étude des Calamités*, 2, No. 5, March-April 1939). The author states that the region principally affected was that of Chillan-Concepcion-Cauquenes and that previous occurrences affecting the same area were on May 25, 1751, and February 20, 1835. On January 24, 1939, a series of shocks commenced with light rockings at 23h. 35m., each lasting about three minutes. These gradually became stronger until the climax was reached when a terrific shock occurred, followed by after-shocks. The earthquakes are considered to have been due to an orogenic movement which, being shown by inclinographs, was mentioned in the *Bulletin d'études de l'Observatoire de Salto* in November 1938. It was then stated that the culmination would probably be a series of small shocks or a larger one, though in the present state of the science the exact time and place of these shocks could not be foretold. The anticipated seismotectonic process commenced on January 17 by a shock of intensity V felt at Coquimbo and La Serena and on January 18 by a shock of intensity IV felt at Antofagasta and La Pampa. These were interspersed and followed by minor ones. The shock of January 24 reached a probable intensity XI at Chillan and Cauquenes, and in general the intensity decreased with epicentral distance. There were, however, some exceptions owing to the geological structure of the country, such as at San Carlos and San Gregorio between Chillan and Cauquenes, where the intensity was not above VIII. About the same time as the shock, the volcanoes Quisapu, Antuco and Llaima are reported to have erupted. The author supposes that a 'trigger' action may have been the passage of the centre of a strong anticyclone over the south of Chile at the time, and mentions reports of observations of brilliant lights, thunder, lightning, rain, hail, and peculiar atmospheric conditions accompanying the shock.

Zoned Olivines

AN important investigation of zoned olivines and their petrogenetic significance by S. I. Tomkeieff has recently been recorded (*Min. Mag.*, 229-251, March 1939). The widespread occurrence of zoned olivine in igneous rocks is demonstrated by measurements of the optic axial angle—which varies with the composition in the forsterite-fayalite series—supplemented by determinations of other serial properties such as refractive indexes and birefringence. As a rule, the zoning is found to be continuous, varying from a magnesium-rich centre to an iron-enriched margin. The difference in composition between centre and rim exceptionally reaches 40 per cent fayalite. The olivine in the British Tertiary dolerites

ranges between 18 per cent fayalite in the core to 40 per cent in the outer zone, but in the British carboniferous dolerites the corresponding average range is lower, being 31-39 per cent of fayalite. Data are assembled to show that there is an intimate connexion between the composition of the magma and that of the olivines crystallising out of it at different stages of solidification or differentiation. The recorded observations on natural olivines and the rocks in which they occur are in complete agreement with the results of the recently published study of the forsterite-fayalite binary system by Bowen and Schairer (*Amer. J. Sci.*, 29, 151; 1935).

Origin of the Earth's Magnetic Field

W. M. ELIASBERG (*Phys. Rev.*, 55, 489; 1939) has devised a thermo-electric theory of the origin of the earth's magnetic field. It is known that the electric currents which produce the magnetic field must be located inside the earth, and there is considerable evidence to show that the deep interior core of the earth is fluid and metallic. The continuous production in the core of heat which is lost from the outside leads to up and down convection currents just as in the atmospheric vortices of meteorological theory. The combination of these convection currents and the rotation of the earth leads to Coriolis forces perpendicular to the convective motions. These forces produce an asymmetry in each vortex such that there is an upward motion in the eastern part and a downward motion in the western part. At any horizontal level in any given vortex, the motion leads to an asymmetric temperature distribution. It is probable that this is accompanied by an asymmetric variation of the thermo-electric properties, due to phase changes in the material. A numerical calculation, with temperature variation of the order 10° , leads to currents of the right order of magnitude to account for the earth's magnetism, and the theory accounts indirectly for the rough coincidence of the earth's rotational and magnetic axes. The thermo-electric mechanism does not account for the magnetism of sunspots, which are probably due to currents in the upper layers of the sun's atmosphere.

Isotopic Abundance and Atomic Weight of Europium

THE abundance of the isotopes of europium was determined by Aston in 1934. He found two isotopes of mass numbers 151 and 153 respectively, the former having an abundance of 50.6 per cent and the latter of 49.4 per cent. Using the packing fraction $(4 \pm 2) \times 10^{-4}$, and the correction factor (0.999725) for the conversion of the atomic weight from the physical to the chemical scale, the value of the atomic weight obtained was 151.19 ± 0.03 . Recent determinations of the atomic weight of europium by chemical methods carried out by Baxter and Tummeler give 151.963. Kapfenberger (*Z. anorg. Chem.*, 238, 273; 1938) obtained the value 151.901 by determining the ratios $\text{EuCl}_2 : 2\text{Ag}$, and $\text{EuCl}_2 : 2\text{AgCl}$. H. Lichtblau now reports the results of a reinvestigation of the isotopic abundance of europium (*Naturwiss.*, 27, 260; 1939). Details of the method are given, and the result obtained is $^{151}\text{Eu} : ^{153}\text{Eu} = 96.8 \pm 1.2 : 100$. Other isotopes were not found, and if they exist the upper limit of their abundance is 0.4 per cent. The mean mass number calculated from the abundance is $152.619 \pm 6 \times 10^{-4}$. Using Dempster's value for the packing fraction, $(2 \pm 0.5) \times 10^{-4}$, and the above-mentioned correction factor for converting the

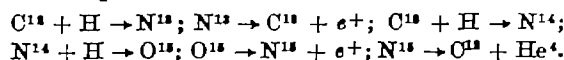
physical to the chemical atomic weight, the atomic weight is calculated to be 151.95 ± 0.01 . Using Aston's value for the packing fraction, the atomic weight is 151.92 ± 0.03 .

Overhead Line Vibration

THE paper on the vibration of overhead line conductors by Messrs. E. W. W. Double and W. I. Tuck, read to the Institution of Electrical Engineers on April 12, is a useful contribution to an important practical problem. When a smooth cylindrical body is placed in a fluid moving with steady velocity at right angles to the axis of the body, it is known that the formation of eddies in the fluid behind the body depends on the velocity of the fluid, the length of the axis of the cylinder and the dynamic viscosity of the fluid. A simple formula derived from the three quantities leads to Reynolds' number, the value of which enables us to find the velocity of the water flow when it changes from steady streamline flow to the turbulent condition when eddies are formed behind the cylinder. The generally accepted theory is that vibrations are set up when the eddy frequency of the vortices coincides with one of the elastic periods of the vibrating line. This cause resonance, which initiates and maintains vibrations. Field observations were made on the vibrating conductors consisting of 100-ft. lengths of stranded steel cored aluminium conductor in air, under given controlled conditions of vibration, to get data on the behaviour of the conductor and clamps and the maximum bending stresses induced in the conductor. It was thought that when these data were found it would be possible to deduce the maximum safe 'stringing' tension of the line, assuming that it depended mainly on the repeated bending stresses. A study of cables broken at the end of the suspension clamp showed that the 'scoring' of the aluminium wires aided by abrasion weakened them so that full use was not made of the fatigue strength of the aluminium. The actual break occurs at points where the wires were 'nicked'.

Energy Production in Stars

THERE have been many attempts to account for the production of energy in stars with the aid of atomic transmutations. A. A. Bethe (*Phys. Rev.*, 55, 434; 1939) has now described in detail a cyclical scheme of reactions in which reactions between protons, carbon, nitrogen and oxygen nuclei result in the combination of four protons and two electrons into an α -particle:



It is shown that the probabilities of these reactions, at a temperature of about 20 million degrees, corresponding to the central temperature of the sun, give about the right rate of energy production for that body. The dynamics of the process are also consistent with the mass luminosity relations which have been observed among the stars. Nuclear reactions other than these are examined and shown to play little part in the energy production—in particular, it is not possible for elements heavier than He^4 to be built up continuously in ordinary stars, and these elements must have existed already when the star was formed. In some faint stars, however, it is possible that energy is produced by the reaction



International Standard of Concert Pitch

By Dr. G. W. C. Kaye, O.B.E., F.R.S.

THE question of the international standardization of concert pitch, to which reference has already been made in NATURE (November 5, 1938), was the subject of an International Conference on May 11 and 12 last, under the auspices of the International Standards Association (I.S.A.). The Conference, which was held at Broadcasting House by the courtesy of the British Broadcasting Corporation, was organized, at somewhat short notice, by the British Standards Institution under its director, Mr. J. Maistre. Five countries (France, Germany, Great Britain, Holland and Italy) sent delegates, while the official views of Switzerland and the United States of America were before the Conference. The International Union for Broadcasting (U.I.B.), and the International Consultative Committee on Telephony (C.C.I.F.) were also represented by delegates. The President of the Conference was Dr. G. W. C. Kaye, Chairman of the British National Committee on Acoustics, and the British delegation consisted of Dr. Kaye, Dr. F. W. Alexander, Captain E. H. T. Broadwood, Mr. L. S. Lloyd and Mr. Henry Willis.

The Conference was formally opened by Sir Cecil Graves, deputy director-general of the B.B.C., who, after welcoming the delegates, pointed out that the fixing of a new concert pitch is a problem for the musician to decide, after which the aid of the technician must be sought to help the musician to make and maintain the pitch he has chosen. Although it is probable that the extreme range of variation in the pitch of orchestras the world over does not exceed a semitone, it was scarcely necessary to stress the increased comfort and assurance of a standardized pitch to singers and to players of concertos for stringed instruments. There is no doubt, too, that the manufacturers of musical instruments, particularly of organs and pianos, would welcome a standardization which would relieve them of the frequent necessity of re-tuning. As regards listeners to music, whether at the concert hall or through the medium of broadcasting, no real comparison on the score of brilliancy of two different performances of the same symphony by different conductors is possible unless the two performances are based on the same pitch. In these days of emotional stress, it is no small achievement for nations to come together to discuss a subject that is very much bound up with the emotional factor. General agreement on principles and practice might well be a promising portent for the future of the world.

In his opening address, the President reminded the delegates of the occasions in the past when agreement had been sought on the present question, but no outstanding measure of international unification had ever resulted. He hoped that before the Conference dispersed, it would have set up a musical milestone of lasting significance. The question of an international standard of concert pitch, while always of commercial importance in the international trading of musical instruments, has assumed new prominence in view of the requirements of international broadcasting and the development of electro-acoustical instruments. It was in fact the

urgent requirements of the International Broadcasting Union which finally led to the decision to endeavour to bring about international agreement.

After suggesting that the Conference should confine itself to the standard convention of expressing concert pitch in terms of the note A in the treble clef, brief reference was made to the historical background of concert pitch—to the early and pronounced meanderings of pitch during the fourteenth to the nineteenth century; to the first attempt at standardization a century ago in Great Britain, namely, the philharmonic pitches of 433 in 1826 and of 455 in 1845; to the value, 440, adopted by the Stuttgart Conference in 1834; to the French Diapason Normal, 435, of 1859, and its endorsement by the International Congress of 1885 in Vienna. In the United States, a figure of 440 is now general after many vagaries, while as regards Great Britain, reference may be made to the standardization at 439 of piano pitch by the piano makers in 1899, and to the lowering in 1927 of the pitch of the British Army bands from 455 to 439. The first question before the Conference was virtually that of reviewing the present general upward departure from the standard adopted in Vienna more than fifty years ago. Incidentally, so far as actual frequency measurements go, the standardization requirements of musical pitch present an easy problem to the physicist who can, if desired, measure frequency to an accuracy of 1 in 100 million.

A survey of the reports submitted by different countries to the Conference indicates that the present position can well be regarded as propitious for international agreement:

	Treble A (cycles per sec.)
French Standards Association, proposes	440
German Standards Association, proposes	440
American Standards Association, proposes	440
British Standards Institution, proposes	440
Dutch Acoustics Committee, agrees	440
Swiss Standards Association, agrees	440
International Union for Broadcasting, suggests	440
Italy has adopted	435 ± 4
Mean of European Concert Broadcasts	443
Electric organs, American	440
Electric organs, British	439

A friendly and vigorous discussion followed, during which it was happily found possible to establish eventual agreement on the main points at issue. Thereupon, taking cognizance of the general lack of observance of the Vienna standard (435) in favour of an appreciably higher though variable figure, which moreover shows a constant and regrettable tendency to increase, and having regard to the aesthetic, technical and economic importance of early international standardization within the limits of existing practice, the Conference unanimously agreed to forward the following recommendations to the parent International Acoustics Committee for submission to, with a view to ratification by, the national standardizing bodies affiliated to the International Standards Association; also to the U.I.B., the

C.I.J.F. and the International Electrotechnical Commission (I.E.C.):

(1) That the international standard of concert pitch shall be based on a frequency of 440 cycles per second for the note A in the treble clef. ("La normale".)

(2) That this value shall be maintained within the closest limits possible, by soloists, orchestras, choirs, etc., throughout all musical performances, and also in recorded music.

(3) That with a view to reducing the necessary tolerances to acceptable values, a set of technical recommendations be drawn up, preferably on the basis of international co-operation.

An appendix to the recommendations relates to a future programme of study designed for early discussion, so as to render effective as soon as possible the practical observance of the new standard concert pitch: for example, the differential influence of temperature on the various orchestral instruments and the consequential tuning adjustments before and during a performance; the feasibility of transmitting the standard pitch by means of broadcasting or telephone; the provision of sub-standards of pitch,

portable or otherwise, and the advisability of the verification by an official laboratory; the production of specifications dealing with the appropriate tolerances in the manufacture of musical instruments and the setting up of supervisory safeguards, both national and international, for verifying the observance of the new standard pitch and so preventing the possibility of its falling into disuse, as has occurred with the Vienna standard.

The success of the Conference was a happy vindication of the decision to go forward with the plans for bringing the delegates of the different countries together, despite the troubled nature of the times. The delegates further consorted in complete and amicable accord on the occasions of visits to the Acoustic Laboratory of the National Physical Laboratory by the kind invitation of the Director, and to Lyn Capel, Surrey, at the invitation of Captain Broadwood, whose beautiful house and estate, in all the glory of the spring foliage, formed a lovely setting for his genial hospitality and the delightful unaccompanied old English melodies of the famous Tudor Singers under the direction of Mr. Cuthbert Bates.

Telephony in the United States

THE annual report by the directors of the American Telephone and Telegraph Co. for the year 1938 is of great interest. The taxes last year were equal to about 80 cents per month per telephone, which is about 14 per cent of the average telephone bill, or about one third of the total pay roll. Notwithstanding the heavy taxation and increased wages, the earned dividends for the last two years were nearly the same.

Until 1927, the longest distance a telephone call could be made was about 3,000 miles; to-day there is no limit. We can talk round the world. The improvement in transmission on a call from New York to San Francisco as compared with twenty years ago when trans-continental service was inaugurated is roughly equivalent to the difference between conversing in an open field at a distance of several hundred feet and conversing with someone in the same room at about one third the cost. Five years ago the time of making a long-distance connection was reduced from 7.5 minutes to 3 minutes. Last year a direct radio telephone circuit from San Francisco to Australia was made, replacing the original route from New York via London. This new circuit is several thousand miles shorter and made possible a substantial reduction in the price of a call.

The ocean liner *Nieuw Amsterdam* has been added to those with which the Bell system operates ship-to-shore radio telephone service. Twelve shore stations of the Bell system and its connecting companies now serve nearly a thousand small vessels on the Atlantic and Pacific coasts and on the Great Lakes.

The damage experienced by the destructive effects of fires, floods, tidal waves and hurricanes in 1938 was the most extensive ever experienced. In September all these destructive forces combined, causing a disaster in the eight north-eastern States affecting the greatest number of telephones and communities since the telephone was invented. More than half a million telephones were silenced, and 240 communities were isolated. The wreckage of telephone plant put

the Bell system to the greatest test it had ever been called on to face—a test of the organization, of its men and women, and of its resources of equipment and supplies. More than 2,300 trained men with 615 motor-vehicles were loaned by fourteen telephone companies. Enormous quantities of materials were rushed in promptly by the Western Electric Co. The Bell companies in the stricken area, assisted by the resources of the entire Bell system, successfully met the challenge of the catastrophe, the telephone men and women, unmindful of hardship, carried on with resourcefulness and courage, and the result was an almost impossible job splendidly done.

Research in the field of radio telephone transmission has been specially pushed in the direction of increasing the efficiency and the steadiness of trans-oceanic circuits in anticipation of the adverse conditions likely to occur in 1940 and 1941 at the time of the expected maximum effect of sunspot disturbance. Highly efficient adjustable directional antennae have been prepared. One of these, two miles long, is now being installed in the trans-Atlantic route. Two noteworthy achievements in civil and military aeronautics were made last year. One was the development of an accurate instantaneous terrain clearance indicator by which a pilot is at all times apprised of his height above the ground. The other was the development of an aeroplane locator for use at ground stations. By dialling the frequency of the aeroplane radio, the airport operator can see on a map the direction of any aeroplane within range. This should be of great value in reducing risks to aeroplanes in bad weather.

The Company has a memorial fund which provides annual awards in recognition of unusual acts of service. This year one (posthumous) gold medal worth £100 and thirty-two bronze medals were awarded to individuals, and four special bronze plaques were awarded to groups of employees in recognition of their skill, courage and devotion to duty along the Ohio River Valley during the flood of January 1937.

Jubilee of Johns Hopkins Hospital

LET us hope," said John Shaw Billings at the opening on May 7, 1889, of the Johns Hopkins Hospital in Baltimore, "that before the last sands have run out from beneath the feet of the years of the nineteenth century, it will have become a model of its kind, and that upon the centennial of its anniversary it will be a hospital which shall still compare favourably, not only in structure and arrangement, but also in results achieved, with any other institution of like character in existence."

Half a century has rolled by since that memorable day, full of pride, tradition, and famous men whose names continue to shine with undiminished brightness in the medical firmaments: Osler, Welch, Talsted, and Kelly. The intellectual child of that healthy Baltimore bachelor and banker John Hopkins, when the hospital opened its doors, it consisted of seventeen buildings with two hundred and thirty beds, seven graduate head nurses, and seventeen probationers. There were but four services: medical, surgical, gynaecological, and pathological. To-day "Hopkins" has developed into a medical centre with 1,024 beds and 690 nurses.

On May 4, 5, and 6 a large number of old Hopkins people, medical men and nurses, and many distinguished visitors gathered together at Baltimore, to celebrate the fiftieth birthday of an institution of which it has been said that it has become more famous than the historic city beyond its walls. At the exercises held on the green lawn of the hospital in the afternoon of May 4, Dr. James B. Herrick,

"dean of American physicians", described Osler's text-book of medicine as Johns Hopkins's greatest single contribution to medicine. A serious note was struck by the Hospital's director, Dr. Winford H. Smith, who suggested that the days of great individual fortunes are passing and with them the days of great philanthropies and benefactions, so that one of the prime problems of the hospital of the future will be increasing dependence upon Government for support. In the evening a historical play, "The Flowering of an Idea", written by Dr. Alan M. Chesney, dean of the Medical School, and dealing with the early development of the Hospital, was performed.

A carefully planned and fascinating programme consisted of exhibits, lectures, demonstrations, and conferences. Among others, Dr. Simon Flexner spoke on "The Nuffield Benefaction and the Full-Time Chairs at Oxford". At a reunion dinner attended by some thousand medical men and nurses, Dr. J. M. T. Finney acted as toastmaster, and the speakers included Dr. Howard A. Kelly, the only surviving member of the "Big Four" immortalized in Sargent's painting, and Dr. Lewellys F. Barker.

The eyes of the scientific world will be focused upon Johns Hopkins Hospital during the next fifty years of its existence. It has had a great past, and its responsibility towards the future is enormous beyond reckoning. "A city that is set on a hill cannot be hid."

WALTER BETT.

Scientific and Industrial Research in Australia

THE twelfth annual report of the Council for Scientific and Industrial Research, Commonwealth of Australia, covers the year ended June 30, 1938.*

The most important development during the year was the decision of the Government to extend the work of the Council for the secondary industries, for which purpose the sum of £250,000 was appropriated for capital expenditure, involving establishment of the Standards Laboratory and an aeronautical and engine testing laboratory and an information section. A site has been offered by the University of Sydney for the Standards Laboratory within its own grounds. It is proposed that the laboratory should be organized in sections for meteorology, electro-technology and physics. The aeronautical laboratory is to be located in Melbourne, for which purpose a site has already been acquired. In addition to providing the information service visualized by the Secondary Industries Testing Research Committee, the proposed information section is intended to initiate research work in co-operation with industry, and the Imperial Agricultural Bureau plan will be extended to include other branches of science and industry than agriculture.

* Parliament of the Commonwealth of Australia. Twelfth Annual Report of the Council for Scientific and Industrial Research for Year 1937-38. Pp. 96. (Canberra: Government Printer, 1939). 4s

In addition to the preparation of bibliographical references, the work of the section will cover the supply of scientific and technical information, the preparation of information relating to recent advances in the application of science to industry, etc., the preparation and publication of articles, Press statements, reports, etc.

The report gives brief reviews of the work carried out by the various departments of the Council. The Division of Plant Industry has continued its work on the breeding of pasture plants, the storage of fruit and on the root rot of wheat. Tobacco investigations have included the control of downy mildew, and a survey is being made of the potato virus diseases of Australia.

The work of the Division of Economic Entomology during the year on the sheep blowfly pest has been concerned with the study of attractiveness, the development of standard methods of testing poisons and investigations of dressings. Further work has been carried out on the control of codling moth with the particular object of finding an efficient alternative to lead arsenate.

The Division of Animal Health and Nutrition occupied the new animal health research laboratory at Melbourne during the year, and work on pleuro-

pneumonia in cattle and mastitis in dairy cattle was continued. The Division has also continued its studies in fleece chemistry, yield and fibre measurement and on the sheep blowfly problem, and an investigation on sheep dips was initiated during the year.

In addition to continuing its various soil surveys, the Division of Soils has been concerned with the use of a spectrograph and the polarograph for the determination of traces of metals in soils and in plant and animal diseases.

The work of the Division of Forest Products has continued to expand during the year and, in addition to the chemistry of wood and pulp and paper investi-

gations, has been concerned with the preservation of timber, the seasoning of timber and various problems in the wood manufacturing industry.

The Division for Food Preservation and Transport occupied its new laboratory at Homebush Bay, Sydney, during the year and has completed its work on the cooling of beef in sides. Other work has dealt with the loss of bloom on chilled beef, the storage of oranges, peaches, plums, pears and grapes as well as on apples and eggs. Further progress has been made during the year by the Council in the provision of staff and facilities for fishery investigation in which aerial reconnaissance has again been used.

The Dutch Congress of Natural Science and Medicine

THE twenty-seventh Dutch Congress of Natural Science and Medicine was held at Nimeguen, Holland, during April 11-13, under the presidency of Prof. G. Holst. Reference was made to the general lectures in the programme in a note in NATURE of April 1, p. 554. At a joint meeting of the physical and chemical sections Prof. Errera, of Brussels, gave a special address to the Congress on his investigations of the absorption of organic compounds in the infra-red part of the spectrum. Besides the well-known absorption bands belonging to special atomic configurations, new absorption bands appear which must be ascribed to multi-molecules (association). In solutions, there appear special bands due to the interaction of an atomic group of the solvent with the molecule in solution.

MATHEMATICAL PHYSICS AND PHYSICS

Among the papers presented to the section on mathematical physics, the following may be mentioned. Methods of approximation of the general wave equation were discussed with special reference to the Schrödinger equation. Prof. de Laer-Kronig treated a new perturbation theory, leading to a difference equation, which can be solved numerically by the application of an extension of the well-known Wentzel-Kramers-Brillouin approximation. It was shown by Prof. Zernike that the intensity of light in the vicinity of a focus can be described, even for the most general boundary conditions, by a special kind of orthogonal functions, introduced by him. Dr. Bremmer demonstrated that the Wentzel-Kramers-Brillouin approximation of the wave equation may be considered as the first of a series of terms, which can all be interpreted physically. Ehrenfest's theorem of the classical motion of the centre of a wave packet describing a particle in quantum-mechanics was extended by Prof. Fokker for a very general type of propagation equation.

In the physical section, Dr. Matthijs gave an account of measurements on the thermo-electric force of superconducting metals in the neighbourhood of the transition point, showing that superconductivity becomes evident at a temperature superior to the transition point.

In a discussion on nuclear physics, Mr. Barendregt reported experiments on pair formation by β -rays, which process appears to take place much more

frequently than theory predicts. Dr. Heyn gave an account of experiments, made in collaboration with Mr. Aten, jun., and Dr. Bakker, on the fission of thorium and the thorium nuclei by neutron bombardment. From experimental evidence it follows that these nuclei can break up in more than one way.

CHEMISTRY

In the chemical section, Mr. van Pelt communicated experiments on the bromination of pyridine and compounds containing a pyridine ring. It was found that, depending on the temperature, either *ortho*- or *meta*-substitution occurs. Dr. Heertje dealt with the measurement of the density of fibres. A gas-volumetric method with helium was used. Evidence was produced for the assumption that water is absorbed by cotton in two different ways. Prof. Aten described an objective colorimeter which can be constructed at very low cost using ordinary laboratory apparatus. Mr. Troelstra discussed the latest improvements in electrodialysis.

BIOLOGY

The programme of the biological section contained a large variety of communications. The main topic was the need of magnesium in plants (O. de Vries) and animals (Sjollema). Further botanical subjects dealt with were the transport of substances (Aris), the relation between yield and the ratio between roots and sprouts (Boonstra), bacterial leaf-symbionts (De Jongh), antagonisms between micro-organisms (Westerdijk), the influence of colchicine on nuclear divisions (Wellensiek) and problems in the rooting of cuttings (Funke, Hubert and Rappeport).

Zoological subjects discussed included: Colorado beetle (Roepke), the life of termites in the Netherlands Indies (Kalsbeek), metabolism in trypanosomes as a basis for control (Krijgsman) and the power of orientation of migratory birds (Van Dobben).

In addition, pollen analysis investigations (Florschütz), vertebrate fauna (van der Vlerk) and botanical investigations (Polak) of the quaternary in the Netherlands were discussed in the geological section, while the general lectures of Ornstein on physics and biology and of Gorter on very thin membranes attracted considerable attention from biologists.

University Events

CAMBRIDGE.—G. Manley of Gonville and Caius College has been appointed University demonstrator in geography.

The Board of Management of the Frank Edward Moore Fund will shortly proceed to the award of two studentships for research in medicine. The studentships are open to male graduates of any University who were born in any country within the British Empire other than Scotland. The students appointed will work in the Department of Medicine of the University of Cambridge under the direction of the regius professor of physics. The commencing salary will be £300 a year, and the appointment will be for two years in the first instance. Further information may be obtained from the regius professor of physics, Department of Medicine.

The following have been elected to fellowships at St. John's College: Dr. W. A. Deer, Strathcona research student (1934), Royal Commission for Exhibition of 1851 senior student (1938), formerly at the University of Manchester. F. Hoyle (Emmanuel College), Part I, Mathematical Tripos, Class I (1934), Part II, Mathematical Tripos, Class II (1935), Part III, Mathematical Tripos, honours with distinction (1936), Mayhew Prize (1936), Goldsmiths' senior student (1937), Smith's Prize (1938).

LEEDS.—The Council has received the following donations: £50 from the Education Committee of the National Association of Local Government Officers to assist in the encouragement of the study of public administration; £110 from the Anglo-Saxon Petroleum Company (Royal Dutch Shell group) for a scholarship tenable in the Mining Department.

LONDON.—Prof. W. E. Le Gros Clark has been appointed as from October 1 to the University chair of anatomy tenable at University College. He has held University chairs of anatomy at St. Bartholomew's Hospital Medical College and at St. Thomas's Hospital Medical School, and since 1934 he has been professor of anatomy in the University of Oxford.

Dr. Samuel Nevin has been appointed to the University chair of the pathology of mental disease tenable at the Maudsley Hospital. He will take up his duties in September next.

Dr. Patrick D. F. Murray has been appointed, as from October 1, to the University readership in biology tenable at St. Bartholomew's Hospital Medical College. He has held a Rockefeller travelling fellowship and a Smithsonian research fellowship; and since 1937 he has held a teaching post in the Department of Zoology at Bedford College.

The title of reader in economic statistics, with special reference to mathematical economics, in the University has been conferred on Mr. Roy G. D. Allen in respect of the post held by him at the London School of Economics.

The title of professor emeritus of medicine in the University has been conferred on Prof. T. R. Elliott on his retirement from the professorship of medicine and the directorship of the Medical Unit at University College Hospital Medical School.

The degree of D.Sc. has been conferred on Mr. C. L. Wilson, an internal student, of University College and on Mr. F. G. Young, an internal student, of University College.

Science News a Century Ago

The Royal Geographical Society

THE eighth anniversary meeting of the Royal Geographical Society was held on May 27, 1839. According to the annual report, sixty-three new members had been elected; and the Society consisted of 651 members, and sixty foreign, honorary and corresponding members. The president, in handing a gold medal to Chevalier Bunsen to be sent to the naturalist and traveller Dr. Wilhelm Ruppell (1794–1884) of Frankfort, said that the medal was awarded in testimony of Dr. Ruppell's services in the advancement of physical geography. Dr. Ruppell had made three journeys into Africa. After the first he had placed himself under the tuition of the learned Baron von Zach. He then returned to Egypt, visited Arabia, the gulf of Akabah (which he was the first to explore geographically), Abyssinia and Kordofan. All the produce of his travels in the department of zoology, which absorbed a large part of the pecuniary means at his disposal, he had generously made over to his native city.

Daniell's Constant Battery

ON May 30, 1839, at a meeting of the Royal Society, the fifth letter of J. F. Daniell to Faraday on voltaic combinations was read. The letter also gave an account of the effects of a large constant battery. The constant battery consisted of seventy cells in a single series, which gave, between charcoal points separated a distance of three-quarters of an inch, a flame of considerable volume, forming a continuous arch, and emitted radiant heat and light of the greatest intensity. The latter, indeed, proved highly injurious to the eyes of the spectators, in which, although they were protected by grey glasses of double thickness, a state of very active inflammation was induced. The arch of the flame between the electrodes was attracted or repelled by the poles of a magnet according as the one or the other pole was held above or below it; and the repulsion was at times so great as to extinguish the flame. When the flame was drawn from the pole of the magnet itself, included in the circuit, it rotated in a beautiful manner. The heating power of the battery was so great as to fuse, with the utmost readiness, a bar of platinum one eighth of an inch square; and the most infusible metals, such as pure rhodium, iridium, titanium, the native alloy of iridium and osmium, and the native alloy of platinum.

Lyell's "Elements of Geology"

ON June 1, 1839, in its column headed "Our Library Table", the *Athenaeum* included this note about Lyell's "Elements". "The author states that the present treatise was originally intended to appear as a supplement to his 'Principles' but that he was subsequently induced to enlarge it, and bring it out in the form of a distinct work. It is an attempt—and we think a very successful one—to put forward in a simple and clear manner, those facts which are indispensable to a knowledge of the science, and to place the student in possession of the data by which geologists of the existing school explain the more palpable and widely spread geological phenomena. The bold and ingenious speculations, so ably developed by Mr. Lyell in his larger work, and to which his present fame is mainly to be attributed, are here, in a great measure, kept out of the field."

Societies and Academies

Paris

Academy of Sciences (*C.R.*, 208, 1125-1178,
April 12, 1939).

H. VALLÉE: The adjuvant factors of vaccination. The acidity of anthrax vaccine and its various insoluble sediments are essential factors in determining immunizing power.

O. C. DE BRAUBERGARD: The problem of the exact measurement of a long line.

J. VILLEY and R. LEDUC: Auto-propulsion of a projectile-source.

L. MALAVARD: Prandtl's correction in a 'mixed' [partly directed, as opposed to free] channel: electrical method and calculation.

R. GRANDMONTAGNE: Evaluation of the brightness of the mean night sky by means of a cesium photo-electric cell.

MILLE. P. FAVRIER: Objective character of indiscernibility.

G. REBAUD: Formulae for the convection of heat for a fluid flowing normal to the axis of a cylinder.

MILLE. E. MONTEL: Determination of the mobilities of gaseous ions.

M. CHÈNE: Preparation of two phosphides of vanadium by fusion electrolysis [of vanadium anhydride dissolved in alkaline phosphates].

P. ROUARD: Study of very thin platinum films. The metal was deposited on glass by cathodic sputtering. Films less than 7 mμ in thickness are different in properties from the massive metal.

P. LAMBERT and J. LECOMTE: Infra-red absorption spectra of hydrocarbons of high molecular weight and of some heterocyclic compounds.

A. PIKARA: Variation with heat of the magnetic birefringence of polar liquids.

MME. Z. SOUBAREW-CHATELAIN: Hydrated neutral sodium dimolybdate.

J. VAUTHIER: Action of nitric acid on iron carbide.

MILLE. G. CAUQUIL: Action of selenium oxide on 1-methyl-4-isopropylidenecyclohexanone-3.

MILLE. Y. GARREAU: New addition products of diphenols.

B. BRAJNIKOV: Geology of Vérala Planina (Bulgaria).

E. DE MARTONNE: Formation of 'sugar-loaves' [rocky peaks with precipitous sides, several hundred metres high] in Brazil.

R. BERNARD: Possible presence of cyanogen bands in the spectra of the red auroras of type B.

MME. O. THELLIER: Diurnal variation of the electric conductance of the atmosphere and the number of ions and condensation nuclei at the Observatory of Chambon-la-Forêt.

MILLE. A.-M. DE LA BERNARDIE: Existence of antagonism between thyroxine and the vitamins.

B. S. LEVIN and L. OLIZKI: Total loss of pathogenic action of *B. typhi murium* given orally, after prolonged culture in lecithin media.

Budapest

Hungarian Academy of Sciences, April 17.

G. RADOS: Semi-definite Hermitian forms.

G. ZEMPLÉN: Synthesis of α-1-xyloido-6-glycose, the isomer and derivative of the primverose.

P. FRÖHLICH and I. MISCHUNG: Emission of phosphorus.

J. FINKEV: Flotation of grey slate from Recek.

A. BUZÁGH and E. ERNYEI: Permeability and absorption of liquids by sediments.

F. PAPP: Several minerals from Szarvaskő.

G. ZILAHY SEBES: Sexual organs of the Heleides.

L. GOMBAY: Electric conductivity of phosphorus.

P. KOLLER: Development of the mechanism of sex determination.

Geneva

Physical and Natural History Society (Feb. 2, 1939).

E. PAREJAS: Transversal tectonic of Anatolia (preliminary note). The Alpine folding runs mainly from south-east to north-west. The most important transversals are those of the Dardanelles, Marmora, Antalya, Istanbul-Chypre, Tüz Golu-Odessa, Kizilirmak-Crimea, Kertch and the Caucasus.

MME. R. DOVAZ: Vaginal mucification in the pregnant guinea pig. During gestation, the ovaries sometimes contain big follicles; in such cases, there are excessive vaginal mucus and intense leucocytosis. The condition depends on the food conditions or the temperature.

A. MIRIMANOFF: Is sterilization in the cool possible in microbiology? Attempts to generalize the sterilization of culture media, at ordinary temperature, by volatile anaesthetics, which would conserve thermolabile factors, have been unsuccessful.

G. TIERCY: Solution of the equation of transfer of energy and the function $B(\tau)$ in astrophysics. Investigation of the form of $B(\tau)$ necessary to give a finite value at the surface of a star, and also to the intensity of radiation, while the derivative of the function would become infinite.

March 2, 1939.

E. BRINER and E. PERROTET: Determination of the solubility of ozone in water.

T. POSTERNAK: Pigments of *Penicillium rubrum* and *P. citreoroseum*. The red pigment of the former is the phenolic of *P. phanicum* (2,2'-dioxo-4,4'-dimethyl-diquinone). The pigment of *P. citreoroseum* has the properties of a poly-oxyquinone.

J.-L. PERROT: Fertilization in *Arion empiricorum* Fer. (preliminary note). The possibility of direct self-fertilization by ripe autochthonous sperms in the ovo-testis cannot be excluded; but there seem to be varieties of different physiological character.

M. PERROT: Systematic position of *Euparypha pisana* Muller, from a study of the chromosomes. Conchological, anatomical and zoogeographical characters and cytological observations separate the genus *Euparypha* clearly from *Helix*, *Archelix* and *Cepaea*. It is proposed to put *Helix pisana* in a new sub-family, the Euparyphinae.

E. A. H. FRIEDHEIM: Negative effect of sources of mitogenetic rays on growth of tissue cultures. Hanging-drop cultures of chick fibroblasts submitted to the action of various 'inductors' (root and juice of onion, cultures of *B. tumefaciens*, tadpoles and tadpole extract, chick embryo, embryo extract, normal and cancerous human blood, monochromatic ultra-violet light from 2,000 to 3,600 Å.) have not shown more abundant mitoses than untreated cultures.

March 16.

P. BALAVOINE: (1) Variation of composition of the water of Lake Geneva. Analyses during 1936

1937 and 1938 show that the surface water is impoverished in calcium carbonate during the warm months by 7-10 per cent in relation to the total dissolved matter. This seems to be a physico-chemical effect, rise of temperature playing the chief part in this precipitation. (2) Observations on snow. Snow is able to condense strongly traces of ammonia in the atmosphere. The ammonia content of snow is ways very small (0.01-0.05 mgm. per litre of water fusion, exceptionally 2.0 mgm. per litre); but this explains the presence of ammonia in tanks not receiving faecal water.

M. GYSIN: A soda orthose in the syenitic rocks of Divrik (Turkey).

Moscow

Academy of Sciences (C.R., 21, No. 5; 1938).

N. GUNTHER: Theory of integrals of Stieltjes-adon and integral equations.

K. WULFSON: Sensitivity threshold of a gas radiometer.

M. L. VINGEROV: K. Wulfson's article "The sensitivity Threshold of a Gas Radiometer".

R. I. GARBER: Formation of elastic twins during the twinning of calcite crystals.

N. MIHAL: Determination of gravity anomalies from the astronomical-geodetical deflection of a plumb-line.

V. I. NIKOLAEV and B. I. STEPANOV: A method of producing pure common salt through bihydrate of sodium chloride, $\text{NaCl} \cdot 2\text{H}_2\text{O}$.

V. I. NIKOLAEV and E. I. RUDNENKO: Adsorptive properties of clay (kaolin).

G. B. BOKY: The number of physically simple crystal forms.

A. E. FERSMAN: Geochemistry of Kislovodsk environs.

A. K. GERGENEGIU: A new valuable bearer of vitamins and its commercial use.

D. S. BELIANKIN: Contribution to characteristics of the breccia-like and banded lavas of the volcano Elbrus.

G. L. KAMENSKI: Movement of ground waters in water-riverine tracts.

E. N. SHMARGON: Analysis of the chromomere structure of mitotic chromosomes in rye.

P. A. POVOLOCHKO: Causes of constancy in the chromosome number of the autotetraploid *Nicotiana glauca* var. *eghisi*.

V. L. RISCHKOV and K. S. SOUKHOV: Virus of the tobacco mosaic tested for its power of fermentative activity.

C.R., 21, No. 6; 1938.

S. BACHVALOFF: Couples of stratifiable congruences.

N. DOBROTIN, N. IWANOWA and B. ISAJEV: Recoil-ray showers.

N. MALKIN: Helmholtz's formula and the isostasy hypothesis.

A. S. MOROZOV: Effect of sodium chloride and sodium sulphate salts on sugar content of melons.

S. W. BRUJEWICZ, R. M. PRYZENLAK, V. L. PONTIKOVSKAJA and M. A. SUBIRJAKOV: Accumulation of biogenic elements (nutrient salts) in mud water of freshwater basins.

A. L. BERNING: (1) Caspian relicts in the fauna of the Uzbek lakes. (2) Elements of subtropical fauna in rice fields of Uzbekistan.

T. K. ENIN: Intervarietal crossing in peas.

E. G. MININA: Phenotypical modification of sexual characters in higher plants under the influence of the conditions of nutrition and other external factors.

V. A. RYBIN: Colchicine-induced tetraploidy on flax.

SHEGHIUS LYOFF and G. M. TOUPKINA: Effect of sodium fluorine on the formation of citric and gluconic acids of the fungus *Aspergillus niger*.

A. G. EBERZIN: The Azov horizon of Kuban.

Vienna

Academy of Sciences, February 2.

K. GRAFF: Variation of the brightness of the satellites Titan and Iapetus of Saturn during 1922. The author's measurements during 1922 are in agreement with the hypothesis that the eastern and western hemispheres of Iapetus have an albedo in the ratio 1:6.3. The same hypothesis is in agreement with the observations of Wendell from 1896 to 1900.

February 9.

W. JENTSCHKE and F. PRANKL: Confirmation of the formation of heavy nuclei by the disintegration of uranium bombarded by neutrons. The energy of the particles emitted by uranium under neutron bombardment is found, by measurement of the ionization they produce, to be not less than 6×10^7 ev, while their range is only about 2 cm.; they are, therefore, almost certainly heavy nuclei having a high charge.

L. SCHMID and W. HOSSE: Amber (5). The constituents soluble in alcohol are examined chemically.

F. KERNER v. MARILAU: Temperature of springs on a slope of the Alps.

O. AMPFERER: Forms of mountain tectonics.

February 23.

L. SCHMID: Acids occurring in amber.

F. KOCCY: Determination of helium in rock-salt and sylvine. Rock-salt contains about 10^{-4} c.c. per gm. and sylvine about 10^{-4} c.c. per gm. of helium. The coloration of rock-salt is not connected systematically with the helium content; on the other hand, the magnitude of the latter indicates that the irradiation of the rock-salt must have been ample to produce the coloration.

G. ORTNER and G. PROTIWINSKY: Reaction of fast neutrons with neon nuclei. The neon was contained in an ionization chamber and the sum of the energies of the ^{10}O and ^4He nuclei into which it disintegrates on bombardment with neutrons was measured by the magnitude of the bursts of ionization produced. The results are in partial agreement with other work on the energy-levels of the ^{10}O nucleus when formed by other reactions.

W. CZULIUS and J. SCHINDLER: Method for separating the radioactive nuclei formed from uranium bombarded by neutrons. The nuclei arising from the explosion of the uranium nucleus are collected on a cylinder of celluloid wrapped around the uranium; by this means they are obtained free from any contamination by natural decay products of uranium.

K. W. F. KOHLRAUSCH and R. SABATHY: Studies of the Raman effect (99). Esters of mono- and polybasic carboxylic acids.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

LECTURER IN MECHANICAL ENGINEERING in the Haddon Mining and Technical School—Director of Education, County Education Office, Derby (May 27).

LECTURER IN PRODUCTION ENGINEERING in the Birmingham Central Technical College—The Chief Education Officer (May 31).

LECTURER IN MECHANICAL ENGINEERING in the Rugby College of Technology and Arts—The Principal, 61 Clifton Road, Rugby (May 31).

LECTURER IN ENGINEERING in the County Technical College, Wednesbury—The Director of Education, County Education Office, Stafford (May 31).

TEACHER OF MATHEMATICS, PHYSICS AND CHEMISTRY in the Smethwick Technical College—The Chief Education Officer, Education Office, 215 High Street, Smethwick (May 31).

LECTURER IN PHYSICS AND LECTURER IN TELECOMMUNICATION in the Woolwich Polytechnic, London, S.E.18—The Secretary (May 31).

LECTURER IN PHYSICS in the School of Science, Khartoum—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1 (May 31).

LECTURER IN THE DEPARTMENT OF PHYSICS AND APPLIED PHYSICS in the Technical College, Cardiff—The Director of Education, City Hall, Cardiff (June 2).

LECTURER IN MECHANICAL ENGINEERING in King's College, Newcastle-upon-Tyne—The Registrar (June 3).

LECTURER IN MECHANICAL ENGINEERING in the Shrewsbury Technical College—The Clerk to the Governors, County Buildings, Shrewsbury (June 3).

ASSISTANT LECTURER IN PHARMACOLOGY in the University of Sheffield—The Registrar (June 5).

LECTURERS IN CIVIL ENGINEERING, MATHEMATICS AND PHYSICS in the Northampton Polytechnic, St. John Street, N.C.1—The Principal (June 5).

HEAD OF THE DEPARTMENT OF MECHANICAL ENGINEERING in the Northampton Polytechnic, St. John Street, N.C.1—The Principal (June 5).

CHIEF ENGINEER at the Royal Ordnance Factory, Irvine, Ayrshire—The Under-Secretary of State (O.S.), The War Office, London, S.W.1 (June 5. Quote 141 A).

TECHNICAL ASSISTANTS (grade II—engineering) in the Munitions Technical Planning Establishment—The Under-Secretary of State (O.S.), The War Office, London, S.W. (June 6).

LECTURER IN PHYSICS AND MATHEMATICS AND LECTURER IN MATHEMATICS AND ENGINEERING DRAWING in the Sir John Cass Technical Institute, Jewry Street, Aldgate, E.C.3—The Principal (June 7).

THREE ASSISTANTS (grade III—coal-mining explosives) at the Safety in Mines Research Board Station, Harpur Hill, Buxton—The Establishment Officer (June 10).

ASSISTANT LECTURER IN GEOGRAPHY in University College, Hull—The Registrar (June 10).

LECTURER IN CHEMISTRY AND LECTURER IN MECHANICAL ENGINEERING in the Midway Technical College (Senior Department), Gillingham, Kent—The District Education Officer, Fort Pitt House, New Road, Rochester (June 10).

ASSISTANTS (grade III—metalurgy) in the Admiralty Technical Pool—The Secretary of the Admiralty (O.E. Branch. Ref. O.E. 5834/39. June 10).

ASSISTANT LECTURER IN GEOGRAPHY in the University of Sheffield—The Registrar (June 12).

ASSISTANT INSTRUCTOR IN AGRICULTURE in Nottinghamshire—The Director of Education, Shire Hall, Nottingham (June 14).

RESEARCH ASSISTANT IN VETERINARY PARASITOLOGY in King's College, Newcastle-upon-Tyne—The Secretary, Duke of Northumberland Memorial Fund (June 10).

RESEARCH OFFICER at the Farnham House Laboratory—The Secretary, Agricultural Research Council, 6A Dean's Yard, Westminster, S.W.1 (June 15).

UNIVERSITY LECTURER AND TWO UNIVERSITY DEMONSTRATORS IN ANATOMY in the University of Cambridge—Dr. F. J. W. Broughton, Department of Physiology, Cambridge (June 17).

TWO SENIOR METEOROLOGICAL OFFICERS in Hire—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin (June 20).

BIOCHEMIST at the Long Ashton Research Station—The Secretary, University of Bristol.

SENIOR LECTURER IN MECHANICAL ENGINEERING in the County Technical College, Mansfield—The Principal.

Annual Reports on the Progress of Chemistry for 1938. Vol. 1: Pp. xviii+447. (London: Chemical Society.) 12s. net. [2]

Air Raid Shelters. Report of the Lord Privy Seal's Conference (Cmd. 6006.) Pp. 26. (London: H.M. Stationery Office.) 6d. net. [2]

Ministry of Health and Scottish Office. Inland Water Survey Committee: Third Annual Report, 1937-38. Pp. 23. (London: H.M. Stationery Office.) 4d. net. [3]

International Committee for Bird Preservation: British Birds Annual Report for 1938. Pp. 25. (London: o/o Zoological Society of London.) [3]

City of Norwich. Report of the Museums Committee to the Council for the Years 1936-1938. Pp. 22+8 plates. (Norwich: Norwich Museum.) [2]

Ministry of Health. Memo. Ev. 4: Government Evacuation School Pp. 32. (London: H.M. Stationery Office.) 3d. net. [1]

Other Countries

Smithsonian Institution. Explorations and Field-Work of the Smithsonian Institution in 1938. (Publication 3535.) Pp. iv+132. (Washington, D.C.: Smithsonian Institution.) [2]

Field Museum of Natural History. Geological Series, Vol. 6, A 23: A New Amphibion from the Deep River Miocene. By Paul McGrew. Pp. 241-350. 15 cents. Geological Series, Vol. 6, A 24: New Pantodonts and Dinocerata from the Upper Paleocene Western Colorado. By Bryan Patterson. Pp. 351-384. 50 cents. (Chicago: Field Museum of Natural History.) [2]

Kungl. Svenska Vetenskapsakademiens Handlingar. Serien Band 17, No. 1: Botanische Ergebnisse der Schwedischen Expedition nach Patagonien und dem Feuerlande 1907-1908. 11: Moerzen 3. Chlorophyceen. Von Dr. M. Hyman. Pp. 24. Serien 3, Band 17, No. 2: Crinoids of S. Africa. By Torsten Galden. Pp. 23+plates. Serien 3, Band 17, No. 3: South African Actinaria as Zoantharia. By Oskar Carlgren. Pp. 148+3 plates. (Stockholm: Almqvist and Wiksell.) [2]

Health Bulletin No. 12 (Malaya Bureau No. 4): Table for the Identification of Indian Freshwater Fishes, with Descriptions of Certain Families and Observations on the Relative Utility of the Probable Larvivorous Fishes of India. Revised and enlarged by Dr. Sunder Lal Hora and the late Dev Dev Minkler. Second edition. Pp. iii+47+7 plates. (Delhi: Manager of Publications.) 7 annas 8d. [2]

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 88: The Oriental Peach Moth (*Oryctes moles* Busck). Investigations in the Goulburn Valley, Victoria; Progress Report for the Seasons 1935-38. By G. A. H. Nelson. Pp. 23. Pamphlet No. 89: Needle Fusion of Phases in Southern New South Wales. By W. V. Lindbrook. Pp. 20. (Melbourne: Government Printer.) [2]

Survey of India. General Report, 1938, from 1st October 1937 to 30th September 1938. Pp. xi+76+14 plates. (Calcutta: Survey of India.) 1.8 rupees; 2s. 6d. [2]

Kungl. Sjökartverket. Resultat av de Beobachtungen & Magnetischen Observatorien zu Lovö (Stockholm) im Jahre 1933. Pp. 101. Resultat av de Beobachtungen des Magnetischen Observatoriums zu Lovö (Stockholm) im Jahre 1934. Pp. 101. Jordmagnetiska Publikationer Nr. 12: The Re-Survey of the Magnetic Meridian Stations in Sweden for the Epoch July 1, 1936. By Gustaf Ljungdahl. Pp. 25. (Stockholm: Kungl. Sjökartverket.) [2]

Union of South Africa: Department of Mines. Geological Series Bulletin No. 12: The Gold Occurrences South-West of Pietermaritzburg. By Dr. J. Williams. Pp. 28+7 plates. (Pretoria: Government Printer.) 6d. [2]

Government of Iraq: Ministry of Defence. Meteorological Service Occasional Publication No. 1: Mean Monthly Temperatures and Pressures at Three Selected Hours, Mean Monthly Maximum and Minimum Temperatures, Absolute Maximum and Minimum Temperatures and Mean Monthly Rainfall. Pp. 8. (Baghdad: Government Press.) 25 fils. [2]

Advisory Committee on Education. Staff Study No. 4: Federal Aid and the Tax Problem. By Clarence Heer. Pp. ix+101. (Washington, D.C.: Government Printing Office.) 15 cents. [2]

U.S. Department of Agriculture. Circular No. 518: Breeding Area and Economic Distribution of the Beet Leafhopper in New Mexico Southern Colorado, and Western Texas. By V. M. Romney. Pp. 1. (Washington, D.C.: Government Printing Office.) 5 cents. [2]

Carnegie Endowment for International Peace. Annual Report of 1938 of the Division of Intercourse and Education. By Nichol Murray Butler. Pp. 87+8 plates. (Washington, D.C., and New York: Carnegie Endowment for International Peace.) [2]

Report of the Botanical Survey of India for 1937-38. Pp. 1. (Calcutta: Government of India Press.) [2]

Catalogues, etc.

'Kodtrax': Kodak X-ray Film for use without Intensifying Screen Pp. 4. (London: Kodak, Ltd.)

Zeits Nachrichten. Folge 2, Heft 8, November 1938. Pp. 267-30. (Jena and London: Carl Zeiss.)

The Control of the Menopause. Pp. 20. (London: The British Drug Houses, Ltd.)

Landeskunde, Kartographie: Zeitschriften, Bücher, Abhandlungen (Antiquarisch-katalog Nr. 731.) Pp. 224. (Leipzig: Buchhandlung Gustav Fock, G.m.b.H.)

Aves, Mammalia, Pisces. (No. 97.) Pp. 52. (Den Haag: An quariaat Junk.)

South America, Central America and the West Indies: a Catalog of Books, Prints, Old Maps. (Catalogue No. 688.) Pp. 70. A Catalog of the Works of Novelists and Dramatists, General Literature, 6. (Catalogue No. 689.) Pp. 36. (London: Francis Edwards, Ltd.)

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Proceedings of the Royal Society of Edinburgh, Session 1938-1939. Vol. 59, Part 1, No. 5: Solution in Multiple Series of a Type of Generalized Hypergeometric Equation. By Prof. T. M. MacRobert. Pp. 49-54. 6d. Vol. 59, Part 1, No. 6: Investigation of Visual Threshold Values. By Mrs. M. M. Beattie. Pp. 55-61. 6d. Vol. 59, Part 1, No. 7: The Fertility of Scottish Married Women, with Special Reference to the Period 1936-1938. By R. S. Barclay and Dr. W. O. Kermack. Pp. 63-80. 1s. 6d. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Morgate, Ltd.) [244]

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Whither the Gas Industry?

THE "independent non-party group" concerning itself with "Political and Economic Planning" under the suggestively abbreviated title P E P, has added to its publications a "Report on the Gas Industry in Great Britain"*. This report has been produced by the Gas Group of P E P and will be followed, we are told, by a more comprehensive P E P report on fuel policy in Great Britain, for the purposes of which the findings of the coal, gas and electricity groups will be re-examined. The work has been well done and presents a picture of the gas industry as it exists to-day of a kind that, for interesting and revealing detail, has no rival. The development of the industry through various phases is also indicated with clarity, which is very desirable for a full understanding of the present situation and future possibilities.

For a long period after Murdoch and Winsor came forward a century ago with their processes for making coal-gas and using its luminous flame for lighting, improving technique simply served that purpose, important but limited, and under conditions of virtual monopoly. The introduction of the Bunsen burner and the Welsbach mantle, and the development of electrical supply, then played their part in gradually broadening the basis of the gas industry as a purveyor of heat as well as light, and in creating its competitive aspect. This has brought about the condition of to-day, in which the gas industry is no longer one for the heating of coal in retorts for making lighting-gas, but one for the systematic treatment of coal by carbonization and gasification in such a manner as to secure thereby products of

maximum thermal, chemical and monetary values. The realization of these values has also demanded agencies for their proper utilization and, brought into the scope of the industry, schemes for the distribution of gas (the primary product) and the provision of efficient appliances for its combustion, as well as a new-found solicitude for the yields, quality and fate of coke, tar, and such chemical products as benzole, with its practically unlimited market as a liquid fuel.

With this increasing complication there has arisen the paramount necessity for scientific and efficient management, and for wise and far-seeing administration, if the industry is to deal adequately with the problems it has to face. There are such matters to settle as the degree of linking-up in production and management which may with advantage be effected, partly with a view to better supply and partly so as to bring first-class men into more effective use than is possible with the very numerous scattered works now in being and working independently. It may be pointed out that the small gas-works is not at all necessarily an uneconomical unit if well designed, constructed and run. Similarly, the best method of utilizing the spare gas from coke-oven plants well repays careful study. The possibilities in that direction have been demonstrated already in such districts as Sheffield, where the cheap supply obtainable by the gas company from neighbouring coke-oven plants has been largely responsible for the wide and extending use of coal-gas in metallurgical and other industrial furnaces.

Such utilization of coke-oven gas seems an obvious and desirable economy; but it raises questions which require careful consideration when one remembers, for example, that the coke oven

* Report on the Gas Industry in Great Britain: a Survey of the Current Trends and Problems of the Industry, with Proposals for its Future Development. Pp. vii + 213. (London: P E P, 1939.) 10s. 6d. net.

cannot with advantage continue to make unwanted metallurgical coke in order that the gas supply may be maintained. There is, again, the vexed question of tariffs in the gas industry, the allotment of charges on a rational basis to small and large consumers, where the gas industry has inherited statutory limitations imposed in the old days, which tell against it in competition with the newer electrical undertakings, the successful working of which is indeed largely conditioned by their greater freedom in this respect.

The discussion of these matters, even in brief, is not possible here; but they are gone into thoroughly in the P E P report, which is, in effect, a call to the industry to organize itself in a manner befitting its responsibilities and opportunities. The acknowledgment is rightly made of much that has already been done. It has to be admitted that contact has already been made with the universities (particularly Leeds), and some recruiting of young men, although not nearly enough, has been so effected with great advantage to the industry. Co-operation with the Board of Education has meant a considerable extension of such training as can be given by evening teaching in technical schools to the coming non-commissioned ranks, both for gas-manufacture and for supply.

Discussion and reports on technical and other matters are very full and frequent, partly because the various gas companies and municipal gas departments are not in direct competition with one another and can pool information more freely on that account. This is more particularly the province of the central Institution of Gas Engineers (and the branch associations), which in the past have rather tended to regard gas-engineering and gas-manufacture as the same thing, but are, slowly it is true, broadening their views and basis of membership so as to recognize the essential unity of the whole gas-engineering profession. The Society of British Gas Industries has served as a meeting-ground for the many industries concerned with the manufacture of gas plants and appliances for both domestic and industrial use; the British Commercial Gas Association has made itself responsible for publicity work, while the National Gas Council and, more recently, the Gas Federation, have effected co-ordination on matters of common interest, particularly on the financial, legal and political sides. Co-operative research work has been so far mainly the concern of the Institution of Gas Engineers through its Executive Research Committee and the Joint Research Committee of

the Institution and the University of Leeds pioneering effort which has met with much success over a long term of years. There has, however, also been instituted a considerable research organization in the larger gas companies (particularly in London) contracting firms and appliance manufacturers.

The report is appreciative up to a point of that the gas industry has done in organizing itself but calls for a greater effort, and particularly form of organization which shall include a central authority within the industry for the co-ordination of its many activities. It would also be at giving full opportunities for the personnel of the industry to exercise its talents for the mutual general good and for the recruiting and training of first-class men. It would seek to effect improvement, which is indeed needed in most of the industries of Great Britain, by not only securing an adequate supply of research workers but also ensuring that the results of their work are understood and utilized by the executive management. It would aid schemes of development and amalgamation which it approved, and would claim a right to prohibit what it believed to be ill-advised.

Such extensive powers would plainly only be given after full consideration of their implication and under such conditions as would not allow vested interests or bureaucratic self-confidence to impede travel along new paths. The long view is essential in such matters, and the future possibilities in the treatment of coal by the gas and cognate industries were perhaps never so alluring as at the present time. The use of high temperatures and pressures in combination for the gasification of coal is bringing into prominence new reactions for the controlled transformation of 'fixed carbon' into methane and other hydrocarbons, and the various technical potentialities of the gasification process, chemical and thermal, are awaiting more complete investigation. Moreover, perhaps the most striking feature of recent progress in the technical world has been the new chemical engineering which is emerging from a vastly increased knowledge of materials of construction, particularly in the metallurgical field and this is going to facilitate enormously not only the laboratory investigation of determining conditions but also the translation of the results into large-scale processes. The gas industry has splendid opportunities, but only a well-founded and well-manned vessel can hope to sail these uncharted seas.

What We Know About Flow

Second Report on Viscosity and Plasticity
 Prepared by the Committee for the Study of
 Viscosity of the Academy of Sciences at Amster-
 dam. (Verhandelingen der Koninklijke Neder-
 landsche Akademie van Wetenschappen, Afdeling
 Natuurkunde, Eerste Sectie, Deel 16, No. 4.) Pp.
 i+287+2 plates. (Amsterdam: N. V. Noord-
 Nederlandsche Uitgeversmaatschappij, 1938.) n.p.

THE subject of viscosity and plasticity is one
 of peculiar difficulty. The two states of
 matter of which we have a moderately satisfactory
 knowledge are the gaseous and the perfect solid.
 The flow of a gas is easily understood, but it is
 remarkably clear that the mechanism of gaseous
 flow has little bearing on that of liquid viscosity,
 since none of the basic assumptions is valid for
 the liquid state. The perfect crystal is incapable
 of plastic deformation, at any rate under forces
 anything like as small as those which produce
 formation in real solids. We know extremely
 little about the liquid state, and there is practically
 no direct evidence for the internal flaws which we
 are forced to postulate in order to account for the
 fitness of, in particular, metals, and even the
 conception of these flaws which the theories offer
 lacks definiteness.

The problem of flow is, however, fundamental
 to any understanding of the structure of real
 solids and liquids, and is, further, of the greatest
 importance for the industrialist who is concerned
 with metals, glasses, emulsions such as asphalt or
 clay, or plastic polymers, to mention only a few
 materials. The literature is so extensive, and the
 work has been carried out from so many different
 points of view, that one of the great needs of
 workers in this field is a reliable survey, of the
 present position, and our Dutch colleagues have
 undertaken the task of supplying this need. The
 first volume of the "Report on Viscosity and
 Plasticity" prepared by a Committee of the
 Academy of Sciences at Amsterdam appeared in
 1935, and received notice in NATURE (Nov. 2,
 1935, p. 697). The second volume is now before
 us. In the interim, Dr. Houwink, who contributes
 a chapter on "The Yield Value" to this latter
 volume, has written a valuable book on "Elasticity
 and Plasticity" (see NATURE, May 7, 1938, p. 810)
 which in many ways supplements the "Reports".
 The viscosity of simple liquids is the main
 subject of the first two chapters of this second
 Report, due respectively to Dr. J. M. Burgers,
 who has played so prominent a part in the work

of the Committee, of which he is the secretary,
 and to Prof. F. M. Jaeger. Certain generalities
 are first discussed, such as the statistical view of
 liquids with which the names of Prins and Bernal
 are connected, and the Prandtl model; interesting
 as these are, it cannot be said that they have yet
 come into any very close contact with experiment.
 A survey is then given of various theories of liquid
 viscosity that have been put forward, starting
 with that of van der Waals junior. Some of these
 are based on the assumption that the viscosity is
 primarily a function of the specific volume, a view
 which offers grave difficulties, since Bridgman's
 work on viscosity at high pressures has shown
 clearly that widely different viscosities can attach
 to the same volume; for example, for mercury,
 with which molecular distortions or associations
 cannot be invoked, the viscosity at equal volume
 is 0.0140 at 75° as against 0.0152 at 30°. The
 data on carbon dioxide, summarized in Fig. 11 of
 this "Report", are equally unambiguous on this
 point. Michels and Gibson found that, with high-
 pressure nitrogen at constant volume, the viscosity
 always increased with temperature. The obstacles
 in the way of the assumption might have been
 more strongly emphasized.

Generally speaking, the treatment of the
 various points of view is clear and critical, and
 the present writer has been gratified to find that
 difficulties which he has himself experienced have
 been felt by the author, with regard, for example,
 to the interesting calculations applied by Herzog
 and Kudar, where the exposition of the basic
 principles "is not such as to give a clear picture of
 what is actually intended", and, again, with
 regard to the obscurities of Lederer's theory. In
 general, there is a tendency on the part of many
 theorists to lose sight of the experimental facts,
 and, especially, of the need of showing how the
 absolute magnitude of the viscosity can be pre-
 dicted. The theory of Eyring and Ewell is not
 reviewed at all, which is to be regretted, since a
 critical analysis of its assumptions and achieve-
 ments would have been interesting. The account
 includes a welcome review of the extraordinary
 properties of the so-called 'liquid crystals' or
 liquids possessing mesomorphic states, and also
 deals with mixtures and solutions. Considering
 how little is known of simple liquids, it is not
 surprising that this part of the subject is not in a
 very satisfactory state.

A very valuable section, by Dr. J. M. Burgers,
 is devoted to the influence of suspended particles

on the viscosity of a liquid, a subject which is of topical interest in view of the importance attached to the experiments of Staudinger and his school. Here, as in so many fields, the pioneer paper is due to Einstein, who worked out the influence of spherical particles, and a further stage is represented by G. B. Jeffery's work on the behaviour of ellipsoidal particles in a viscous liquid. The problem is a particularly complicated one, in view of the conflict between the Brownian motion and the hydrodynamic forces in orienting elongated particles, a point on which experimental evidence is furnished by the double refraction of the flowing liquid.

Further difficulties are furnished by the possible deformation of long molecules, such as those of the polystyrenes, and the influence of the particles on one another. Dr. J. M. Burgers shows his usual skill in exposing, in a clear and critical manner, the essence of the large body of mathematical work which has been done on the problem, and in correlating it with experiment. His account is not overburdened with detail, but at the same time it is far from being a mere list of results. It supplies a clear and balanced picture, such as only one thoroughly conversant with the difficulties could give, of the present state of research on the subject. The general impression that it leaves is that, while much has been done, the conception of uniform, isolated rigid ellipsoids of revolution, immersed in a viscous fluid, is not altogether adequate to describe the behaviour of, for example, polystyrenes in solution.

The remainder of the "Report" is devoted to the discussion of 'yield value', to which reference has already been made, and to chapters on plastometers by Dr. C. J. van Nieuwenburg and on

technical viscometers by Dr. R. N. J. Saal. The chapter on yield value contains an extension of Dr. J. M. Burgers of the treatment of the plastic flow of metal single crystals which he put forward in the first "Report". This development of the Becker-Orowan theory is extremely interesting and leads to expressions giving the dependence of the yield value on temperature and rate of deformation; unfortunately, there is the usual difficulty in throwing them into a form capable of critical experimental confirmation and in finding relevant experimental data. The attempt is, however, stimulating and suggestive. The introductory remarks of Dr. van Nieuwenburg should be read by all who attempt to design plastometers, since they present clearly the weaknesses that attend most of the attempts to measure plasticity, a quantity which we cannot yet satisfactorily define. This lack of certainty as to what is really being measured finds its expression in the somewhat capricious design of the instruments.

A very valuable feature of this "Report" is its critical, but not carping, point of view. The authors have maintained their strong individuality but they have not abused their position as reporters to push unduly any particular point of view. They have clearly pointed out the great gaps in our knowledge, but have not been too severe on those who have attempted to fill them, even if their efforts have been inadequate. The general impression left by the "Report" is how little we know for certain about the fundamental features of flow phenomena. One of the best ways of emphasizing our needs, and of stimulating workers to supply them, is a report like this.

E. N. DA C. A.

Origins of Hindu Customs

Hindu Customs and their Origins

By Stanley Rice. Pp. 220. (London: George Allen and Unwin, Ltd., 1937.) 7s. 6d. net.

MR. STANLEY RICE, both as a member of the Indian Civil Service stationed in Madras, and after his retirement, as a member of the State Council of Baroda, has been in intimate relation with the problems of caste, which is the principal, though not the only, topic of this volume. Nowhere is the caste system so rigid as in Madras; while in Baroda he was an eye-witness of the difficulties which confronted the attempts to alleviate its more seriously obstructive characteristics, to which the Maharaja refers here in his

foreword. It is not surprising, therefore, that although the author's interest in caste in this volume is that of the anthropologist and the student of origins, it is inevitable that he should from time to time take a side glance at its place in the present and future social and political situation in India.

Of the various theories which have been put forward from time to time to account for the existence of caste in India, Mr. Rice counts none as acceptable. The view that it arose out of the Aryan conquest involves, he shows, a number of inconsistencies and leaves much unexplained—no least, perhaps, that the caste system is more rigid in the south than in the north, where it is natur-

expect that an Aryan system would manifest itself most strongly. At the same time, he holds, is no less difficult to accept occupation as the root of caste. This cause is not adequate to the effect, nor is the effect such as would naturally flow from such a cause.

The theory which Mr. Rice himself advocates is not entirely new; but it has not previously been worked out in detail. Shortly, it is that the system indigenous to India, and was of aboriginal origin. It grew out of aboriginal elements simulated by the conquering Dravidians, and by whom it was transmitted to the Aryans at some time considerably later than the Aryan invasion. The central features of caste, he points out, are the regulation of marriage and the fear of pollution by taking food or drink from, or by consorting with, a member of another forbidden or inferior caste. These two elements he traces to primitive roots connected with on one hand totemism, and on the other with the conception of uncleanness or pollution. Such an aboriginal origin alone, he maintains, would explain the existence of outcasts or untouchables. As Hinduized aboriginals, and the theory of caste as originating from an Aryan conquest, they would automatically enter the ranks of the inferior castes and would not require a special category.

The solution which Mr. Rice offers is perhaps the best that so far has been suggested. At the same time it is not free from objection. The argument for totemism is by no means so strong as is claimed, and the association of animal forms with members of the Hindu pantheon is susceptible

of explanation as a mode of Hindu thought which is not necessarily totemic. Further, is it true to say that in the matter of caste India is unique? Is it possible to set aside, as does Mr. Rice, the contention that it was characteristic of the group of Nordic peoples, of which the Arya were members? The obvious discrimination between caste and class distinction, to which he refers, rests on a comparison with modern conditions; and while they are perhaps stronger than he admits, historically they grew out of something far more rigid. Among the early Teutonic peoples breach of the marriage regulation was sometimes punishable by death. It would seem, therefore, as if the Aryan conquerors may have contributed more than a little to the system as a regulation of marriage, even though reference to it may be much later than their first appearance in India.

The influence of aboriginal culture in religious belief is traced further in discussion of the origin of reverence for the cow; while in the essay on the Brahman in Indian society, he glances incidentally, but with illuminating understanding, at the character, influence, and aims of this class in relation to the political situation.

Chapters dealing with Mahratta customs and the esoteric meaning of Hinduism complete a series of studies which is not only of interest to the anthropologist and student of Hindu culture, but also brings home to the lay reader the inner meaning of the day-to-day problems with which the administration and the statesman have been, and still are, confronted in dealing with the assemblage of races and beliefs which make up "India".

Farmland Grass

Grassland Management for the Practical Farmer by W. R. Peel. Pp. xv + 191 + 8 plates. (London: Macmillan and Co., Ltd., 1938.) 7s. 6d. net.

THIS book deals with the subject and with the results of scientific investigations in a very practical way from start to finish, and it contains nothing which a farmer can fail to understand.

The author introduces his subject well by describing the general factors which determine the productivity of grasses, such as leaf to stem ratio and palatability. The differences in habit between indigenous and commercial strains are pointed out and the importance of the indigenous strains is stressed.

The characteristic habits of those grasses and clovers most commonly met with are well described,

but, very wisely in a practical book on management, no morphology has been introduced. The factors to which certain grasses owe their importance agriculturally, such as palatability, early growth and winter greenness, are clearly set out, for the encouragement of desirable species to the exclusion of the less productive species is the underlying principle of good management.

The renown of the Romney Marsh pastures and the Leicestershire fattening pastures is familiar to all farmers; but few can have any clear idea how these famous pastures became established or why their productivity has persisted. The author shows how these and other well-known types of pastures, both good and bad, have been produced by the type of farming practised, and by management. He also shows how alterations in the type of

pasture are speedily brought about by a change from the traditional method of farming. The lesson to be learnt is that all pasture consists of associations of different species of grasses and clovers, and that any particular association is the result of a particular system of farming and management.

There follows, quite logically, a description of the various methods by which grassland can be improved, from the ploughing up and reseeded of the poorer types, to the harrowing and manuring of the types which have deteriorated least. Full practical details of the various methods of improvement are given, and the management of young grass in its early years receives the attention it merits. The various methods of conserving the extra grass at flush periods are described, and some valuable notes on silage-making and on the nutritive values of the conserved products are given in the appendixes.

Once the grassland is back to good productivity, careful management is required to maintain this productivity. The principles of good management

are clearly set out, the need for controlled grazing and the periodic rest, the provision of the ear bite and winter keep, and the manuring for pasture and hay are all fully described, as are the many other practical details of grassland management.

The last chapter deals effectively with the use of temporary pastures, and gives full details of sowing land down to grass, and of seeds mixture. However, there is no bewildering list of seed mixtures to confuse the farmer; but a few typical mixtures for various purposes are given. There are also useful notes on the most suitable arable crops to grow on freshly ploughed grass.

Farmers and others who have read this book will cease to look upon grass as such, but will see it as an association of many different species and strains of plants which require careful management to ensure full productivity; but which if left alone or not managed to maintain an association of the most productive species, will rapidly degenerate into an unproductive piece of land inhabited by a few species of grasses which have little or no feeding value.

The Life-Work of a Palaeontologist

Published Papers and Addresses of John Campbell Merriam

Vol. 1. Pp. viii + 666. Vol. 2. Pp. vi + 667-1288. Vol. 3. Pp. viii + 1289-1944. Vol. 4. Pp. viii + 1945-2672. (Publication No. 500.) (Washington, D.C.: Carnegie Institution, 1938.)

BEFORE Dr. John C. Merriam became president of the Carnegie Institution, Washington, in 1920, he was for many years professor of paleontology and historical geology in the University of California at Berkeley. During that period he devoted special attention to the fossil vertebrates occurring in the coastal region of the western United States, and made many notable discoveries, which he described chiefly in the publications of the University and of the California Academy of Sciences. His scattered papers have now been collected and reprinted, with some addresses and more popular writings, in four handsome volumes, which are issued by the Carnegie Institution. They are admirably edited, with references to the source and original pagination of each paper; and when they are reduced from the quarto form many of the plates are subdivided to maintain the size of the figures. The reprints are arranged under several subject headings, and a bibliographical list in chronological order is appended to the fourth volume just before the index.

Dr. Merriam studied at Munich under Prof. K. A. von Zittel, and the first reprinted paper in his inaugural dissertation on some Pythonomorph reptiles from the Chalk of Kansas published in 1894. Then follow several papers on remains of new fossil reptiles which he collected from the Triassic formations of California and Nevada. His important discovery of the marine Rhynchocephalians which he named *Thalattosauria* is described and discussed in a memoir which was published in 1905. His valuable contributions to our knowledge of the Triassic *Ichthyosauria* form the subject of a still larger memoir which appeared in 1908.

Most of Dr. Merriam's papers are on fossil mammals, which were collected with special care to determine their relative ages. He began by examining the John Day region of Oregon, where he found mammalian remains of all periods from the Oligocene onwards. He then studied other western coast areas, and finally co-operated with the Los Angeles Museum in collecting and describing the skeletons of Pleistocene mammals found embedded in the asphalt lake of Rancho La Brea, which now forms a public park in the outskirts of Los Angeles. Rancho La Brea has yielded the most remarkable series of Pleistocene carnivores and birds of prey hitherto discovered. They were attracted to the spot by easy prey—peccaries,

reese, camels, elephants, ground sloths, and other animals which were accidentally trapped in the phalt. Unfortunately, the detailed description of the collection is little more than begun.

Other papers discuss the discoveries of fossil man in association with extinct mammals in North America, and Dr. Merriam summarizes the results in an address which was delivered to the International Geological Congress at Washington in 1933. There seems to be no doubt that typically modern man lived in North America with some of the large mammals which became extinct before historic times.

The technical papers are followed by reprints of some popular articles on the same subjects; and the final volume is devoted chiefly to miscellaneous addresses and to papers on the educational use of the national parks. Dr. Merriam has done great service in providing guides and exhibits to help the public to appreciate the scientific interest of the vast open spaces which the United States Government has preserved for their enjoyment. His activities have indeed been numerous and varied, and the volumes before us form an imposing record of the life-work of a leading man of science.

A. S. W.

Popular Astronomy

1) Everyman's Astronomy

by Mary Proctor. Pp. viii+246+23 plates. London: The Scientific Book Club, 1939.) 2s. 6d.

2) Starcraft

by William H. Barton, Jr., and Joseph Maron Joseph. Pp. vii+228. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 10s. 6d.

1) THE title of Miss Proctor's book is rather misleading, as it suggests a general elementary treatise. Actually, it is a collection of seventeen disconnected essays on astronomical subjects, written in a popular style. In its general scope it is somewhat reminiscent of the many similar volumes of essays published, sixty or seventy years ago, by the author's distinguished father, the late R. A. Proctor.

There is some internal evidence to suggest that the various chapters were written at different times. This has resulted in some repetitions and contradictions, and the attempt to bring the details up to date has not always been very successful. Perhaps the most interesting part of the book is to be found in the last seven essays, all of which deal with the subject of meteoric astronomy. Here the author has collected a considerable number of facts and numerical data relating to the more famous falls of meteorites, and these notes may be found useful for reference by other popular writers and lecturers.

The chief objection to the book is that it has throughout such a strong nineteenth-century flavour. The author appears only partly to have digested the results of modern research, and often quotes the necessarily tentative ideas of out-of-date authorities on matters which have long since ceased to be subjects for mere speculation.

There is also a tendency to dwell at great length on trivial points, while more important matters

are either passed over or put in a way that can only mislead or mystify the reader. A few misprints occur in the book, but they are mostly too obviously such to be of serious consequence. There are some fine illustrations, though one is wrongly described in its legend.

(2) Messrs. Barton and Joseph have written their book for American schoolchildren. It is, in a sense, a field-book of elementary practical astronomy. The principal constellations are taken separately. A diagram of each is given, with instructions for finding it at various seasons of the year; and some short notes on the chief objects contained in it are added. There are also photographs of some of these objects, obtained with the large American telescopes.

Simple instructions are given for the making of a sundial and other astronomical instruments, including a reflecting telescope. With regard to the latter, we are inclined to think that any young person capable of following successfully the very abbreviated directions supplied would scarcely be satisfied with so scrappy a treatment of the subject.

There are some inaccuracies of statement in the book; for example, it is alleged that the companion of Polaris is visible in a field-glass, and that Saturn's rings are invisible to the naked eye because of their "faintness". The derivation of geocentric is given as "*geus*, the earth, and *centric*, the centre", while heliocentric is said to be derived from "*helio*, the sun, and *centric*, to circle about"!

The tone of the book is rather condescending, and the authors' attempts to be colloquial are often quite pathetic. Of course, American children may prefer "squinting" through a telescope to merely "looking" through it, like other people. All we can say is that those we have met have not seemed "that dumb".

W. H. STEVENSON.

An Approach to a Philosophy of Education
By Dr. Theodore H. Eaton. Pp. ix+278. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 12s. 6d. net.

THIS book is in two parts. Part 1 (longer and more important) attempts the establishment of systems of values from the points of view of the biologist, the psychologist, and the student of social sciences. Part 2 deals with the application of those systems to education.

The book is a good example of that essentially American stream of pragmatic thought of which Dewey and Thorndike are representatives. Like them, the author eschews metaphysics and attempts to found a system of values out of the stuff of common experience; and like them he draws inspiration from the ever-changing phenomena of American society in the twentieth century.

Dr. Eaton finds the highest biological values in parenthood and self-preservation; the highest psychological values in the achievement of integrated personality; and the highest social values in a critical attitude of mind based on standards of general human welfare. Difficulties at some points seem too easily brushed aside. Summary treatment, for example, is accorded to such questions as the meaning of 'biologically fit', and the nature of those 'satisfactions' which are the basis of personality. Freedom is scarcely discussed at all, and too little is said in explanation of the power which ideals involving self-sacrifice have held. But the title of the book does not allow us to demand full treatment of all these.

The Málers of the Rajmahal Hills
By Sasanka Sekher Sarkar. Pp. xiv+135+11 plates. (Calcutta: The Book Co., Ltd., 1938.) 4 rupees; 6s.

THE author of this monograph, a recruit to anthropological research, to whom Sarat Chandra Roy extends a cordial welcome in a commendatory preface, has now spent some years in the investigation of the Málers of the Rajmahal Hills, and has already contributed a number of papers on specific points to scientific literature. In this work, which is of a more generally descriptive character, he is especially interested in the problem of their relation to the Oraons. He is unable to accept the view that they are a branch of the Oraons, a relic from the time of the migration of that people, presumably as a result of Moalem pressure. In support of his contention he points, *inter alia*, to the absence of totemism and exogamic clans among the Málers; while he stresses the fact that as a hill people, they never have occupied the plains, nor could they be persuaded by the Government to do so.

Only two accounts of this interesting people have appeared in print previously—some thirty years ago. A point of interest in the present account is the change which has taken, and is still taking place in their culture. Dormitories, for example, for bachelors and spinsters are now decaying institutions, while the ancient custom of interment, under Hindu influence, has given place to cremation.

A Textbook of Inorganic Chemistry for Colleges
By Prof. James F. Norris and Prof. Ralph C. Young. (International Chemical Series.) Second edition. Pp. x+803. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 21s.

IN the preparation of the second edition of this book Prof. Norris has been assisted by a co-author whose interests lie in the field of inorganic chemistry. A special feature of the book is the careful development of the fundamental ideas of atomic structure, isotopes, electronic valency, radioactivity, modern dissociation theory, etc., in such a way that they fit naturally into the course, and so much is presented at each step as can readily be understood by the student. The modern theory of acids and bases is used.

The pedagogic aspect of the subject has been kept constantly in mind, and for this reason the book will be of special interest to teachers. A useful feature is the numbered bibliography at the end, providing a wide range of suitable material from which both students and teachers can extend their knowledge of particular topics in which they are specially interested.

L'Antenne Rayonnante
Par Pierre Baudoux. (Institut Belge de Recherches Radioscientifiques, vol. 7.) Pp. 255. (Paris: Gauthier-Villars et Cie., 1938.) 40 francs.

THIS publication is a monograph describing a mathematical analysis of the current distribution in antennae of various forms and of the resulting radiation therefrom. The classical theory of the problem is outlined, and the author then obtains solutions and an analysis of the appropriate coefficients to a closer degree of approximation than hitherto. After considering the vertical antenna of uniform cross-section, he deals with the spindle (or cigar-shape) and pyramidal forms of antennae that are now in such common use at radio transmitting stations. The dipole antenna is also dealt with. The final chapter describes experiments carried out with model antennae of various shapes of about 1.5 metres in height using oscillations of wave-length 2-5 metres. The current distribution in these models was measured and the resulting radiation deduced for comparison with the theoretical analysis. R. L. S. R.

Fortschritte der Biochemie
Teil 3 (1931-1938). Von Prof. Dr. Felix Haurowitz. (Wissenschaftliche Forschungsberichte: Naturwissenschaftliche Reihe, herausgegeben von Dr. Raphael Ed. Liesegang, Band 49.) Pp. xi+167. (Dresden und Leipzig: Theodor Steinkopff, 1938.) 9 gold marks.

THIS is the third volume of a series in which Prof. Haurowitz has presented reviews of the progress of biochemical research over a period of years. The present work covers the period 1931 to the beginning of 1938. It is comprehensive, concise and accurate, but it is unlikely to appeal to British or American men of science, who are accustomed to rely on reviews which appear annually and usually treat subjects in greater detail. J. O. D.

The Last Thousand Feet on Everest

Physiological Aspects

By Prof. Yandell Henderson, Yale University

A MOUNTAINEER at rest on the North Col of Mount Everest (bar. 335 mm.) probably consumes nearly the same amount of oxygen as at sea-level. This amount, 250–350 c.c. S.T.P. per minute, is required for the maintenance metabolism of muscle tonus, the resting heat production and the work of breathing and the heart beat. If a mountaineer ever rests on the summit of Everest (bar. 240 mm.), even there he will probably consume nearly the same amount. On any less, anywhere, he would die.

When he climbs, a man consumes far more oxygen; but at every altitude the amount is limited by the barometer. He cannot do more work climbing, nor climb faster, than the oxygen that he can absorb from the air will permit. No amount of muscular strength can escape this limitation. The advantage of the athlete over the ordinary man, and the superiority of the acclimatized mountaineer over the unacclimatized, consist less in their strength than in their ability to obtain larger amounts of oxygen.

During steady vigorous exertion for an hour or more at sea-level, or up to 5,000 feet, a man may absorb and consume ten or twelve times the resting amount of oxygen, with a corresponding expenditure of energy. For shorter periods the rate of consumption may be much more, but not so long. As he ascends and the air grows thinner, the amount of oxygen that he can obtain, even by the greatest possible volume of breathing, decreases; and his decreased capacity for work results in a directly proportional decrease in the number of feet, or metres, that he can climb upward in each hour. Up to the greatest altitude and lowest barometer for which a man's oxygen consumption and capacity for work in climbing have been reported—by Christensen in the Andes—the ratios of oxygen to work are nearly uniform with those at sea level.

From measurements on Marathon runners by Benedict and Cathcart, and others, we know that a vigorous young man can consume 3,300 cubic centimetres of oxygen per minute for two hours or more. Such men do an amount of work equivalent to climbing 3,000 feet, or even a thousand metres, an hour; and men have done this, although the ordinary rate of climbing in the Alps and Rockies is only 1,200–1,800 feet an hour. As an extreme case Dr. D. B. Dill informs me of

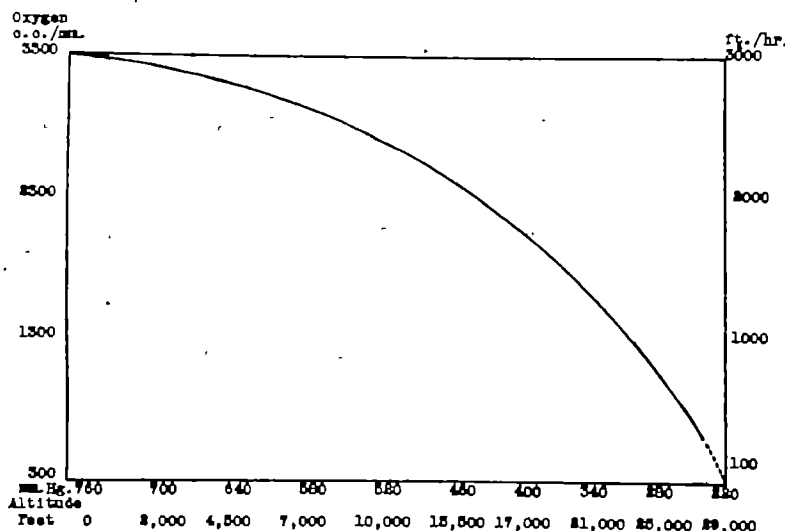
a man of 80 kilos who, on a treadmill in the Harvard Fatigue Laboratory, 'climbed' the equivalent of 1,400–1,500 metres in an hour, linear distance 5,000 metres, with an oxygen consumption of 4.0–4.4 litres per minute. Last summer in a contest on Mount Washington (altitude 6,288 feet), the best of sixteen contestants starting at Pinkham Notch, 4,800 feet below the summit, ran up the eight miles of motor road to the top in 1 hour 17 minutes, and the slowest in a little more than 2 hours (Foster).

At 10,000 feet (bar. 525 mm.) the measurements of Dill and Edwards, Margaria, Schneider and others, indicate that, on an oxygen consumption of 2,800 c.c. per minute, an amount of work may be performed equivalent to that of a man weighing 150 lb. and climbing about 2,500 feet an hour. At 14,000 feet on Pike's Peak, Schneider and I repeatedly ascended 1,000 feet in half an hour, and we were both well past the age of greatest vigour. The manager of the Summit House, whose weight was 156 lb., climbed from Manitou (altitude 6,600 feet) to the summit up the cog railroad, a rise of 7,500 feet in 8.9 miles, in two hours and thirty-one minutes. He probably climbed more rapidly at first than toward the end of the ascent. But very few men could make such a climb, at such a rate, at such an altitude. The oxygen consumption found by Christensen in the Andes at 17,500 feet (5,340 metres) was 1,800 c.c. per minute, and the work done on a bicycle ergometer was equivalent to that of a man of 70 kilos (154 lb.) climbing 600 metres an hour. The periods of exertion were less than an hour. But the natives, as Dr. Dill informs me, commonly climb from their homes at 17,500 feet up to the sulphur mine where they work at 18,800 feet in about an hour.

For greater altitudes there are no measurements of oxygen consumption on acclimatized, or partially acclimatized men. But the rates at which men can climb at the great altitudes of the upper slopes of Mount Everest and other peaks in the Himalaya are significant. There the rates of climbing decrease progressively as the altitude increases; and we may fairly infer that the amounts of oxygen that the men can obtain from the air decrease correspondingly. As they go higher and higher their rate of ascent becomes slower and slower, until at 27,000 feet Somervell

had to "take 8 or 10 respirations for each step, and stop to rest for a minute or two every 20 or 30 yards. At 28,000 feet Norton, in an hour's climb, ascended only about 80 feet."

If from such data we may extrapolate (as in the figure) to obtain estimates of the rate at which a mountaineer might climb the last few hundred of the last thousand feet of Everest and the corresponding oxygen consumption, we see that the rate of ascent must approach zero: in other words, a minimum of progress in an unlimited amount of time. The corresponding oxygen consumption would approximate that of bodily rest as a limit. Men have come near to the summit of Everest in distance; but they have still been far from it in terms of time. As I have recently



APPROXIMATE AMOUNT OF OXYGEN THAT A MAN CAN OBTAIN AND UTILIZE DURING STEADY CLIMBING AT ALL ALTITUDES BETWEEN SEA-LEVEL AND THE SUMMIT OF MOUNT EVEREST, AND THE MAXIMUM RATES IN FEET PER HOUR AT WHICH HE CAN ASCEND.

pointed out elsewhere, inhalation of oxygen from an 'open circuit' inhalator, although helpful during rest, is of no value during climbing; for all the oxygen is blown away by the tremendous volume of breathing. Only by the use of a 'closed circuit' respirator, such as that used in mine rescue operations, can men obtain sufficient oxygen and climb sufficiently rapidly to ascend and descend the last one or two thousand feet of Everest within the period of a day.

THE HEART AT GREAT ALTITUDES

The mountaineer is generally inclined to consider his heart as the organ that limits his exertions. But the above considerations tend to indicate that such is not the case. During the Oxford-Yale expedition, which spent five weeks on the summit of Pike's Peak, altitude 14,100 feet, during the

summer of 1911, we found both in ourselves and others that during mountain sickness the stroke volumes of the heart were diminished; arterial pressure was lowered; and the pulse rate was increased even during bodily rest, and greatly accelerated under even moderate exertion. But as acclimatization developed, arterial pressure, the stroke volume of the heart, and the pulse rate returned to the same values as at the foot of the Peak, essentially as Christensen and Forbes have found during the recent expedition to the Andes.

For comparison of the stroke volume on Pike Peak and in Colorado Springs (altitude 6,000 feet) we used a 'recoil board'—a light wooden plank supported on a number of soft rubber stoppers. A man lying upon it illustrates the Newtonian

principle that "every action has an equal and opposite reaction" for with each heart beat, as blood is propelled alternately headward and feetward, the man's body and the plank recoil in the opposite direction. This movement of about 0.1 mm. was magnified sixty times by a system of levers and recorded on a smoked drum. As the amplitudes of these curves and the arterial pressures were the same in acclimatized men at 14,100 feet as at 6,000 feet, the strokes of the heart must also have been of the same volume and force.

From these observations it appears that readjustment of the circulation plays no considerable part in acclimatization. During intense muscular exertion at sea-level, the volume of blood that

the heart can pump is probably one of the factors that limit exertion. At great altitudes the limiting factor appears to be chiefly the volume of air that a man can respire, or rather the amount of oxygen that he can absorb from it. As he obtains less oxygen his muscles can do less work; and as his muscles contract less often the volume of the venous return to the heart, which limits the volume that the heart has to pump, is probably much less than during vigorous exertion at sea-level.

Above altitudes of 20,000 feet, according to Argyll Campbell, acclimatization becomes increasingly incomplete. As he has shown also, after a prolonged stay under a low pressure of oxygen, the heart suffers along with other organs and functions. But any ill-effects after mountaineering at great altitudes are assignable rather to prolonged slight asphyxia than to any strain from overwork.

READJUSTMENTS IN ACCLIMATIZATION

Acclimatization to any altitude above or below sea-level, or to sea-level, is wholly a response to the pressure of oxygen, and not to that of the barometer otherwise. It is an adjustment which enables the acclimatized man to obtain sufficient oxygen to live normally, or nearly normally, at altitudes at which, if wholly unacclimatized, he would become unconscious or even die. The readjustment is not in the heart or lungs, but consists chiefly in alterations in the composition of the blood. The red corpuscles are increased and—even more helpful—the bicarbonates (BHCO_3) of the plasma are decreased. Until the bicarbonates are decreased the mountaineer cannot breathe any very much larger volume of air without disturbing the relation of the carbonic acid (H_2CO_3) and bicarbonates, and thus the hydrogen ion concentration, of his blood.

The decrease of bicarbonates is not effected through any process of an acidotic type. It develops through an entirely different process in three stages: (1) The sensitivity or excitability of the respiratory centre (E_H) varies inversely with the pressure of oxygen (O_2), or, more precisely, with the ratio of the pressure of oxygen to the bicarbonates of the blood, that is, $E_H \propto (\text{BHCO}_3) : (\text{O}_2)$; and the initial increase in the volume of respiration is due to this increase of sensitivity. (2) The increase of pulmonary ventilation decreases the partial pressure of carbon dioxide in the air of the lungs, and the amount of carbonic acid in the arterial blood. The relation $(\text{H}_2\text{CO}_3) : (\text{BHCO}_3)$ and the pH of the blood are thereby temporarily disturbed; and (3) this disturbance in turn induces a compensatory decrease of bicarbonates which restores both the relations $(\text{O}_2) : (\text{BHCO}_3)$ and $(\text{H}_2\text{CO}_3) : (\text{BHCO}_3)$ to normal levels. On descent to a lower altitude these processes are reversed.

The decrease of the bicarbonates in the blood affords two advantages to the acclimatized man. It causes him to breathe a larger volume of air

than at sea-level on the same production of carbon dioxide, and thereby raises the pressure of oxygen in his lungs and arterial blood. Less well recognized, but equally important, is the effect of the lowered bicarbonates upon the interchange of gases as the blood passes through the tissues. As the amount of carbon dioxide produced in the tissues is the same under the same exertion at all altitudes, any decrease of the bicarbonates allows the carbon dioxide to exert a much greater effect upon the ratio $(\text{H}_2\text{CO}_3) : (\text{BHCO}_3)$ and the hydrogen ion concentration than it would if the bicarbonates were at sea-level value. This increase of hydrogen ions promotes the unloading of oxygen from haemoglobin.

Yet acclimatization to a great altitude also imposes a handicap. It has been supposed that men or horses—particularly in the Andes—that have come from a higher to a lower level shortly before a race should have an advantage. Exactly the opposite is, however, the case; for Edwards has recently reported that a man acclimatized to an altitude can there do less work on a bicycle ergometer than at sea-level, even if the oxygen in the air that he breathes is artificially increased to the sea-level amount (150 mm. partial pressure). The probable reason is that, owing to the lowering of the bicarbonates in the blood, the man must breathe a correspondingly increased volume of air in order to exhale the increased amount of carbon dioxide.

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Shape of Tobacco Mosaic Virus Particles in Solution

By Dr. J. R. Robinson

THE ease with which solutions of the tobacco mosaic virus protein show a strong double refraction of flow suggests that the particles present are extremely elongated. It was reported by Bawden and Pirie¹, who described the general properties of the virus. Bernal and Fankuchen² studied the virus by means of X-rays, and pointed

out that the long tapering structures which have been called crystals are more strictly paracrystals. There is regularity of arrangement in the cross-section, but not in the direction of the long axis. The paracrystals are believed to consist of long, rigid rods, packed closely side by side, but without order, in the direction of their length. These rods

are supposed to exist free in solutions of the virus. By their orientation they give rise to the double refraction of flow.

It has now been shown clearly^{3,4} that the double refraction of flow does in fact arise from the orientation of rigid rods, and not from the deformation of flexible particles. Kuhn⁵ gives a method of determining, from measurements of double refraction of flow and of the angle of isocline, the amount of double refraction to be ascribed to any individual particle with its immediate fluid environment. Calculations such as Kuhn describes have been applied to the results of measurements upon virus solutions supplied by Dr. N. W. Pirie. They show that a tenfold increase in the double refraction of flow with increasing rate of shear is not accompanied by a corresponding increase in the birefringence of the individual particles.

From the fact that spontaneous birefringence first appears in the solutions at a concentration of 1.6 per cent, Bawden and Pirie suggest, on the assumption that this represents Staudinger's limiting concentration, an axial ratio of the order of 90. But they point out that the particles are highly charged, so that the interpretation of the critical concentration is complicated. Moreover, the observed critical concentration almost certainly does not correspond to Staudinger's limiting concentration. For this is calculated from an effective volume which requires that the particles be free to rotate in the solution about central axes perpendicular to their lengths, so that each may trace out a disk^{6,7} (Staudinger, 1931, and 1932, p. 129), whereas spontaneous birefringence implies that the particles are not free to move (whether through mechanical interference or by reason of their charges). If they were free to move, they would attain random orientation, and the solution would become isotropic.

Attempts to determine precisely the shape of the virus particles have usually been based upon measurements of viscosity. Unfortunately, the theory of the viscosity of suspensions is in its present state insufficiently developed to permit of a completely satisfactory solution of the problem. Certain general principles have, however, emerged, and as these are passed over or violated in much of the published work, it may be worth while to review the situation.

Interpretation of the experimental results has generally been sought through the aid of an equation due to Kuhn⁸, which may be stated in the form

$$\eta_{sp.} = 2.5\phi + \frac{\phi^2 f^3}{16} \quad (1)$$

Here $\eta_{sp.}$ is the specific viscosity, defined as $\eta_{rel.} - 1$, where $\eta_{rel.}$ is the relative viscosity. Since $\eta_{rel.}$ is the ratio of the viscosity, η^1 , of a suspension or

solution to that of the pure solvent, η_0 , the definition may be formally stated as

$$\eta_{sp.} = \eta_{rel.} - 1 = \frac{\eta^1 - \eta_0}{\eta_0} \quad (2)$$

If the total volume of the particles is v , and that of the solvent is V , where v is very small compared with V , then ϕ is defined as $\phi = v/V$. f is the axial ratio of any particle, the ratio of its length to its diameter.

From its derivation, equation (1) is applicable only to suspensions so dilute that there is no interaction between a given particle and any other particle, but only between the particles severally and the liquid immediately surrounding them.

It is also only applicable when Brownian agitation is overwhelming, so that there is random orientation. The extent to which this condition is not fulfilled in practice does not seem to be realized, though Lauffer⁹, who used a high precision quartz viscometer, admits that the particles may be "somewhat" orientated. This condition is important because the orientation of the particles, which becomes more marked as higher rates of shear are applied, is accompanied by a decrease in the measured viscosity. This has been shown experimentally by simultaneous measurements of the viscosity and of the optical properties of a 0.02 per cent solution of the virus in a rotating cylinder viscometer. A beam of plane polarized sodium light was passed through the annulus of a Couette viscometer, parallel to the common axis of the cylinders. The angle of isocline, which gives the direction of orientation of the particles, was found by rotating the polarizer and the analyser together and crossed. The strength of the double refraction, which gives the intensity of the orientation, was determined by inserting a quarter-wave plate orthogonally to the polarizer, and rotating the analyser alone as in the method of compensation due to de Sénarmont. It was also found possible to develop a theoretical explanation which yields successful quantitative predictions of the variation of the viscosity with the rate of shear. This is further confirmed by the agreement of experiments and predictions upon the sign and magnitude of the temperature coefficient of relative viscosity.

Briefly, the orientation is the statistical aspect of precessional motions imposed upon the suspended particles by the velocity gradient in the flowing liquid. That direction of the particles for which the precessional motions have their minimum angular velocity is their most probable direction, and therefore the direction of orientation. Theory and experiment agree that as the velocity gradient increases, the direction of orientation approaches that of the streamlines (the angle of

isocline increases from 45° towards 90° ; and the intensity of the orientation increases (the strength of the double refraction of flow increases). To maintain the precessional motions of the particles, work must be done continually. As the velocity gradient is increased, the theory shows that, on account of the increasing orientation, the amount of work so used becomes less compared with that required to maintain the flow of the solvent alone. Since the viscosity coefficient of a liquid is a measure of the rate at which energy is dissipated in its flow, this is reflected experimentally in a reduction in the measured viscosity. Dilute suspensions of the virus exhibit a distinct viscous anomaly.

Because of this anomaly and the extensive orientation which is its basis, measurements made at high rates of shear cannot be interpreted satisfactorily by means of Kuhn's equation. It has already been mentioned that Kuhn gives a method for determining the birefringence to be associated with each particle, and with it, of the maximum possible double refraction of flow which would correspond to a complete orientation of the particles. With the 0.02 per cent virus solution, one half of this value is reached at a velocity gradient of 5.6 cm. per sec. per cm. in the Couette apparatus. The rates of shear in capillary viscometers are generally hundreds or thousands of times greater than this, so that the assumption of random orientation is unjustified.

Yet most workers seem to have used capillary viscometers, and to have published no data from which the rate of shear might be computed. Lauffer states that his results were obtained with such an instrument. Frampton and Neurath¹⁰ do not state how they obtained their results. That they are in good agreement with those of Lauffer suggests that they too used a capillary viscometer.

It is instructive to compare the results of Lauffer¹¹ with those obtained in the Couette instrument. Lauffer states that the specific viscosity of a 0.0296 per cent solution of the virus is 0.0165. The following figures were obtained with a 0.02 per cent solution in the Couette apparatus.

Mean rate of shear (sec. ⁻¹) ...	0.36	0.72	1.44	2.16	2.88	3.60	4.32	5.04
Specific viscosity ...	0.291	0.279	0.260	0.243	0.230	0.219	0.205	0.199

Short extrapolation gives the value 0.30 for zero shear, and this is confirmed by the theory. If Kuhn's equation can be applied to any of these results, it is to that for zero shear, where alone the orientation is random. This would give $f = 176$, approximately, instead of Lauffer's value of 35.

The theoretical treatment, the general description

of which has been given, replaces Kuhn's equation by the more complicated one,

$$\eta_{sp.} = \frac{\eta f^2}{4} \left[1 - \frac{\Delta}{\Delta_m} (1 - 2 \cos^2 \Psi) \right], \quad (3)$$

where Δ is the observed double refraction of flow at any rate of shear, Δ_m is the maximum value corresponding to complete orientation, Ψ is the observed angle of isocline at the given rate of shear, and the remaining symbols have the meanings already allotted to them.

This equation does not assume that the orientation is random, but takes account of its progressive increase as the rate of shear is raised, and so predicts the viscous anomaly. Applied to the experimental results obtained with the 0.02 per cent virus solution, it suggests that f is of the order of 87. (The actual figure is not stressed, for the virus preparation was not fresh. What is important is the anomaly, and the caution which it demands in interpreting measurements made with flow viscometers.)

It must be emphasized that this is not the axial ratio of the virus particle, but only that of the model particle, conceived as a rigid string of beads, which leads to a predicted viscosity equal to that observed for the virus. It does not seem to have been realized that precisely the same difficulty is inherent in Kuhn's equation.

It should also be noted that the equations (1) and (3) are extremely approximate in their derivation, so that they can only indicate the order of magnitude of f . More strict hydrodynamical treatment would have given a less rapid rise in specific viscosity than that proportional to f^2 which the approximate theories indicate.

Neurath and Saum¹² have recently approached the problem by comparing measurements of molecular weight by diffusion and in the ultracentrifuge. They suggest a shape factor which would correspond to a value of f between 52 and 56. It is impossible to assess this result in the absence of more details as to its derivation, but it is interesting to note that it falls between 87 and Lauffer's obviously too low figure of 35.

Whether or no it is justifiable to assume random orientation depends mainly upon the absolute size of the suspended particles. For the existing orientation represents a dynamic equilibrium between a hydrodynamic orientating tendency and the disorientating Brownian agitation. As the size of the particles increases, the former effect becomes more, the latter less, important. The diffusion coefficient for angular rotation, which measures the intensity of the Brownian agitation, is roughly inversely proportional to the cube of the length of the particle. The degree of orientation depends

upon the relation of this quantity to the value of the velocity gradient. In a recent theoretical paper, Peterlin shows that random orientation can only be asserted if the suspended particles are shorter than 10^{-6} cm. Lauffer¹¹ suggests that the length of the virus particle is of the order of 10^{-4} cm., which would exclude the assumption of random orientation involved in his use of Kuhn's equation. Since Kuhn's equation can only be applied when the particles are smaller than 10^{-6} cm., it is clear that its use in interpreting measurements of the viscosity of virus solutions should be discontinued.

Only measurements made in a cylinder apparatus, where simultaneous control and determination of the state of orientation are possible, can be expected to be significant when the particles are so large as to be considerably orientated at low rates of shear.

Quite apart from the high rate of shear which inevitably obtains in them, capillary viscometers are quite unsuited for the study of anomalous systems. In these systems the viscosity depends upon the rate of shear. In a capillary viscometer the rate of shear, and with it the viscosity of an anomalous liquid, varies across the lumen from a high value near the walls to zero on the axis of the flow tube. No precise significance can be attached to a measured 'viscosity'.

G. I. Taylor¹² reported that in his model experiments some time was required for the establishment in a steady state of the motions of precession of the particles. Peterlin¹⁴ points out that even when the particles are so small as those of the virus, this process may require some seconds. All theoretical formulae which are not concerned with a variation of viscosity with time must assume that this steady state is reached. In a cylinder apparatus, unlimited time may be allowed for its attainment. But in a capillary viscometer, a given element of volume

of the liquid remains in the flow tube only for a fraction of a second, and time may not be allowed for the steady state to be established.

Since the variation of the velocity gradient across the lumen of the capillary is accompanied by a variation in the state of orientation, capillary methods are also unsuited for the measurement of double refraction of flow. The double refraction of flow of the suspension as a whole can only be referred to the birefringence of the individual particles if an independent measurement of the state of orientation is also possible. Comparisons between different systems are only valuable if they can be made in corresponding states of orientation. When a cylinder instrument is used, the angle of isocline may be measured as well as the double refraction, and provides the necessary control.

The methodological problem is summed up in the statement that the viscosity of a suspension is most emphatically not a simple physical property of that suspension, as it would be of a Newtonian liquid. The energy dissipated depends upon the type and upon the rate of flow; so the recorded viscosity depends upon the method of measurement, and especially upon the rate of shear which is employed. A statement of the 'viscosity' of an anomalous system which does not include reference to these controlling factors has little meaning.

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Lazzaro Spallanzani

Celebration at Pavia

ON April 11-15, the University of Pavia honoured the memory of one of its greatest sons, Lazzaro Spallanzani (1729-1799). The celebrations took the form of a special meeting of the Italian Society of Experimental Biologists, to which a number of representative foreign men of science were invited, with closely associated and contemporaneous meetings of the Italian Botanical and Geographical Societies, as well as a congress of veterinarians.

On the morning of April 11, in the Great Hall of the University, with a Duke of the Royal House presiding, there assembled a most colourful company to listen to the oration given by Prof. Botazzi of Naples, and to receive the greetings and congratulations conveyed from scientific bodies and institutions in foreign countries by their official delegates. Thereafter the company passed along cool cloisters bedecked by fine statues and plaques to the Pavian worthies—Volta, Golgi, among

hers—to the quadrangle where the shrouded marble figure of Spallanzani waited. The unveiling itself was a simple act, and then it seemed that relative merit had at last been recognized, for the fine new monument dominated its environment; then to lunch, given by the Mayor of Pavia in the splendid and attractive Almo Collegio Borromeo. Then, somewhat reluctantly, for the entertainment was rich and satisfying, on to the aula, Spallanzani in the Zoological Institute, formerly a palace and, so far as university department buildings go, still most palatial. If the place where work is done affects its quality, then no wonder great discoveries have been made in Pavia.

All through the afternoon, specialists in different fields of biology, each acknowledged in his turn the indebtedness of his particular branch of science to Spallanzani. It was an inspiring experience to stand and speak where he had stood and taught. His mantle seemed to brush one's shoulder. As speaker followed speaker, it seemed that the history of science in the eighteenth century was a record of Spallanzani's own work: 1754–60, a teacher of logic, metaphysics and Greek in the University of Reggio; 1760, lecturer in the Natural History Department of the University of Modena; 1769, invited to the chair of natural history in Pavia, a post which he adorned until his death. Whilst at Modena he had been active in experimentation designed to test the reality of spontaneous generation, and his contributions concerning the anatomy and physiology of the circulatory system were of such quality as to justify Haller's dedication to him of one of the volumes of his "Treatise of Physiology". With the greater opportunities that Pavia offered, his interests passed rapidly from problems of regeneration to the origin of springs, to the systematics of the Protozoa, to the functions of chlorophyll, to tissue respiration, to the role of the sperm in fertilization, to the chemical aspects of digestion,

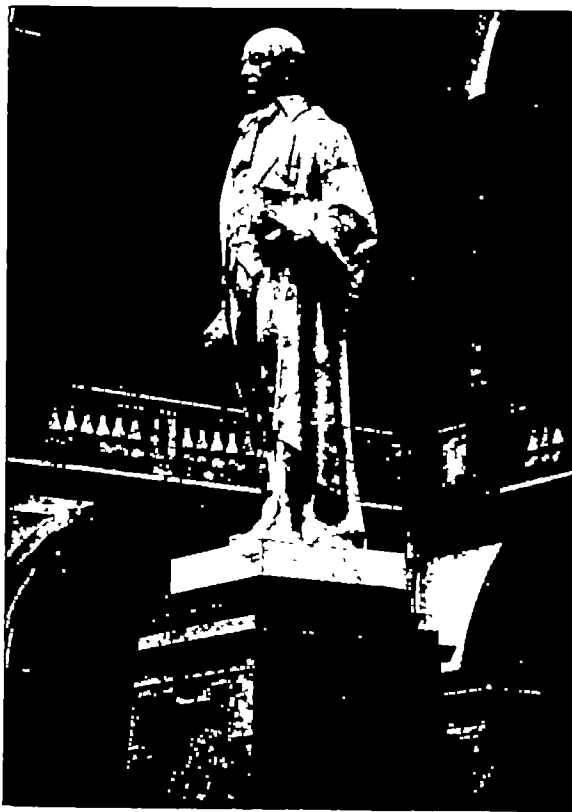
whilst at the same time work carried out on journeys along the Mediterranean coast earned for him the title of the founder of volcanology. He augmented the content of each and every subject that he touched, and many of his discoveries, being made before their quality could be assessed, had long to lie dormant until men's minds were later turned in their direction.

It was not surprising, therefore, to listen, during the afternoon and the following three days, to a series of papers dealing with the most diverse of subjects, every one of them nevertheless testifying

to the fact that Spallanzani had made notable contributions to each and all. Abderhalden (Halle) on digestion; Federley (Helsingfors) on the chromosome and gene; Ruggles Gates (London) on the nature of genic differences; Camara (Lisbon) on the branched chromosome; von Muralt (Bern) on the relationship of Spallanzani and Albrecht von Haller; Pupilli (Bologna) on the physiology of the circulatory system; Crew (Edinburgh) on artificial insemination and its uses in the experimental study of the species problem; Timoféeff-Ressovsky (Berlin) on genetics and evolution; Jucoi (Pavia) on physiological genetics; Montalenti (Bologna) on tissue respiration; Brunetti (Pavia) on

animal electricity; Baltzer (Bern) on hybrid grafts and partial homology of nuclei from different species, were among those who contributed to the homage that was so gladly paid. Meanwhile the botanists, geologists and veterinarians were similarly occupied, so that the air of Pavia must have been heavily laden with well-merited eulogy of Spallanzani.

The veterinarians in their meetings dealt entirely with the techniques and possible uses of artificial insemination. It will be remembered that Spallanzani, being greatly impressed by the results of the artificial insemination of trout eggs by Waltheim, succeeded in 1779 in artificially inseminating a bitch. It is a great pity that at



STATUE OF SPALLANZANI AT THE UNIVERSITY OF PAVIA

this meeting there was no one from the U.S.S.R. Had there been, they could have been reminded that they, who have exploited this technique more than any other people, are greatly indebted to the Italian Spallanzani, and their hosts could have been given further reason for their rejoicings by the knowledge that Spallanzani's early sowings had produced so abundant a harvest.

The foreign delegates were housed in the Collegio Ghislieri and in the Almo Collegio Borromeo. 'Housed' is certainly the wrong word, for the hospitality they received was so warm and so friendly, and the accommodation itself so welcoming, that they who had come as strangers, left as friends.

During the days of the congress when for brief intervals the clamour of discussion died down, there were pleasant excursions to the Certosa di Pavia, a Carthusian monastery crowded with works of art; to the town of Pavia itself; and to the

Spallanzani Museum at Reggio. In addition there were evening concerts, exquisite yet informal, such as could only be enjoyed in Italy, in the rooms of the Circolo del Littorio. The foreign delegates came away full of admiration and gratitude, entertaining the wish that all congresses, if a meeting in Italy where they do these things well, should at least be constructed on the Italian model.

This celebration was notable also for the appearance of the first number of a new journal *Scientifica Genetica* (see NATURE of April 22, p. 676). This is a matter of some considerable interest for it truly marks a stage in the development of the science in Italy. A rapidly growing school exists and the stage of its development is indicated by the recognition of the need for the publication of a specialist scientific journal which will cater primarily for the geneticists of the Latin-speaking countries.

F. A. E. CREW.

Obituary Notices

Sir Frank Dyson, K.B.E., F.R.S.

IT is with much regret that we record the death at sea on May 25 of Sir Frank Dyson, Astronomer Royal from 1910 until 1933, whilst on the voyage home after a visit to Australia.

Frank Watson Dyson was born on January 8, 1868, and was educated at Bradford Grammar School and Trinity College, Cambridge. He was second wrangler in the Mathematical Tripos in 1889, and was placed in Class I, Division 2, in Part II of the Tripos in the following year. He was awarded a Smith's Prize and elected to a fellowship at Trinity College. In 1892 he was appointed to an Isaac Newton Studentship, being the second holder of the studentship, which had shortly before been endowed by Mr. Frank McClean for research in astronomy or physical optics.

In 1894 there occurred a vacancy in the post of chief assistant at the Royal Observatory, Greenwich, through the election of H. H. Turner to the Savilian professorship at Oxford, and Dyson was selected by the Astronomer Royal, W. H. M. Christie, to fill the vacancy. The choice proved to be a singularly happy one, and Dyson threw himself with characteristic energy and enthusiasm into the various branches of the work at Greenwich.

Dyson's first important work, undertaken in collaboration with W. G. Thackeray, one of the assistants, was a new edition of Groombridge's Circumpolar Catalogue. Stephen Groombridge, a retired West Indian merchant, had made at Blackheath between the years 1806 and 1819 some 27,000 observations of more than 4,000 circumpolar stars, using a 3½-inch aperture transit circle of 5 feet focal length. The observations had been well made, with

careful attention to the instrumental adjustments but the reductions were not in accordance with modern ideas of accuracy. A complete new reduction was made, starting from the original observing books. The Groombridge stars were re-observed at Greenwich, and from the comparison of the two series of observations, supplemented by such other observations as were available, the proper-motions of the stars were derived. These proper-motions were discussed for the derivation of the constant of precession and the solar motion. The work was completed in 1906 and provided a valuable addition to the available data on the proper-motions of the stars. The publication came at an opportune time. In the previous year Kapteyn had announced his important discovery of star-streaming from the analysis of the proper-motions of the bright stars observed by Bradley in the years 1750-62. The Groombridge proper-motions were used by A. S. Eddington, who succeeded Dyson as chief assistant at Greenwich on the appointment of Dyson in 1906 as Astronomer Royal for Scotland, to confirm the existence of star-streaming amongst these fainter stars, which extended to a greater distance from the sun than the stars used by Kapteyn.

The work on the Groombridge Catalogue directed Dyson's attention to the problems of stellar motions, in relation to the distances and luminosities of the stars and to their distribution in space. Both whilst at Edinburgh and after his return to Greenwich in 1910 as Astronomer Royal, on the retirement of Sir William Christie, he published a number of papers on these subjects.

As chief assistant, Dyson had also taken a considerable part in the Greenwich share in the international co-operative plan for photographing the

heavens and preparing an astrographic catalogue: the zone of the sky allotted to Greenwich was from declination 65° N. to the pole. On his return to Greenwich as Astronomer Royal, many of the programmes of work were directed to making the information about this zone of the sky as complete as possible. Measurement of the parallaxes of stars of large proper-motion, determinations of photographic magnitudes and of effective wave-lengths were undertaken. The whole zone was photographed again, the photographs being obtained through the glass; by placing corresponding early and late photographs film to film, the proper-motions of the stars were conveniently and rapidly derived from differential measures.

The problems to be solved at total eclipses of the sun claimed much of Dyson's attention. He took part in several himself and was fortunate in never having cloudy weather. In the total eclipse of 1927, which was visible in England, he selected Giggleswick as the station for the Greenwich party, and this proved to be almost the one place where the eclipse was observed under favourable conditions. His own work on the spectra of the chromosphere and of the corona made important contributions to the subject. It was in large measure as the result of his initiative and energy that two expeditions went from England to observe the total eclipse of May 1919. Dyson had pointed out in 1917 that this eclipse would afford a particularly favourable opportunity for testing whether there was a deflection of rays of light passing near the sun of the amount predicted by Einstein from his theory of relativity. Preparations were made for the two expeditions in the hope that the Great War would end in time to make it possible for them to set out. How the expeditions set out, obtained their observations and vindicated Einstein's prediction is well known. This successful confirmation, coming at so crucial a time, undoubtedly did much to bring about a general acceptance of Einstein's theory. After his retirement in 1933, Dyson wrote, in conjunction with Dr. R. v. d. R. Woolley, "Eclipses of the Sun and Moon", published in 1937, which is the best book that has been written on this subject.

Dyson took a great interest in problems of time-keeping and in the craft of clock-making. He was responsible for the distribution through the B.B.C. of the 'six-pipe' time signals, the signals being sent direct from Greenwich and making accurate time more readily available than it had hitherto been. He was for many years president of the British Horological Institute, which awarded him its Gold Medal in 1928, and he was a member of the Court of Assistants of the Clockmakers Company, of which he was twice master.

After the Great War, when international co-operation in science had lapsed to a considerable extent, Dyson played a prominent part in the reconstitution of international scientific co-operation with the International Research Council and in the formation of the International Astronomical Union. The success that this Union has achieved in securing international co-operation in different branches of astronomy is in no small degree due to Dyson's wise

guidance. His election as president for the period 1928-32 was a fitting recognition of his services to the Union.

Dyson received many honours. He was president of the Royal Astronomical Society, 1911-13; president of the British Astronomical Association, 1916-18; vice-president of the Royal Society, 1913-17. He was awarded a Royal Medal of the Royal Society in 1921, the Bruce Gold Medal of the Astronomical Society of the Pacific in 1922 and the Gold Medal of the Royal Astronomical Society in 1925. He received honorary degrees from the universities of Oxford, Cambridge, Edinburgh, Durham, Leeds, Toronto, Perth and Melbourne, and was foreign or corresponding member of various national academies. He was created a Knight Bachelor in 1915 and a K.B.E. in 1926.

Dyson was a man of engaging personality and of singular charm. To all of his staff he was not merely a chief but also a friend. He married Caroline Best, daughter of Mr. Palemon Best; she died in March, 1937. They had two sons and six daughters. Foreign astronomers from all parts of the world and many other visitors to Greenwich were sure of a warm welcome and of friendly hospitality in their home. Dyson had a keen sense of public duty, and much of his leisure time was spent in work for the various schools, hospitals, charities and other good causes in which he was interested. Of no man might it more appropriately be said:

"His life was gentle, and the elements
So mix'd in him that Nature might stand up
And say to all the world 'This was a man!'"

H. S. J.

Engineer Vice-Admiral Sir Henry John Oram,
K.C.B., F.R.S.

Of the many engineers who held high positions during the Great War, none had a more onerous and responsible task than Engineer Vice-Admiral Sir Henry Oram, who died at Cranleigh on May 5 at the age of eighty years. From October 1907 until June 1917 he was engineer-in-chief of the Fleet, and as such was responsible for the design, construction and maintenance of the machinery of hundreds of warships from battleships to armed trawlers, and for a personnel of something like 70,000-80,000 officers and men. He had served in various grades at the Admiralty from 1884 until 1907, when he succeeded Engineer Vice-Admiral Sir John Durston and "under him", as *The Times* said, "was created the post-Dreadnought Fleet, which formed the backbone of the Navy in the conflict with Germany, and the very high standard of efficiency obtained under the stress of war in the engine rooms of ships of all types and classes reflected the highest credit upon his professional skill, sound judgment and administrative ability".

Though, unfortunately, little has been published on the work of the engineering branch of the Navy during the Great War, both Admiral Jellicoe and

Admiral Beatty paid tribute to the high standard of efficiency maintained in the engine rooms of His Majesty's ships under difficult conditions.

Oram was a product of the eminently successful system of training introduced by the Admiralty about a century ago, whereby a boy with no other advantages than those of character and physique could climb to the top of the ladder. He was born on June 19, 1858, and at the age of fifteen years entered Devonport Dockyard as an engineer student; during the next six years he passed through the engine and boiler shops, the foundry, the smithery, the drawing office and so forth, meanwhile attending the Dockyard School. In 1879 he passed for an assistant engineer R.N. and then entered upon three further years' training at the Royal Naval College, Greenwich, where at that time the staff included Hirst, Cotterill, Reinold, Hearson, Waghorn, White and W. E. Smith, while among Oram's fellow students were Rear-Admiral F. T. Bowles, U.S.N., and Rear-Admiral Miyabara, afterwards the engineer-in-chief of the Japanese Navy. From Greenwich Oram passed out with the highest distinction, and for the next two years, 1882-84, served afloat in the Indian troopships *Crocodile* and *Malabar*, the running of these and their sister ships being looked upon as the best experience for junior engineers. This proved to be Oram's only sea service, for in 1884 he was appointed to the staff of Sir James Wright at the Admiralty and never again left Whitehall.

To detail the many developments with which Oram was associated would be to trace the progress of naval engineering during the course of forty years. When he entered the Navy there were plenty of ships with horizontal simple-expansion engines working with steam at 30 lb. pressure; when he retired the standard type of machinery was the geared steam turbine working with steam at about 250 lb. pressure generated in oil-fired water-tube boilers. He was associated with all the troubles over forced draught, and by his invention of the "Admiralty" boiler-tube ferrule helped to mitigate some of them; he saw the introduction and development of the splendid triple expansion engines of last century; he was already in a responsible position when the various types of water-tube boiler—Thornycroft, Yarrow, Normand, Babcock and Wilcox, Dürr, Nielsens, Belleville, etc., were being installed, and he attended the trials of the historic *Turbinia*, and saw the turbine supersede the reciprocating engine for all warships.

There was nothing meteoric in Oram's rise to the top of his profession. He passed through all the grades of assistant engineer, engineer, chief engineer, etc., and in 1903 when the new titles were introduced he became an engineer-rear-admiral. He was made a C.B. in 1906, a K.C.B. in 1910, and his scientific attainments were fully recognized by his election in 1912 as a fellow of the Royal Society. He was the first naval engineer to be so honoured. In 1915 he was elected a member of the Athenaeum under Rule II.

Besides his work at the Admiralty, Oram lectured on marine engineering at the Royal Naval College, Greenwich, and he practically rewrote the admirable text-book on the marine steam engine, first published by

Richard Sennett, the engineer-in-chief from 1887 until 1889. In 1908-9 he served as president of the Junior Institution of Engineers and in 1914 of the Institute of Metals, giving to both societies very valuable addresses. At the jubilee meeting of the Institution of Naval Architects he contributed a paper entitled "Fifty Years' Changes in British Warship Machinery." Though not like his predecessor Sir John Durston or his immediate successors Sir George Goodwin and Sir Robert Dixon, a president of the Institute of Marine Engineers, his name appears among the honorary members. From the United States he received the Distinguished Service Medal.

Since his retirement Admiral Oram had lived at Rudgwick and he was buried in the churchyard there on May 8.

EDGAR C. SMITH.

Mr. Daya Ram Sahni, C.I.E.

We regret to record the death of Rai Bahadur Daya Ram Sahni, the distinguished Indian archaeologist, formerly director-general of the Archaeological Survey of India, which took place at Jaipur in March at the age of sixty years.

Sahni was educated at the University of the Panjab, and was one of the first to hold a Government of India scholarship in archaeology. He was also a gold medallist of his university. He joined the Archaeological Survey as scholar and assistant in 1904, reaching the grade of superintendent in 1917. He was a regular contributor to the records of the Survey, dealing more particularly with the decipherment of inscriptions and describing Buddhist sites. He is the author of two well-known and authoritative works on the Buddhist remains at Sarnath; and he contributed two chapters to Sir John Marshall's great work on Mohenjo-daro and the Indus civilization. Sahni was appointed deputy-director of the Archaeological Survey in 1925, and director-general in 1930, retiring in 1935, when he received the honour of C.I.E. On his retirement he accepted the offer of the appointment of director of archaeology from the Jaipur Government and was responsible for excavations at Bairat, one of the most important sites in Jaipur, publishing a report on his results.

We regret to announce the following deaths:

Sir George Kendrick, who was actively associated with the development of the University of Birmingham, where he endowed the Poynting chair of physics, on May 28, aged eighty-nine years.

Sir William Lobjoit, O.B.E., during 1920-27 controller of horticulture at the Ministry of Agriculture, on May 28, aged seventy-nine years.

Dr. C. H. Mayo, founder with his brother of the Mayo Clinic, Rochester, Minnesota, for surgical research, and regent of the American College of Surgeons in 1913-36, on May 26, aged seventy-three years.

News and Views

of W. E. Le Gros Clark, F.R.S.

PROF. WILFRED E. LE GROS CLARK, whose appointment to the chair of anatomy at University College, London, vacant since the sudden death of Prof. H. H. Collard in January last, will take effect as from October 1 next, has been professor of anatomy in the University of Oxford since 1934. Born on June 5, 1895, he was educated at Blundell's School, Tiverton, and passed through the Medical School of St. Thomas's Hospital, London, where he was a pupil in anatomy of Prof. F. C. Parsons, well known as an anthropologist, and an authority on the physical characters of the peoples of Britain. During the Great War, Prof. Clark served in the R.A.M.C. with the rank of captain, and after demobilization was for two years principal medical officer of Sarawak, Borneo. He returned to England in 1923 and in 1924 became reader in anatomy in the University of London. Three years later, in 1927, he was appointed to the chair of anatomy at St. Bartholomew's Hospital, London, transferring to the chair of anatomy at St. Thomas's Hospital in 1930 on the retirement of Prof. Parsons. Apart from his contributions to anatomical and medical journals, Prof. Le Gros Clark is the author of a number of authoritative studies on anthropological topics, including more particularly the physical characters of the Eskimo and the comparative morphology of early man and the apes, his most considerable contribution to discussion of the latter being his "Early Forerunners of Man", which appeared in 1934.

Dutch Congress of Natural Science and Medicine

IN NATURE of May 27, p. 908, reference was made to the Dutch Congress of Natural Science and Medicine held at Nijmegen on April 11-13. A correspondent has sent the following notes on some of the medical papers. On the first day of this Congress the main medical paper was read before a very large audience by Prof. B. Brouwer, of Amsterdam. Prof. Brouwer spoke on the hydrodynamic intra-cranial and intra-vertebral conditions in connexion with the development of modern neuro-surgical diagnostic and operative technique. He showed very clearly the great importance which is attached to very simple physical examinations of the cerebral fluid and the ventricular system for the localization of intra-cranial and intra-vertebral space-occupying lesions. Prof. Brouwer stressed the point that ventricular estimation and ventriculography—when in safe hands—are of the greatest value for the early diagnosis of many intra-cranial space-occupying lesions. Dr. A. Biemond, of Amsterdam, spoke on the diagnosis of mid-line brain-tumours. Going over a list of the ante- and post-mortem findings of twenty mid-brain tumour cases, Dr. Biemond tried to divide this material into three groups, according to their clinical picture and their operability. The prognosis, how-

ever, of mid-brain tumours, even in the light of modern neuro-surgery, is not very hopeful, according to Dr. Biemond's experience. Very much in contrast with this paper was the contribution of Dr. F. Verbeek, of Groningen. Dr. Verbeek described the tremendous advances which have been made during the last twenty years in the neuro-surgical field. A review of his neuro-surgical patients gave much more hope that even the mid-brain tumours will be accessible for operative treatment. Dr. A. Brouwer (Eindhoven) spoke on the technique of X-ray photography. Dr. C. E. Burger (Eindhoven) dealt with X-ray photography as a method for mass examination in the attack on tubercular infection. Dr. J. H. van der Tuuk (Eindhoven) spoke on deep X-ray treatment and its measurement, with reference to apparatus operating up to one million volts.

Teachers in Technical Institutions

IN his presidential address at the annual conference of the Association of Teachers in Technical Institutions on May 29, Dr. E. A. Seeley commended the Spens Report as establishing the parity in status and value of the education given in junior technical schools with that given in 'grammar' and other post-primary schools, but blamed it for disparaging the cultural potentialities of junior commercial and household science schools. These should be given the opportunity of showing that they are capable of developing "on a broad scientific and realistic basis" an education equal in cultural as well as vocational value to that of the schools associated with engineering and building. Referring to the report presented to the Board of Education six months ago, without apparent result, on scholarships for students in technical colleges, Dr. Seeley urged that the nation cannot afford to let willing and competent students be kept from attendance at these colleges by lack of means, while allowing the places that should be occupied by them to be filled by anyone whose parents happen to be able to pay his fees. As regards relations with other associations of teachers, the hopes entertained last year of a workable scheme of federation are for the time being in abeyance. The address closes on the note "education for service"—the sense of responsibility of teachers to the community and the necessity of realizing the social implications of their work: they must train in citizenship as well as in technology.

Indian Education, Past and Present

THREE lectures on "Some Aspects of Indian Education, Past and Present" by Sir Philip Hartog, sometime vice-chancellor of the University of Dacca and president of the Auxiliary Committee of the Indian Statutory Commission on the Growth of Education of 1928-29, have recently been published

in the "Studies and Reports" series of the University of London Institute of Education (London: Oxford University Press. Pp. 110. 2s. 6d.). The lectures, originally delivered in 1935, have been revised and brought up to date and supplemented with memoranda designed to remove, if possible, the imaginary bases for the accusation made by Mr. Gandhi and others that the British Government systematically destroyed an indigenous system of elementary schools and with it a literacy which the schools are presumed to have created. Among the many factors which have militated against the success of Indian educational policies, Sir Philip stresses the extreme lengths to which the policy of devolution was carried with a blind faith that local bodies would learn by making mistakes, the amenability of the Government to pressure exercised by the vocal middle classes in favour of diverting to secondary and higher education funds which ought to have gone to primary education, the extent to which universities have been financially dependent on examination fees and the overcrowding of universities with students who ought never to have been admitted. It has been said that the nineteenth century Liberal thought he knew the final truths about education and failed to recognize that it must serve the community as well as the individual. Sir Philip mentions several hopeful indications, including the work of the social service leagues which he helped to establish at Dacca, of the springing up in Indian educational circles of a new spirit of service to the community.

The Carnegie Corporation of New York

THE report of the president of the Carnegie Corporation of New York, Frederick P. Keppel, for the year ended September 30 records the distribution of grants amounting to nearly four million dollars (including nearly half a million from the Corporation's British Dominions and Colonies Fund) in the following proportions: endowment and support of universities, colleges and schools 22, the arts 17, library interests 15, research studies and publications 14, adult education 5, miscellaneous 27 per cent. It is a document of outstanding interest to trustees and administrators of funds for educational, scientific and cultural purposes and to prospective benefactors and beneficiaries. Highly important questions of principle and policy are lucidly and briefly discussed under the headings "The Public and Foundations", "Funds for Philanthropy" and "Board Procedure". It appears that whilst the volume of large gifts and bequests, derived as they are from fortunes made under conditions which are unlikely to recur, tends to diminish, the funds of the various community trusts made up of relatively small individual contributions have grown steadily in the past ten years from sixteen to fifty million dollars, and the president believes that "current contributions from public funds, from industry and commerce, plus the cumulative contributions of private endowments, are together taking over a steadily increasing share of the total load" of the finance of educational, scientific and cultural enterprises.

Training for Citizenship

A REVIEW of the Corporation's experience in the field of general education leads to some interesting reflections on the present status and influence of the Graduate School (that "sacred cow in American education, to be worshipped rather than studied, understood, and improved") and the extent to which students destined for the professions are trained. Their education must, it is contended, "give far more consideration than it does at present to the place of the professionally trained men and women in modern community, the place that such men and women might take as a *united group*, not divided and weakened in their influence as at present by an *over-emphasis on the spirit and traditions of separate professional guilds*". While education cannot alone create an aristocracy of trained intelligence, it can have regard to such an ideal and foster attitudes that would lead professional men and women to work together rather than separately in contributing to the solution of our political and social problems.

Lines of Magnetic Force

PROF. C. COLBRIDGE FARR, of Canterbury College, Christchurch, New Zealand, has sent a communication in which he advocates the preparation of accurate charts showing the lines of magnetic force running from the south magnetic pole to the north magnetic pole. Prof. Farr points out that the secular change in declination at any observing station is the parallactic angle subtended by the movement of either pole as viewed along a line of magnetic force, and he considers that the comparison of charts, showing the lines of force at different epochs, would lead to a better understanding of the nature of secular variation. The lines of force could be sketched in on existing declination charts, but there would be obvious difficulties in drawing the lines all the way from pole to pole. In forwarding Prof. Farr's letter H. F. Skay, director of the Magnetic Observatory, Christchurch, N.Z., directs attention to the smoothed charts of such lines given by A. G. McNish in *Terrestrial Magnetism*, 41, 87 (1936). The question is whether unsmoothed charts on a large scale would be sufficiently reliable and sufficiently useful to justify the cost of publication.

National Museum of Wales

AT a Court of Governors of the National Museum of Wales held at Aberystwyth on May 23, Lord Harlech from the chair reported on the result of his recent visit to the United States of America, when he was accompanied by Sir Cyril Fox, the director, to appeal to Welshmen in the States on behalf of the National Museum. The sum of £10,000 has already been received in response to the appeal. Lord Harlech stated that the attitude of Welsh Americans towards the Museum was such that the response would have been much greater had it not been for the international tension in Europe at the present time. The variety and range of the recent accessions to the collections of the Museum,

which were reported to the governors by Sir Cyril Fox on this occasion, are an indication of the activities of the Museum in the preservation and display of objects illustrating the history and culture of the Welsh people. Among these were a collection of prehistoric finds from Breconshire, a thirteenth-fifteenth century stone fireplace from the Vale of Glamorgan, and a turned chair of mid-sixteenth century date; while among objects deposited were an important collection of carved stones dated at about A.D. 1230-40 from Castell-y-Bere, and the extremely interesting Iron age fire-dog found in 1852 at Carreg Coodog Farm, Denbighshire. It was also reported that the services of the Museum had been called upon by the Office of Works to report on the antiquities of Pembrokeshire, which are threatened by a tank school.

Inland Water Survey Report

THE third annual report of the Inland Water Survey Committee, issued by the Ministry of Health and the Scottish Office (H.M. Stationary Office, 4d. net), while recording a year of useful activity in various directions, chiefly with the aid of external agencies, finds occasion to express disappointment at the results achieved and to state the conviction of the Committee that action should be taken by the Government, financially or otherwise, for ensuring the extension of the work in both England and Wales and Scotland. The Committee points out that it has no staff at its disposal for taking actual measurements, and that it has to rely in England and Wales (and to some extent in Scotland) on voluntary action by catchment boards and others for the execution of this part of the work of the Survey. It finds, moreover, that relatively very few suitable records of river flow are being kept, and that neither the information available from water undertakers, nor that from catchment boards, is sufficient in scope or adequate in quality to enable a comprehensive survey to be made. It is convinced that in order to be of real use, such a survey should be carried out on similar lines to the Ordnance Survey or the Geological Survey in their respective fields. It may be pointed out that this was precisely the view taken by the British Association Committee four years ago, when the Government reluctantly agreed at its instance to institute a survey.

As regards the actual progress made with the Survey, the examination of river basins, begun in the first and second reports, has been continued, and the results of the investigation of the river basins of the Earn (Perthshire), Eden (Fife), Tyne (East Lothian), Trent, Great Ouse, Wye and Nith (Dumfriesshire) are described in the report. During the year, the Department of Agriculture for Scotland was authorized to spend £500 on the equipment and maintenance of river discharge measurement stations. The existing level-indicating and recording stations on the Clyde, Kelvin, Irvine and Tay have been maintained and stations established on the Earn, Eden, Tyne and Nith. The Tweed basin has also been reconnoitered. In the sphere of underground water, the field work carried out by the Geological

Survey in the Nene basin has been continued, and work is proceeding on a memoir dealing with the underground water resources of an area which includes Northampton and Oxford. The results of measurements for twenty-eight gauging stations in fourteen river basins, collected by various authorities, have been published as "The Surface Water Year Book of Great Britain, 1935/6". The report also deals with several technical difficulties which have been met with during the process of collecting these statistics, and recommendations are made about recording charts and arrangements for securing accuracy of measurement.

Scientific and Industrial Research in New Zealand

AN admirable survey of the work carried out under the Council of Scientific and Industrial Research, New Zealand, during 1927-28 has been issued by the Department as Bulletin No. 69. It includes accounts of work carried out by the Dairy Research Institute, the Plant Research Bureau and the Wheat Research Institute, as well as of the activities of the Department in soil survey, fruit research, animal research, tobacco research and the work of the research associations. The work of the Dairy Research Institute on the cause and control of openness in cheese is described in some detail, as well as further work on discoloration in cheese, and on cheese manufacture. Reference is made to the work of the Plant Diseases Division on chemical sprays and the spray certification system which has been introduced, as well as on virus diseases of tobacco, tomato and of potato, and the importance of the methods introduced for the control of smut of barley. The contribution of the Wheat Research Institute to the improvement of the technique of wheat growing and harvesting, the growing of varieties most suitable for special districts, and cheapening the cost of production is emphasized, as well as the selection and distribution of a new wheat, Cross 7, which yields as well as standard varieties, and has by itself a baking quality equal to that of the old varieties plus the proportion of Canadian wheat formerly used. Fruit research has covered manurial experiments on fruit tree nutrition, boron as a cure for internal cork of apples, orchard sprays, wrappers for fruit; and the soil survey studies have included reference to the physiological diseases of plants. An important discovery in the field of animal research relates to the wasting diseases caused by deficiencies in the diet of cobalt, to which the bush sickness in the North Island, Morton mounds disease in the South Island, and Glenhope ailment in Nelson are due.

Commercial Applications of Blended Light

IN practical work, the term 'blended light' is used to describe the mixture of the light from the ordinary tungsten gas-filled lamps with that from mercury discharge lamps. A. H. Olsen contributes a paper to the *Electrical Review* for May 26 in which he discusses the blending of the light from these lamps. A gas-filled lamp depends on the light emitted by a tungsten

filament; it therefore produces a continuous spectrum, red being prominent, but lacking in blue. The resultant colour is yellowish. A mercury lamp depends on the excitation of vapour and consequently emits a light with a broken spectrum, red rays being almost completely absent and blue being very pronounced. If the two light sources are mixed in the proper proportions, we get an approximation to white light. The effective application of this to shop lighting depends on the type of goods displayed; so no definite ratios of the two lights can be fixed and each installation is examined experimentally. In the case of drapers, furnisiers and outfitters, where fabrics are displayed, the proportion of tungsten lumens to mercury lamp lumens is generally in the proportion of three to one. In practice, this means utilizing one 80-watt mercury lamp with two 200-watt tungsten lamps. When this is done, the colours of the fabrics appear much the same as with daylight. Black appears of a richer lustre, and red shades do not appear mauve as they do under mercury light. Although the consumption of electricity might have been expected to be less than if only tungsten lamps were used, it is found that owing to the amount of tungsten light required to blend with the mercury light, the consumption is much the same. In most of the main town shopping centres, blended light installations present a striking contrast to competitive windows in the same area, being much more prominent and displaying the goods more effectively.

Bureau of American Ethnology, 1937-38

ALTHOUGH the normal activities of the Smithsonian Institution have been curtailed of recent years owing to economic conditions in the United States, the Bureau of American Ethnology has been able to maintain its operations in the field, and even to extend them in archaeology, owing to the provision of Federal finance and the supply of labour made available by measures for relief. A summary statement of the research carried out by members of the staff in the period 1937-38 is given in the fifty-fifth annual report (Washington, D.C., 1939. Pp. 8) covering that statistical year—an exiguous document in comparison with the more elaborate accounts familiar to anthropologists in earlier years. A major work of archaeological excavation was that of the Lindenmeier site in Colorado, where Dr. F. H. H. Roberts, jun., has continued the work of exploration of the habitation site of Folsom man which he initiated in 1934. His operations in the summer of 1937 uncovered an area of 2,300 sq. ft., and 735 specimens were obtained, including a number of new types of stone implement. Early in the season 1938 evidence of the artistic effort of Folsom man, "one of the earliest known of New World inhabitants", came to light in the form of pieces of bone with attempts at engraved design. An interesting investigation approaching completion is Dr. John R. Swanton's research on behalf of the United States De Soto Expedition Commission, of which he is chairman. It involved one field expedition in the year, when Dr. Swanton visited Alabama for the purpose of examining old Indian town sites which might possibly be

identified with those mentioned by De Soto. An extended ethnological exploration of western South America has been planned, which was initiated when in April last Dr. J. H. Steward left Washington for Ecuador, where he has since been at work among the highland Indians.

Britain in the Dark Ages

THE northern sheet of "The Map of Britain in the Dark Ages" (Ordnance Survey Office, Southampton, 1939. Pp. 48. Price 5s. net) is, if possible, of even greater interest than the southern sheet issued by the Ordnance Survey in 1935. This is not least, perhaps, because it serves to emphasize the imperfections in the material, while affording suggestion of the more urgent provinces to which further research should be directed, if any substantial advance in knowledge is to be made. Thus, for example, brochs and earth-houses do not appear here, being reserved for future separate treatment, owing to the difficulty of determining their chronological relation to the period covered by the map. This period, roughly, is from A.D. 440 to 840, an approximation to the date of the union of the kingdom of Picts and Scots under Kenneth, son of Alpin. In regard to technical details, the scale of the map is 1:1,000,000. The practice in the use of symbols of archaeological maps previously issued by the Survey is maintained, the form of the symbols suggesting the objects, additions being made to the symbols already in use as required, as, for example, in indicating the distribution of Pictish symbols. An expository introduction deals with certain broad questions—the extent and location of the British, Scottish, Pictish and Anglian regions, the distribution of tribes, the lines of early roads, and the like. The section in which the roads are traced is a particularly instructive synthesis of geographical and archaeological argument, although the editor modestly disclaims any attempt at original research and professes to do no more than record existing knowledge. The discussion of the range of distribution of the ethnic groups brings out very markedly the need for both a systematic survey of Scottish place names and of systematic excavation, directed to specific ends, mainly chronological.

Tribute to the Memory of Sir Victor Horsley

SIR VICTOR HORSLEY was far from being merely a great surgeon. His death while still in the full plenitude of his powers deprived the world of a remarkable personality which expressed itself effectively in many fields, and his old friend and fellow-worker, Mr. C. J. Bond, has done well to place on record personal notes ("Recollections of Student Life and Later Days". 1939. H. K. Lewis and Co. Pp. 48) of an association lasting forty years. Neuro-psychical phenomena held an irresistible attraction for both men, and in elucidating Horsley's share in some of their conjoint work, Mr. Bond outlines some of the conclusions to which he was led by these and other independent researches the scope of which is indicated by his query: How has it come about that the neural machinery exists for the carrying out of neuro-psychical activities in a dual manner while on the psychical side the more

ghly organized, later evolved responses are perceived and executed by a unified consciousness and single will? Of Huxley's activities in the political and sociological sphere he observes, "He clearly realized that what the world sorely needs is a deeper and wider recognition of the fact that selfishness and the aggressive spirit, although they no doubt had some survival value among primitive peoples and savage tribes, yet under modern conditions of so-called civilization they act as brakes on the wheels of human progress".

School Natural History

PERSONS who lament the alleged lack of interest shown by the modern schoolboy in natural history could read the current annual reports of two famous school natural history societies—the reports for 1938 of the Marlborough College Natural History Society and of the Rugby School Natural History Society. Each of these societies has existed long enough for its usefulness to be thoroughly tested, and the Marlborough report is the eighty-seventh, the Rugby one the seventy-second, and the internal evidence is that enthusiasm abounds and observations are made over a wide range of natural history subjects. The two societies seem to be run on quite different lines. At Rugby, activities centre in thirteen specialist sections, which arrange their own discussions and excursions, and meet in common only at the general lectures given by outside speakers. At Marlborough, there appear to be no lectures by outsiders, the members themselves are the lecturers, and there are but two sections, archaeological and natural science. This arrangement, while encouraging more general distribution of interests, has not affected the specialist labours of the members, for it is a remarkable record that from the pages of successive reports of fewer than seven hand-lists have been published, giving a wonderfully complete conspectus of the fauna and flora of the Marlborough district.

The Science Library

THE first part of a fifth edition of the "Hand List of Short Titles of Current Periodicals in the Science Library" (H.M. Stationery Office. 9s. net) has recently been issued. The new edition contains about one thousand main entries with about four thousand cross references from alternative headings, as against over thousand titles in the fourth edition, issued in 1926. Publications of learned societies and institutions are entered under the names of their permanent seats, and publications of Government departments and other bodies under the name of the countries from which they derive their denominations, or, for want of such denominations, under the places whence their acts are issued. The Hand List is not intended as a bibliographical catalogue; it gives merely brief titles of the publications with details of the Library holdings. The List is being issued in two parts, of which the first is arranged alphabetically. It is hoped later to publish a second part with a subject arrangement. The preface to the List gives a very brief but lucid description of the Science Library and its development.

New Medical Journals

THE first numbers of two new scientific journals have been received. (1) *Anais da Faculdade de Medicina de Porto Alegre*, Universidade de Porto Alegre, Brazil, Fasc. 1, pp. 1-303. This is handsomely produced and well illustrated, and the papers, in Portuguese, Spanish, Italian, French, German or English, have summaries in French, German and/or English. It opens with an account of the medical centre of the University, and contains papers, among others, on detachment of the retina (Arruga), hereditary ophthalmic diseases (Meyer), and feminine types (Gomes). (2) *Anales de la Escuela Nacional de Ciencias Biológicas*, Mexico, vol. 1, No. 1, pp. 1-178. This also is well produced and illustrated, and contains articles in Spanish on the cultivation of *Rickettsia* of typhus fever (Siegfried), histology of the poison gland of a spider, *Cryptidromus* (Ancona), calcium chloride in the treatment of scorpion poisoning (Varela), a new species of *Phlebotomus* (Dampf) and some Mexican textile fibres (Huerta and Ancona) and others. Summaries in English and German are provided. In both journals, the printed matter on a page measures about 8 in. × 5 in.

Journal of the Royal Agricultural Society

THE ninety-ninth volume of the *Journal of the Royal Agricultural Society of England* has now been published (price 15s.). It includes, as in the previous volume, "The Farmer's Guide to Agricultural Research", which this year contains an additional section on pests and parasites. As usual, the subjects of the special articles cover a wide field of interest. Agricultural long-term credit facilities in Great Britain are discussed, and farm organization on the silt soils of Holland, Lincolnshire, described. A detailed account is also given of the life-history, distribution and control of bracken, from which there can be no doubt as to the need for urgency in undertaking means for its eradication. The starling is the subject of a further article, and at present it seems uncertain whether it should be regarded as a friend or enemy of the farmer. The Warnford Farm Estate, where pig breeding and bacon production are carried out on a vast scale, has been selected as this year's "Notable Farming Enterprise".

Durban Museum and Art Gallery

UNDER the directorship of E. C. Chubb this combined institution continues to make steady progress, reflected in an increase of visitors, who in the year ending July 31, 1938, numbered 123,771. The educational value of the collections is increased by the lectures to the public and to school children delivered by the staff, and modern developments are shown in the appointment of a guide-lecturer, through the generosity of the Carnegie Corporation of New York, the extended use of cinematograph films to illustrate museum lectures, and the scheme which enables assistants to visit other South African museums for the purpose of gaining experience in museum technique, a scheme sponsored by the South African Museums Association.

Applied Psychology in Italy

A PERMANENT Commission for the Application of Psychology has recently been appointed by the Italian National Board of Researches. It aims at promoting among State institutions, labour organisations and private persons the application of psychology in any field, with regard to selection and orientation, as well as to the organization of work. At present, applications in the scholastic field, where professional orientation has become a function of the school, are being studied in the first place; applications in industries, aviation and public transport will follow. The president of the Commission is Prof. P. Agostino Gemelli.

Appointments for Research in Tropical Medicine

THE Medical Research Council is offering up to three junior fellowships to qualified medical men or women wishing to receive training with a view to careers in research work in tropical medicine. The fellowships will be tenable for three years. The stipend will be at the rates of £300, £400 and £500 per annum in the successive years, with an additional allowance during service abroad and necessary expenses. In three years' time, at least one senior fellowship will be available for candidates who have held the junior fellowships mentioned above. This will be awarded for a further period of three years, carrying stipend at the rate of £600-£750 per annum, with an additional allowance during service abroad and expenses. The Council is also prepared to consider immediate applications for senior fellowships from candidates who have had adequate experience in research work, whether already specially trained in tropical medicine or not. The Council further intends to establish in due course, as suitable investigators become available as the result of the fellowships scheme, permanent and pensionable appointments for research work in tropical medicine, including senior posts. Further information can be obtained from the Secretary, Tropical Medical Research Committee, 88 Old Queen Street, London, S.W.1, with whom applications should be lodged not later than June 19, 1939.

Announcements

SIR EDWARD MELLANBY, secretary of the Medical Research Council, will deliver the annual Stephen Paget Memorial Lecture of the Research Defence Society on the occasion of the Society's annual general meeting, to be held at the London School of Hygiene and Tropical Medicine on June 13. The title of Sir Edward's lecture will be "The Experimental Method in the Conquest of Disease".

THE seventy-sixth annual general meeting (Murdoch Centenary) of the Institution of Gas Engineers will be held on June 6-9 at the Institution of Civil Engineers. The Murdoch Centenary Lecture will be delivered on June 6 by Dr. E. F. Armstrong.

THE Council of the Institution of Naval Architects has accepted an invitation of the Gesellschaft der Freunde u. Förderer der Hamburgischen Schiffbau-

Versuchsanstalt to participate in an International Meeting of Shipbuilders, Marine Engineers and Nautical Experts to be held in Hamburg in June. A visit will be paid to Kiel at the invitation of the German Navy, and two days will also be spent in Berlin under the auspices of the Lillenthal-Gesellschaft für Luftfahrtforschung and of the Schiffbautechnische Gesellschaft.

THE Cambridge University Press has in active preparation, and will publish early in the autumn the authorized biography of the late "Lord Rutherford", by Prof. A. S. Eve, a personal friend for many years and formerly Macdonald professor of physics at McGill University. The author has enjoyed the fullest co-operation of Rutherford's closest colleagues and friends, and of Lady Rutherford, who has allowed use to be made of the collection of his husband's letters and papers. Earl Baldwin has written a foreword.

THE Institute of Ethnography attached to the Academy of Sciences of the U.S.S.R. is preparing an ethnographical work on the different peoples of the U.S.S.R. which will run into many volumes. The first three volumes are to be ready this year and will be devoted to a description of the people of Central Asia and Kazakhstan, Siberia and the Far East, and the European section of the Soviet Union. The Institute for Soil Study of the Academy has just published the first three volumes of a monograph on "Soils of the U.S.S.R.". These volumes contain a geographical description of the soil of the European part of the U.S.S.R. from the far north to the Caucasus. A fourth volume, dealing entirely with the soils of the Caucasus, will be issued this year.

THE German Society of the History of Medicine, Natural Science and Technique will be held this year at Jena on September 21-24, when the chief subjects for discussion will be the eye in the history of medicine, natural science and technique. There will also be an exhibition of historical collections in Jena and Weimar.

ELEVEN thousand fewer persons were killed in accidents of all kinds in the United States during 1938 than in 1937—a decline of more than 10 per cent. Motor-vehicle fatalities declined from about 40,000 in 1937 to between 31,000 and 32,000 in 1938.

PRELIMINARY figures from the census taken in Soviet Russia last January give the U.S.S.R. a population of 170,126,000. The increase since 1926 is 23,100,000, which is approximately equal to the population of Spain. In Moscow the birth-rate was 69 per cent higher in 1938 than in 1936: the death-rate for the entire country has dropped by more than 40 per cent compared with 1913. The census shows that the total number of industrial workers employed in the U.S.S.R. rose from 11,600,000 in 1928 to 27,800,000 in 1938. The entire population has more than doubled since 1926.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 944

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS

Mechanical Device for Smoothing Data

As is well known, the application of any reasonably satisfactory formula for the smoothing of a lengthy series of data involves a considerable amount of time and labour. In a recent article¹, I indicated the possibility of constructing a mechanical device whereby all mathematical computation would be eliminated. Such a machine has now been constructed.

The model (Fig. 1), capable of dealing with 18 datum points, consists of a mounted wooden board to which are attached 18 movable glass cylinders, each about 50 cm. in length, half-filled with mercury. A cylindrical iron rod with a hole near its upper end floats in each cylinder. The floating rod acts as a perfect spring, since the force it exerts is directly proportional to its vertical displacement from its position of equilibrium.

A suitable scale is pasted along the top portion of the wooden board, and the process of obtaining a smooth curve, which can be read off from the scale, is extremely simple. For purposes of illustration, the Central Cape annual rainfall figures during the years 1881-98 were employed. Starting from the left, the first cylinder is adjusted so that the hole in the freely floating iron rod corresponds to the 1881 rainfall, which was 136 per cent of the normal. If all the other cylinders are similarly adjusted to correspond with the rainfall figures of their respective years, and if a string be passed through the 18 holes in succession,

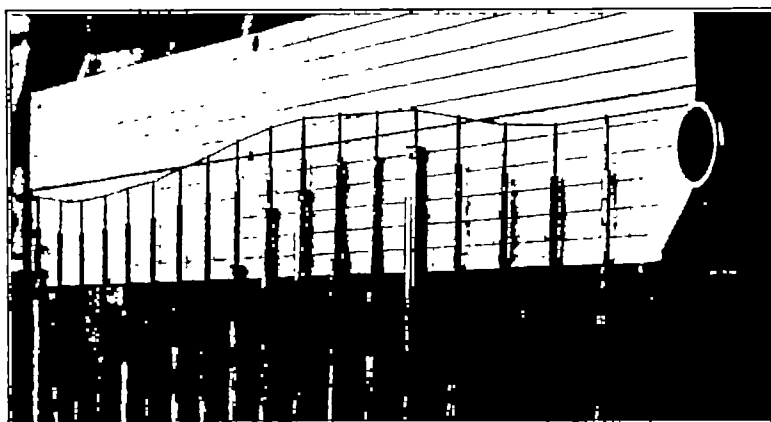


Fig. 2.

the string will in effect be an unsmoothed graph of the rainfall for the period under consideration (Fig. 1).

The string is attached to a movable hook on the left, and at the right it passes over a pulley, which can also be moved up and down. Tension is now applied to the string by suspending a predetermined weight (depending upon the degree of smoothness desired) to its free end, the hook on the left and the pulley on the right being adjusted so that the first and last portions of the string are horizontal. Evidently the effect of the tension on the string will be to displace the iron rods in such a way that a smoothed curve results (Fig. 2). (This photograph was taken at an angle so as to reduce the apparent width of the board.)

The points on the smooth curve may now be read off from the scale, thus reducing many hours of laborious calculations to a few minutes. Moreover, once the cylinders have been adjusted to fit the original data, curves of varying degree of smoothness may be obtained in a minimum of time simply by attaching different weights to the free end of the string.

With reference to the theory underlying this mechanical process, the machine automatically applies a very interesting type of graduation formula to the crude data. In any smoothing process some departure from the observed facts is essential, and in general a compromise must be struck between departure from the observed facts and the smoothness of the resulting curve. If $y_1, \dots, y_n$ be the crude data, and u_1

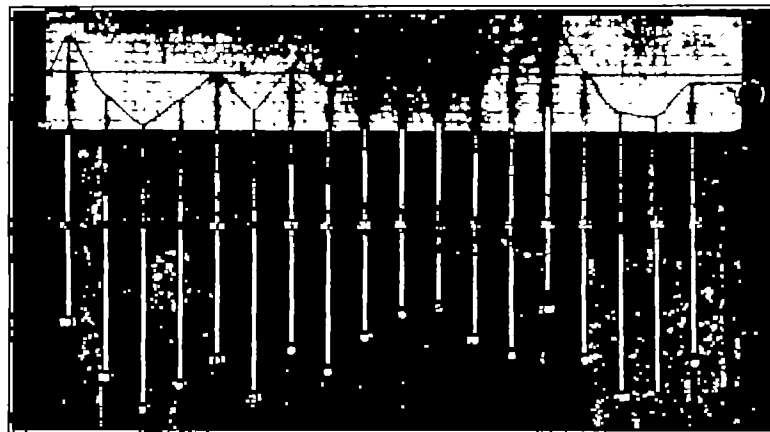


Fig. 1.

. . . u_n the corresponding smoothed values, then $\sum_1^n (y_r - u_r)^2$ may be regarded as a measure of the departure from the observed facts, and the sum of the squares of the first differences, that is, $\sum_1^{n-1} (u_{r+1} - u_r)^2$ may be regarded as a measure of the lack of smoothness or the roughness of the resulting curve. If these definitions be accepted, then the logical way to carry out the smoothing process would be to make k times the sum of the squares of the deviations of the data from the graduated curve plus the squares of the first differences of the graduated curve a minimum, where k is an arbitrary constant. This means that:

$$k \sum_1^n (y_r - u_r)^2 + \sum_1^{n-1} (u_{r+1} - u_r)^2 = \text{minimum.}$$

Application of this minimum principle leads to the result (*loc. cit.*)

$$u_r = \frac{2p-1}{p^n - (1-p)^n} \left\{ \varphi_{n-r+1} \sum_1^r \alpha^{r-s} \varphi_s y_s + \varphi_r \sum_{r+1}^n \alpha^{r-s} \varphi_{n-s+1} y_s \right\}, \quad (1)$$

which is the formula by which the u 's are expressed in terms of the crude data, α , p and φ being defined as follows:

$$\alpha = \frac{1}{2+k}; \quad p-p^2 = \alpha^2; \quad \varphi_r = \frac{1}{\alpha+p} \left\{ p^r + \frac{p}{\alpha} (1-p)^r \right\}.$$

Provided the slope of the smoothed curve is nowhere too great, the smoothed data $u_1, \dots, u_n$ as read off from the machine correspond to the values as given by the formula above. The constant k , and accordingly also α and p , can be simply expressed in terms of the physical characteristics of the machine; thus

$$k = \frac{abpl}{m(b-a)},$$

where a is cross-sectional area of any of the iron rods; b is internal cross-sectional area of any of the glass tubes; ρ is density of mercury; l is distance between two adjacent cylinders; m is the mass attached to the free end of the string.

It is felt that the machine should find a very wide field of practical application wherever investigators are concerned with the study of trends of statistical data, not only in scientific work but also in the economic and industrial world.

A more detailed description of the machine, together with a discussion of experimental results and of possible modifications in design, will appear elsewhere in due course.

T. SCHUMANN.

Meteorological Office,
Pretoria.
April 14.

(Chief Meteorologist.)

¹ Schumann, *Phil. Mag.*, 26, 970 (1938).

Splitting of Protein Molecules by Ultra-violet Light and α -Rays

In a previous communication¹, we have reported on a well-defined splitting of the molecule of *Helix* haemocyanin by ultra-violet light. The idea that we have to deal with a primary photochemical process was put forward.

If this really is the case, one would expect temperature to have very little effect on the reaction. To test this assumption we have irradiated frozen haemocyanin solutions at the temperature of liquid air. The reaction took place with practically the same velocity as at room temperature, giving rise to half-molecules.

For purposes of comparison we also studied the action of ultra-violet light on haemoglobin and serum albumin. The latter reaction has recently been subjected to a very thorough study by a group of American investigators². Irradiation at room temperature and at 0° C. causes the formation of low-molecular substances and also a general inhomogenization of the protein. Our experiments confirmed this result. For haemoglobin, the ultra-centrifugal test also revealed a very pronounced inhomogenization of the protein, a continuous series of molecules of both lower and higher weight than the normal being formed.

When irradiated at the temperature of liquid air, haemoglobin showed no change whatever even after an exposure five times as long as that required to give noticeable effect at room temperature. Serum albumin was just slightly affected. It is obvious, therefore, that the effects observed in haemoglobin and serum albumin, when irradiated at room temperature, are due mainly to secondary reactions.

A more concentrated kind of energy might have a different effect. As a first example of this type we have tried the action of α -rays on *Helix* haemocyanin, haemoglobin and serum albumin, both at room temperature and at the temperature of liquid air. Radon was dissolved in a solution of the protein and the sample left to the action of the radiation from Rn, RaA, RaC and RaC' for different lengths of time. Under these conditions there is added to the effect of α -rays also that of the β - and γ -rays. The ionization due to the latter, however, is only 1-2 per cent of the former and their action is therefore negligible. All the proteins showed qualitatively the same behaviour towards α -rays as towards ultra-violet light. Haemocyanin was split into half-molecules regardless of temperature, while haemoglobin and serum albumin were made inhomogeneous when acted upon at room temperature but not at liquid air temperature.

An attempt has been made to calculate the reaction velocity in the case of *Helix* haemocyanin irradiated by α -rays. The density of the ions along the path of an α -particle is so high that one might assume that every haemocyanin molecule situated on the path is caused to split into halves. If v is the average number of hits that a molecule receives, the probability of no hit is e^{-v} and, therefore, the relative concentration of unchanged molecules

$$c/c_0 = e^{-v}. \quad (1)$$

A consideration of the geometrical conditions shows that in our experiments where a low protein concentration was used (number of molecules per c.c. around 10^{14}) we have as first approximation

$$v = \alpha \tau a, \quad (2)$$

where α is the number of rays per c.c. during the whole period of irradiation, τ is the average range in the solution of the α -particles from Rn, RaA, RaC, and RaC' (4.23×10^{-3} cm.) and a the effective cross-section of the haemocyanin molecule taken as an ellipsoid of rotation (approximately 1.81×10^{-11} cm.²).

A series of experiments with varying number of rays per c.o. gave the following figures.

Time of radiation in days	α	γ from equation (2)	α/γ	
			Experimental determination	Theoretical values from equation (1)
0.8	0.9×10^{12}	0.07	0.91	0.93
2.0	1.9 "	0.14	0.85	0.87
4.1	3.3 "	0.25	0.82	0.77
11.8	5.6 "	0.43	0.77	0.66

In view of the approximations made and the experimental difficulties involved, the agreement between the experimentally determined and the calculated relative concentrations of unchanged molecules is quite satisfactory and supports the assumption that every haemocyanin molecule hit by an α -particle is split. This means that, out of the energy received in any part of the molecule, a portion large enough to cause splitting is transferred to the bond holding the two halves together.

As yet we have not carried out measurements of the absolute number of ultra-violet light quanta active in this splitting, but the independence of temperature points to a quantum yield of unity. It is of interest to note that from studies of the action of various rays on the mutation rate, it has been inferred that the production of a single ion pair within a sensitive spot of the cell, probably the gene, produces mutation*. There seems to be a certain analogy between this finding and our results.

The different behaviour of haemocyanin on one hand and haemoglobin and serum albumin on the other seems to us to be of considerable importance. It shows that the former molecule is easily dissociated by absorption of energy while the latter ones are very stable against a raising of the energy-levels so long as secondary chemical reactions are excluded.

THE SVEDBERG.
SVEN BROHULT.

Institute of Physical Chemistry,
The University,
Uppsala.
April 28.

Svedberg, T., and Brohult, S., *NATURE*, **143**, 830 (1938).

Saniger, H. B., Krejci, L. M., and Kraemer, M. O., *Biochem. J.*, **33**, 1 (1939).

*O. Stabbe, H., "Genmutation", 327 (Berlin, 1938).

Energy of Neutrons liberated in the Nuclear Fission of Uranium induced by Thermal Neutrons

It has been shown that fast neutrons are liberated in the process of nuclear fission induced in uranium by primary thermal neutrons. Two different methods of detection have been used: in the first method¹, the primary and (if any) secondary neutrons are absorbed in a medium in which an endo-energetic reaction can take place, leading to the formation of an easily detectable radioactive nucleus. If the energy threshold is situated above the maximum energy of the primary neutrons, any positive results observed must be ascribed to the secondary neutrons. In the second method², elastic collisions of fast neutrons with heavier nuclei are observed by means of an ionization chamber filled with a gas at atmospheric pressure and connected to a linear amplifier. In order to study separately the effect due to the primary thermal neutrons, the experiment is performed with, and without, a cadmium shield between the source and the uranium mass.

The first method having shown us that fast secondary neutrons are produced with energies of at least 2 Mev. (sufficient to transform ³²S into radioactive ³²P in detectable quantities), we sought to ascertain, by the second method, whether neutrons of energy notably higher than 2 Mev. are also present in the secondary radiation. In our experiment, the oxygen-filled ionization chamber was placed in a nearly cubical box (9 cm. $\times$ 9 cm. $\times$ 8 cm.) containing uranium oxide and surrounded by a thick layer of paraffin wax. The source (300 mgm. Ray + Be), surrounded by a lead shield (5 cm. in the direction of the chamber) was buried in the wax. In order to absorb thermal neutrons, the uranium box could be screened on all sides with a cadmium foil. The pulses were recorded either in the presence or in the absence of this foil and the part of the effect (projection of oxygen nuclei by fast neutrons liberated in the uranium) due to thermal neutrons could thus be evaluated.

In view of the large number of accidental pulses due to the strong γ -radiation emitted by the source, only nuclei recoiling with at least 1.5 Mev. could be taken into consideration. The distribution curve shows that the frequency of pulses observed falls off rapidly between 1.5 Mev. and 2.5 Mev.; between 2.5 Mev. and 3.7 Mev. the frequency decreases much more slowly, pulses observed in this second region being, however, very rare. The total number of pulses recorded is small (with cadmium: 84 pulses in 90 minutes; without cadmium: 161 pulses in 90 minutes); but it appears clearly that recoils with energy of about 2.5 Mev. are notably more frequent in the absence of cadmium and, therefore, that neutrons possessing an energy of at least 11 Mev. are liberated in uranium irradiated with thermal neutrons.

The high energy of these fast neutrons shows that their parent nuclei are in a highly excited state at the moment of their liberation, which is probably simultaneous with the fission. In this way a non-negligible fraction of the fission energy is disposed of; a further fraction is carried off by the β - and γ -rays afterwards emitted by the nuclei produced in the fission. The remainder available as kinetic energy for these recoiling nuclei is therefore considerably smaller than the total amount of energy liberated in the fission process (about 200 Mev.).

H. VON HALBAN, JUN.
F. JOLLIOT.
L. KOWARSKI.

Laboratoire de Chimie Nucléaire,
Collège de France,
Paris.
May 20.

¹ Dodé, M., von Halban, jun., H., Joliot, F., and Kowarski, L., *C.R.*, **203**, 936 (1939).

² Seillard, L., and Zinn, W., *Phys. Rev.*, **55**, 790 (1939).

Homometric Structures

In connexion with a recent discussion¹ of the question of the uniqueness of an X-ray crystal analysis, Prof. Linus Pauling has directed my attention to a curious property of the point position $T_1' - 1a3 - 24(d)$. Pauling and Shappell² have shown that this point position, which involves a single parameter u , has a structure factor which is even in u , while parameter values $+u$ and $-u$ correspond to the structures which are not identical

nor are they mirror-images of one another. An examination of this point position shows that these structures give identical sets of interatomic distances.

For the sake of brevity, we shall make use of the term 'homometric' to describe the relation between two structures which possess the same interatomic distances. For the present, we shall restrict the use of the term to those structures which give the same X-ray diffraction pattern; that is, for two interatomic distances to be considered the same, they must both be terminated by a similar pair of like or different atoms. It follows immediately that identical structures and structures that are mirror-images of one another are homometric to one another. In the discussion which follows, we generalize the term identical to include those structures which are mirror-images of one another as well as those which are identical in the usual sense.

An examination shows that the special point position $O_h^{18} - Ia3d - 24(f)$ also leads to two non-identical homometric structures for positive and negative values of the single parameter; and it becomes important to discuss the frequency of occurrence of this phenomenon. An examination of the subgroups of T_h^{18} and O_h^{18} on the same lattice indicates that there are no homometric pairs of structures, among the special points of one parameter, which can be obtained by a simple change of sign.

No direct method seems to offer itself for the enumeration of the number of possible sets of non-identical homometric structures. For this reason the following brief account of a cursory examination of the problem is presented in the hope that other workers in the field may make further progress. It is obvious that such an enumeration is essential for the complete discussion of the uniqueness of an X-ray crystal analysis, since it is well known that this method can at best determine the interatomic distances.

An examination of the genesis of the homometric property in T_h^{18} and O_h^{18} indicates that it is associated in these groups with the trigonal and the cubic symmetry of these groups. This fact is confirmed by the absence of the property among the subgroups of these space groups. An examination of the special points of the cubic, hexagonal and trigonal system, involving one or two parameters, seems to show that there are no non-identical homometric pairs obtained by a simple change of sign.

A few space groups can be directly eliminated by considering the homogeneity of any point position. In any space group which contains an operation of the second kind, the equivalent points fall into two classes. The set of vectors (A) drawn from any point of the first class to all other points in the cell are enantiomorphous with the set of vectors (A') drawn from any point of the second class. An examination of the two known non-identical homometric pairs shows that in going from one structure to the other the following process is carried out. Each of the two sets of interatomic vectors belonging to the first member of the pair can be split into two halves: A_1 and A_2 , and A'_1 and A'_2 . To construct the second member of the pair, we then combine A_1 with A'_1 , and A'_1 with A_2 , thus arriving at a different structure with the same interatomic distances. It is obvious that such an operation cannot be performed on a group which does not contain an operation of the

second kind, and that the 65 Sohncke groups, therefore be eliminated from consideration. It seems possible to eliminate those space groups which permit only 2, 4 or 6 equivalent points, since at least 4 points are required to establish the presence of enantiomorphism in three dimensions, and does not seem possible to carry out the operation described above on a set of 6 equivalent points. This results in the elimination of a further 44 space groups but it has not proved possible to carry this line of argument further.

A. L. PATTERSON

Bryn Mawr College,
Bryn Mawr, Pa.
April 10.

¹ Patterson, A. L., *Phys. Rev.*, **55**, 682 (1939).

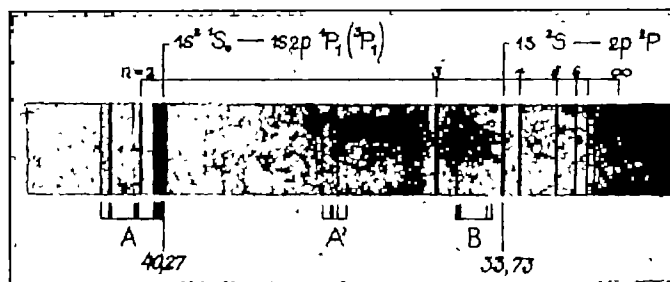
² of "Internationale Tabellen zur Bestimmung von Kristallstruktur" 1, 323 (Berlin, etc. 1935); or B. W. G. Wyckoff, "Analytical Expression of the Results of the Theory of Space Groups" (Washington 1930).

³ Pauling, L., and Shappell, M. D., *Z. Krist.*, **75**, 123 (1930).

Atomic Energy States of an Unusual Type

WHEN examining the vacuum spark spectra of light elements, some rather unexpected lines have been observed, which indicate optical energy states extremely high above the ionization limit, having character approaching that of X-ray levels.

The observations concern the elements from No. (boron) to No. 9 (fluorine), and extend over the wave-length region from 60 Å. to 15 Å. The spectrum in this region should be very simple, only consisting of two series of lines $1s^2S - np^2P$ and $1s^2S_0 - 1s^2P_1^0$. On well-exposed spectrograms we find, however, besides these normal series and a strong intercombination line $1s^2S_0 - 1s^2P_1^0$, a considerable number of additional lines appearing in distinct groups as shown in the accompanying illustration which the groups are marked A, A' and B.



VACUUM SPARK SPECTRUM OF CARBON.

Though at first sight these new lines seem difficult to account for, it is not impossible to find an explanation for them. Beginning with group A, which contains the strongest lines, its position near $1s^2S_0 - 1s2p^2P_1^0$ indicates transitions of essentially the type $1s^2 - 1s2p$. In the first place, one has to consider $1s^2.2s - 1s2p.2s$ and $1s^2.2p - 1s2p.2p$, but the number of observed lines is greater than can be accounted for in this way, one must also include $1s^2.3s - 1s2p.3s$, $1s^2.3p - 1s2p.3p$ or other similar transitions in a three-electron spectrum, possibly also combinations in a four-electron configuration such as $1s^2.2s^2 - 1s2p.2s^2$. The deep terms in the above three-electron transitions are known from the ordinary Li I-like spectra (C IV, etc.); and the

ies limits of the high terms, being normal terms the He I-like spectra, one can predict the location higher series members such as $1s^2.2s-1s\ 3p.2s$ $1s^2.2p-1s\ 3p.2p$. Confirming the explanation of the group A' falls at the position for second ies members to lines of group A. The original spectrogram even shows traces of the third group of same series.

As a consequence of the above explanation, one ist assume the existence of discrete energy levels ng above the ionization limits by amounts up to s times the ionization potential of the same spectrum, in the case of F VII nearly 800 volts ove the ionization limit of F VII. A previously own analogy to these terms are those found by utler¹ in the absorption spectra of metal vapours, igh in certain cases surpassed the ionization limit almost 17 volts.

The lines of group B, approaching the line $1s\ ^2S-^2P$ from the long wave-length side, are undoubtedly analogous to the lines in He I found by mpton and Boyce² and interpreted by them as nsitions of the type $1s.2s-2p.2s$ and $1s.2p-^2.2p$, an explanation which has later been comed by several theoretical calculations³.

We may recall that the X-ray line K α of a free rbon atom may be written as $1s^2.2s^2\ 2p-1s\ 2p.^2.2p$, being essentially the same transition as the sonance line of C V, $1s^2\ ^1S_0-1s\ 2p\ ^1P_1$, at 40.3 Å. he presence of additional outer electrons will duce the field in which the transition takes place, id consequently cause a shift towards longer wave-ngths. The K α of carbon, as observed in various ystal lattices⁴, extends with several maxima from 1.5 to 48 Å. It is then obvious that the lines of roup A with respect to both configuration and wave-ngth take a place intermediate between a true ptical line and the corresponding X-ray line.

B. EDLÉN.
F. TYRÉN.

Physics Laboratory,
University, Uppsala.
April 22.

Boutler, H., *Z. Phys.*, **86**, 496 (1933); and eight subsequent papers.
Jompton, K. T., and Boyce, J. O., *J. Franklin Inst.*, **306**, 497 (1928)
See for references: Kiang, A. T., Ma, S. T., and Wu, T. Y., *Chinese J. Phys.*, **2**, 117 (1936)
Siegbahn, M., and Magnusson, T., *Z. Phys.*, **90**, 1 (1935).

Aurora and Geomagnetic Disturbance

In the course of analysis of simultaneous auroral and geomagnetic events at Fort Rae, North West Canada, during the Second International Polar Year, a feature has emerged about which we consider it advisable to make a preliminary report. If the elevation above the horizon of an auroral arc be θ , and if θ be the elevation of a concentrated linear electric current to which the simultaneous vector components ΔH and ΔZ in the geomagnetic meridian field may be attributed, then in seventy cases selected solely on the basis of a substantial magnitude of each of ΔH and ΔZ , θ and ϕ are on the same side of the magnetic vertical plane five times as frequently as on opposite sides.

This result is significant only because Fort Rae is almost under the zone of maximum auroral frequency, where arcs are formed with equal frequency on either side of the zenith.

In 35 per cent of the selected cases, $\theta-\phi$ is less than 10° ; in 60 per cent within 20° . On occasion,

the movement of an arc across the zenith was accompanied by a simultaneous change in the direction of the vertical disturbance vector, indicating a movement of similar sense of the overhead current system responsible for the vector change.

We deduce that, at least in high magnetic latitudes, there is probably a closer spatial association than has hitherto been supposed between the current system which produces the major short-period perturbations in the earth's field and the currents which manifest themselves as auroral arcs at heights mainly between 100 km. and 115 km.

J. M. STAGG.

Kew Observatory,
Richmond, Surrey.

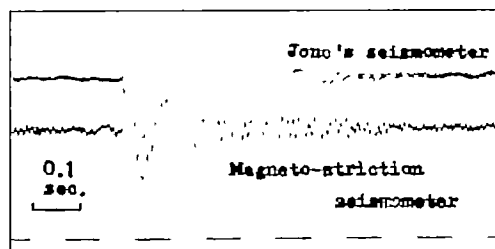
J. PATON.

Natural Philosophy Department,
University, Edinburgh.
May 6.

Sensitivity of the Geophone

IN experimenting with a magnetostriction seismometer originally designed for geophysical prospecting, some characteristics of the instrument were observed to be of interest. The geophone, when combined with a suitable amplifier, is capable of yielding a very high sensitivity, yet by itself it is so strong that it can be handled without a clamp just like a piece of metal, and it appears to be a most suitable instrument to study the effect of bomb explosions on buildings, steel structures and shelters. Actually it can be built into the steel structure and placed almost on the site of an explosion.

The geophone consists of a coil and a magnetized nickel rod carrying a weight. Working in combination with an amplifier, consisting of 4 D.C. valves coupled with resistances, and an improved Shire's oscillograph¹, the sensitivity of the instrument is of the same order as Jones's seismometer², one of the most sensitive portable instruments existing.



The accompanying plate is a record of these two types of seismometers placed side by side recording the same 'earthquake', which was produced by the dropping of a 20 gm. mass from a height of one metre on to a carpet-covered concrete floor about 20 ft. away from the instruments. Being an accelerometer, the new instrument shows a much sharper onset in its record. The natural frequency of the magnetostriction instrument is extremely high. Its oscillation is damped down by internal friction so rapidly that it is not detectable by the camera. In another model, a mechanical lever has been used which increases the sensitivity 30-50 times further.

WENG WEN-PO.

Imperial College,
London, S.W.7.

¹ *J. Sci. Instr.*, **11**, 379 (1934).
² *J. Sci. Instr.*, **9**, 8 (1932).

Digestibility of Straw

STRAW contains large quantities of carbohydrates, which can only be partially digested by farm animals. Various attempts have been made in the past to increase the digestibility of straw by some pre-treatment.

In Great Britain, Godden¹ carried out some preliminary work with soda in 1920, and states that "There is obviously need for much further investigation of the possibilities of soda treatment before a final opinion can be expressed as to its merit for introduction into farm practice".

In the course of a wide investigation of the problem, we have treated oat- and wheat-straws with caustic soda solutions of varying strengths and for different lengths of time.

Our best results were obtained with a concentration of soda of the order of 1.25 per cent with an immersion period of 20-24 hours without any heating. With the volume of solution used, this represented 10 lb. of caustic soda per 100 lb. of straw. Weaker solutions were not so effective, even if the time of immersion were increased. Of the 10 lb. of caustic soda there is a recovery of 40-50 per cent, which can be made up to the correct level for subsequent batches.

The treated straw is easily washed with water, and is then readily eaten by ruminants.

The process seems to depend upon the breaking down of the lignin-cellulose complex to such an extent as to allow of more complete utilization of the material in the paunch than is possible with the untreated straw.

The effect of treatment is shown by the following preliminary figures for the starch equivalent values of treated and untreated straw, calculated from the digestibility data obtained in metabolism experiments with sheep.

	Lb. starch equivalent per 100 lb. straw	
	Treated	Untreated
Oat straw	42.1	21.7
Wheat straw	32.0	13.0

The process is simple in operation, and is now being used on our farm. Treated oat straw fed to fattening bullocks and supplying 7.4 lb. of starch equivalent out of a total of 11.8 lb. has resulted in a daily live-weight gain of just under 2 lb. over a period of 62 days. The animals are in prime condition and ready for the butcher.

R. E. SLADE.
S. J. WATSON.
W. S. FERGUSON.

Imperial Chemical Industries, Ltd.,
Jealott's Hill Research Station,
Bracknell, Berks.
May 2.

¹ Godden, W., *J. Agric. Sci.*, 10, 437 (1920).

Importance of Cytochrome B in Hydrogen Transport

It is quite definitely known¹ that dihydrooxymase can be oxidized by molecular oxygen in the presence of diaphorase I plus the 'cytochrome system', but the nature of the cytochrome reaction has not been clearly demonstrated. On the basis of the experiments reported here, we believe that both cytochrome B

and cytochrome C are required for the oxidation of both CoH₂I and succinate.

Using spectrophotometric technique, we have shown that the rate of oxidation of 60 γ of CoH by a preparation poor in cytochrome C was double when 4×10^{-6} mols of pure cytochrome C were added. By measuring the rate of cytochrome reduction in the presence of sufficient cyanide (10^{-6} mols per ml.) to block completely the action of cytochrome C oxidase, it was possible to show that CoH₂I would reduce cytochrome C rapidly in the case of a fresh enzyme preparation, and not at a or only slowly in the case of an acid-precipitated dried enzyme used in amounts which contained the same quantity of diaphorase I (as shown by the CoH₂I plus methylene blue reaction).

That the missing compound in the dried preparation might be cytochrome B was indicated, among other things, by the fact that the reduction of cytochrome C by CoH₂I in the presence of the free preparation is prevented by strong cyanide (10^{-6} mol per ml.). This is also the case when succinate is the hydrogen donor, and can be demonstrated spectroscopically or visually, using 10^{-7} mols of cytochrome C as the final reduced product. The degree of cyanide toxicity is undoubtedly affected by the enzyme concentration. The fresh enzyme mentioned above contained 3.5 mgm. per ml.

It seems possible that the missing component in the succinoxidase system described by Hopkins, Lutwak-Mann and Morgan² may include cytochrome B. Details and implications of our experiments will be reported later.

Biokemiska Institutet,
Stockholm.
April 29.

V. R. POTTER.
E. E. LOCKHART.

¹ Potter, *NATURE*, 143, 475 (1939), and references.

² Hopkins, Lutwak-Mann and Morgan, *NATURE*, 143, 556 (1939).

Temperature Activation of the Urease-Urea System

THE activity of several enzymes (for example yeast and malt invertase¹, and *E. coli* dehydrogenase²) has been shown to increase exponentially with temperature according to the Arrhenius equation,

$$K = Ze^{-\mu/RT},$$

where K is the rate, Z is a constant, e is 2.718, R is the gas constant, T the absolute temperature, and μ the energy of activation of the reaction in calories per gm. mol.

Hitherto, no comparison has been made of temperature activation of an impure and a highly purified enzyme. A study was made of the hydrolysis of 1.5 per cent urea in phosphate buffer at pH 7.0 using both crude and crystalline Jack bean urease³. The reaction was followed by measuring ammonia formation colorimetrically after Nesslerization, or carbon dioxide evolution volumetrically using the Barcroft differential manometer. For either crude or crystalline urease the rate of urea hydrolysis increases with temperature in accordance with the Arrhenius equation, where $\mu = 8,700$ or 11,700 cal. over the whole temperature range up to the inactivation temperature, or $\mu = 11,700$ below and 8,700 above a critical temperature of about 22° C. When urease is dissolved in water or in reducing or indifferent solutions, $\mu = 8,700$, but when dissolved in oxidizing solutions, $\mu = 11,700$. The activation energy seems

depend upon the oxidation-reduction potential of the digest. When the potential was adjusted with varying proportions of ferri- and ferrocyanide it was apparent that with an E_h above +0.46 v., $\mu = 11,700$, below +0.42 v., $\mu = 8,700$, and between +0.42 and +0.46 v., $\mu = 11,700$ below and 8,700 above the critical temperature.

It is suggested that the energy of activation of the urease-urea system is determined in part by the configuration of certain essential radicals such as the ulphydryl groups in the enzyme molecule. When such structures are in the reduced condition, $\mu = 8,700$, but when oxidized, $\mu = 11,700$. The change from the reduced to the oxidized form is reversible and is accompanied by this shift in temperature characteristic.

The temperature characteristic of 20,800 for soy bean urease is listed in most text-books. This value was calculated by Euler³ from the data of Van Slyke and Cullen⁴ and is incorrect. Recalculations indicate a value for μ of 11,700; this is identical with one of those obtained with Jack bean urease. It is apparent that the activation energy is independent of the source and purity of the urease, but does shift in a predictable manner with the oxidation-reduction potential of the digest.

IRWIN W. SIMER.

Laboratories of Biological Engineering,
Massachusetts Institute of Technology,
Cambridge, Mass. April 13.

¹ Simer, I. W., *J. Cell. and Comp. Physiol.*, 10, 79 (1937); *Enzymologia*, 4, 215 (1938).

² Gould, B. B., and Simer, I. W., *J. Biol. Chem.*, 124, 259 (1938).

³ Sumner, J. B., *J. Biol. Chem.*, 69, 425 (1925).

⁴ Hollerman, L., Parkins, M., and Clark, W. M., *Proc. Nat. Acad. Sci.*, 19, 865 (1933).

⁵ Euler, H., "Chemie der Enzyme", Teil 1 (1920).

⁶ Van Slyke, D. D., and Cullen, G. B., *J. Biol. Chem.*, 19, 141 (1914).

Vitamin C Sources in Eskimo Food

It is the general experience among arctic explorers that when they 'live of the land', scurvy never occurs. Stefansson¹, who directed attention to this fact, cured three cases of scurvy with reindeer meat.

A Norwegian scientific expedition to Angmagssalik was made during 1936-37 for the purpose of examining nutrition, metabolism, physique and health of Eskimos. The accompanying table shows the vitamin C content of the available food. The numbers are means of at least two observations. We used the method of Emmerie and van Eekelen².

It must also be mentioned that 'mattaq' (epidermis of whale) which Bertelsen³ especially has pointed out as a good antiscorbutic remedy, contained 20 mgm. ascorbic acid per 100 gm. (from narwhal). In skin of young seals from the coast of Norway we found such enormous amounts as 180 mgm. per 100 gm.

It is well known that marine algae are used as food in Japan, China, Hawaii, and some algae are eaten on Iceland and on the coast of certain parts of Great Britain. The Eskimos eat them raw or dipped in boiling water (or broth) or with blubber oil. From this source, the Angmagssalik Eskimo get 50 per cent of their vitamin C.

The other 50 per cent is mainly obtained from organs of mammals and birds and also from fish. On an exclusive lean meat diet one gets about 25 mgm. vitamin C a day, even when the meat is boiled. By boiling, 50 per cent is extracted or

oxidized. If the broth also is used, one gets nearly 40 mgm. a day. This agrees with the experiences of Stefansson¹.

VITAMIN C (L-ASCORBIC ACID) IN COMMON ESKIMO FOODS

(Mgm. per 100 gm.)

FJORD SEAL (<i>PA. fastus</i>)		GUILLERMOT (<i>Ursus gryllus</i>)	
Adrenals	127	Liver	22
Thymus	20	Brain	16
Liver	18	Eye	9
Central nervous system	18	Intestine	5
Epithelium	17	KIDNEYDUCK (<i>Sonastoria melano-</i>	
Kidney	13	riae)	
Eye	10	Liver	17
Lymph gland	7	Eye	14
Pancreas	7	Brain	9
Ovary	7	Intestine	4
Skin	3	INVERTEBRATES	
Small intestine	3	Sea mussel (<i>Mytilus edulis</i>)	0
Blood	2	Crayfish sp.	3
Meat	2	COD (<i>Gadus callarias</i>)	
Heart	0	Liver	8
Blubber	0	Meat	2
Other organs (average)	1	Roce	44
PLANTS		Cod liver oil	0
Rosewort (<i>Sedum roseum</i>)	27	MARINE PLANTS	
Mountain willow (<i>Salix</i> sp.)	18	<i>Alaria</i> sp.	45
Dandelion leaves (<i>Taraxacum officinale</i>)	15	<i>Rhodomyrtus palm</i>	17
Angelica (<i>Archangelica officinalis</i>)	14	<i>Fucus</i> sp.	13
Craikberries (<i>Empetrum hermaphroditum</i>)	9	<i>Ascoplyllum nod.</i>	11

In the opinion of one of the authors (A. H.), who has been on sledging journeys of long duration in the Arctic, less than 15 mgm. ascorbic acid a day effectively prevents scurvy.

The Angmagssalik Eskimo get a daily average dose of about 40 mgm. per adult. In agreement with this finding, scurvy is unknown among Angmagssalik Eskimos.

A detailed report on the results of the work of the expedition will appear in a book this autumn.

ARNE HØYGAARD.

HARALD WAAGE RASMUSSEN.

Institute of Physiology,

The University,

Oslo.

May 6.

¹ Stefansson, "Observations on Three Cases of Scurvy", *J. Amer. Med. Assoc.*, 71, 1715-1718 (1918).

² Emmerie, A., and van Eekelen, M., "Some Critical Remarks on the Determination of Ascorbic Acid", *Biochem. J.*, 30, 25-27 (1936).

³ Bertelsen, A., "Animale antiscorbutica i Grønland", *Hospitaltidende*, 64, 537 (1911).

Hormone from the Human Corpus Luteum of Early Pregnancy

THE human corpus luteum of pregnancy is cystic up to the fourth month of pregnancy. The fluid content of the luteal follicle may be as much as 1.5 c.c.

The action of single doses of the luteal fluid (0.5-1.0 c.c.) is different from progesterone ('Proluton', Schering).

The luteal fluid causes deturgescence to supervene in three stages whereas progesterone produces a sudden type of deturgescence; perineal rest is attained twelve days after the injection of luteal fluid whereas with progesterone the perineum returns to rest in five and not later than seven days; the perineal rest induced by luteal fluid lasts 10-11 days, but in the case of progesterone perineal rest is transitory and is over in twelve hours; the effects of luteal fluid are maintained for 20-21 days whereas progesterone does not act longer than seven days.

Progesterone in doses greater than 3 mgm. and less than 20 mgm. prolongs the cycle by 3-9 days whereas the luteal fluid shortens the cycle by 6-8 days.

In virgin rabbits, 0.1 c.c. of the luteal fluid administered intravenously leads within 48 hours to gross enlargement of the uterus (five times the normal), great enlargement of the follicles on the ovary some of which may contain blood, and a great increase in the interstitial cells.

An ether extract of the luteal fluid equivalent to 0.05 c.c. of luteal fluid injected intravenously into a virgin rabbit causes a great increase in the interstitial tissue of the ovary without any effect on the follicles, and the uterus is enlarged to three times its normal size. The fluid not soluble in ether leads to cystic change in the follicles of the rabbit's ovaries, scarcely any action on the interstitial cells, and the uterus is only slightly increased in size.

Progesterone represents probably only a part of the luteal hormonal complex, its chief action in the baboon being that of causing vascular alterations in

the uterine stroma and the perineum after these organs have been sensitized by oestrone. In the rabbit, progesterone causes progestational changes in the previously oestrone-sensitized uterus. The luteal fluid not only affects the uterus and perineum in the baboon but also the ovaries and perhaps even the pituitary. In rabbits both the ovaries and uterus are profoundly affected.

For these several reasons, we are of the opinion that the luteal fluid of the corpus luteum of early pregnancy contains one or more hormones which have not been identified hitherto, and which we suspect to be the true hormone or hormones of the human corpus luteum of early pregnancy.

JOSEPH GILLMAN.

Department of Anatomy,

G. SPENCE SMYTH.

Department of Obstetrics and Gynaecology,

University of the Witwatersrand,

Johannesburg.

April 24.

Points from Foregoing Letters

A MECHANICAL device for eliminating the computations involved in obtaining a smooth curve, from a set of data such as the annual distribution of rainfall, is described by T. Sohumann. The device consists essentially of a vertical wooden board to which are attached movable glass cylinders filled with mercury in which iron rods are floating. The author gives the theory underlying the mechanical process involved and suggests that the device may be useful in dealing with economic and industrial data.

The Svedberg and Sven Brohult state that irradiation of haemocyanin, haemoglobin and serum albumin with ultra-violet light and α -rays, both at room temperature and at the temperature of liquid air, has shown that in the case of haemocyanin the effect (splitting into half-molecules) is a primary reaction while in the case of the two latter proteins the (rather irregular) breakdown is mainly caused by secondary reactions. The amount of haemocyanin dissociated by a certain number of α -particles can be accounted for upon the assumption that each molecule struck by an α -ray is split into halves.

H. von Halban, jun., F. Joliot and L. Kowarski show that secondary neutrons liberated in uranium irradiated with thermal neutrons can communicate to oxygen nuclei, in an oxygen-filled ionization chamber, a recoil energy of about 2.5 Mev.; the secondary radiation must, therefore, contain neutrons possessing an energy of at least 11 Mev.

In connexion with 'homometric' structures (which give the same X-ray diffraction pattern), A. L. Patterson discusses two point positions each of which leads to two non-identical homometric structures for positive and negative values of a single parameter. He inquires into the genesis of the homometric property, which appears to be associated in these cases with the trigonal and the cubic symmetry of the groups.

In the vacuum spark spectra of light elements certain groups of lines have been observed by B. Edlén and F. Tyrén which do not fit in the ordinary series spectra, but indicate atomic energy states of an unusual type very high above the ionization limit of the corresponding ion, approaching in their character X-ray levels.

J. M. Stagg and J. Paton consider that near the zone of maximum auroral frequency the electric current systems responsible for surface geomagnetic disturbance and those manifested as auroral arcs may be more closely associated spatially than hitherto supposed.

That the effect of bombs and explosions upon buildings and shelters can be suitably studied by means of the 'geophone' (a seismometer consisting of a coil and a magnetized nickel rod carrying a weight) is suggested by Weng Wen-Po.

R. E. Slade, S. J. Watson and W. S. Ferguson find that by treatment with cold dilute caustic soda solution the feeding value of oat straw can be increased by 100 per cent and that of wheat straw by 150 per cent. The digestibility of the product has been determined by experiments on sheep, and bullocks have been fattened for the market with the treated straw.

V. R. Potter and E. E. Lockhart suggest that both cytochrome *B* and cytochrome *C* are required as intermediate carriers for the oxidation of dihydro-coxymase and succinate by molecular oxygen and the appropriate enzymes.

I. W. Sizer states that the activation energy of the urease-urea system is independent of the enzyme purity when crude Jack bean meal was compared with the crystalline enzyme prepared from this source. The activation energy is determined by the oxidation-reduction potential of the digest.

It is pointed out by A. Heygaard and H. W. Rasmussen that arctic primitive foods are good sources for vitamin C and a table is given showing the vitamin C content of the most common Eskimo foods. On average diet the Angmagssalik Eskimo daily gets 40 mgm. ascorbic acid per adult. 20 mgm. is obtained from eating marine algae. Scurvy is unknown among Angmagssalik Eskimos.

The presence in the human corpus luteum of early pregnancy of one or more hormones distinct from progesterone is indicated, according to J. Gillman and G. Spence Smyth, by the distinctive action of the luteal fluid upon the uterus and the perineum.

Research Items

Prehistoric Pottery in Southern Africa

THE material from the excavation of the Mumbwa Cave, Northern Rhodesia, considered essential for the elucidation of the prehistory of South Africa, with the exception of part of the collection associated with the deeper burials, and the human skeletal remains, was destroyed by fire in the Ethnological Museum of the University of Witwatersrand. The excavators, Prof. Raymond Dart and N. del Grande, recorded in 1931 that pottery occurred in all the levels, though only sparingly in the deeper, down to the very base of the Late Stone Age deposits at a depth of two metres. It is the fragments from these deeper levels which survive, and have now been described and discussed further by L. W. Wells (*Man* of May, 1939). Not only do these fragments show that the pottery of the deeper levels was homogeneous, but also comparison with photographs of the pottery of the higher levels indicates an identity of characteristics and strong evidence for community of types between all levels. This agrees with the homogeneity of the lithic culture, and the continuity of the associated skeletal remains. The Mumbwa pottery holds an isolated position among African ceramics. It is of a type which, if found unassociated, would have been classified as Bantu; but as it is associated with a well-characterized lithic and human skeletal remains of predominantly Bush-Boekopoid character, devoid of recognizable Negro feature, it must be regarded as an integral part of a stone age culture, and the work of a non-Negro, pre-Bantu people—a conclusion of the highest importance, as hitherto it has been presumed that all unglazed pottery was of Bantu origin.

Desensitization through Histamine

L. FARMER (*J. Immunol.*, 36, 37; 1939) finds that the uterine strips of serum-sensitized guinea pigs which had been given injections of histamine at the height of sensitization were less sensitive to the specific antigen than were the sensitized uterine strips of control animals, while the uterine strips of normal guinea pigs which had received injections of histamine were less sensitive to histamine than were the uterine strips of the untreated controls. These experiments suggest (1) that histamine was the substance responsible for the anaphylactic contraction of plain muscle; (2) that it was possible to desensitize sensitized guinea pigs non-specifically by injection of histamine. In conclusion, Farmer points out that the phenomena observed were a further indirect proof of the correctness of Dale's theory of the anaphylactic mechanism, and that they also furnish a basis for understanding the mechanism of the non-specific desensitization by histamine.

Adrenals and Salt Intake

C. P. RICHTEB (*Endocrinology*, 24, 367; 1939) has found that the salt taste threshold of twenty normal rats averaged 0.055 per cent, that is, the animals detected salt in solutions of approximately 1 part of salt to 2,000 parts of water. Removal of the adrenals in eight rats greatly reduced the salt taste threshold.

It averaged 0.003 per cent; in other words, the animals distinguished between water and salt solution in a concentration of 1:33,000. The adrenalectomized rats showed a craving for salt offered in amounts which could not possibly have had a beneficial effect. The results show that adrenalectomized rats ingest more salt, not because they learn that salt relieves their deficiency discomforts, but because of chemical changes in the taste mechanisms in the oral cavity, giving rise to an enhanced salt discrimination.

Reproduction of 'Immature' Salmon

RECENT researches have directed attention to the occurrence of occasional examples of salmon parr which develop ripe gonads in fresh water without having made that descent to the sea which has generally been considered a prerequisite to reproduction. The observation is no new one; Rondelet, and after him Gosner, discussed it in the sixteenth century, and in 1886 the British naturalist Willughby came very near the mark in stating that while the male parr could fertilize the eggs of adult salmon, the female parr never had ripe eggs. Dr. V. Tchernavin has brought together references to papers dealing with the subject (61 in all) and very briefly summarizes the main results (*Proc. Roy. Physical Soc. Edinb.*, 23, 73; 1939). Both male and female parrs before descending to the sea may produce ripe germ cells, but the occurrence is much rarer in the female and at a more advanced age. Such male parrs take part in spawning with females which have already returned from the sea journey, and they have been known to spawn twice before leaving fresh water. Moreover, males and females of migratory salmon retained in fresh water develop functional gonads and produce progeny which in their turn are fertile.

Distinguishing Races of *Drosophila pseudo-obscura*

RACE A and Race B of *Drosophila pseudo-obscura* produce sterile male hybrids when crossed. They react differently to different ecological habitats and are differentiated by many of the criteria used for species differentiation. Nevertheless they are remarkably similar in morphological appearance and can only be separated easily by examination of their salivary gland chromosomes. K. Mather and T. Dobzhansky (*Amer. Nat.*, 73, 5; 1939) have shown by statistical analysis that the two races may be distinguished by the number of teeth on the sex combs of the males. Race A males have a mean number of teeth of 6.46 and 5.32 teeth on the proximal and distal sex combs respectively, whereas race B have 5.55 and 4.72 respectively. These are shown to be significantly different and the difference is shown to persist under different environments. The authors show that mathematical treatment is necessary to distinguish race A from race B by external characters.

Wood Wasps and their Parasites

H. S. HANSON has recently published an interesting article on this subject (*Bull. Entomol. Res.*, April, 1939). As a member of the staff of the Imperial

Institute of Entomology, he has been engaged on a study of these insects in connexion with a request for parasites of the wood wasp, *Sirex noctilis*, which was rapidly increasing in the coniferous forests of New Zealand. The accidental entry of the *Sirex* into the last-named country has led to a major problem in forestry, and the most feasible method of control seems to be by means of the introduction of certain parasites. Of the latter the most important is the large ichneumon *Rhyssa porusator*, while second in value is the cynipid *Ibalia leucopoides*. Under normal forest conditions, *Sirex* has never been known to become a pest in Britain owing to the control exercised by parasites. While *Rhyssa* is the superior insect as a parasite, *Ibalia* has also received much attention. The combined attacks by both species of parasite result in a higher percentage of host mortality than when either species is acting alone. *Rhyssa* is now established in New Zealand, but no attempt has so far been made to establish the *Ibalia*, which presents certain features making it more difficult to achieve. The method of biological control may be reasonably expected eventually to prove effective and give the desired results. It needs, however, to be carried out on an adequate scale over a period of years. As compared with sylvicultural methods of control it is vastly cheaper, and probably, in the long run, of greater value.

Blister Rust of White Pine in America

MANY years ago the European black currant (*Ribes nigrum*, L.) was introduced into the United States; but now it has been declared a public nuisance, and its cultivation prohibited by statute over a wide area. The reason for this (described in Leaflet 175 U.S. Dept. Agric.) is that the currant and gooseberry, especially the cultivated forms, serve as the alternate host for *Cronartium ribicola* Fischer, which causes blister rust disease of white pine. The fungus is perennial on the pine, living in the bark and wood of infected trees. In the spring spores are produced, which can be carried long distances by the wind, and after a period of growth on the currant or gooseberry, the life-cycle is completed and another type of spore capable of infecting the pine is produced. The disease is a serious menace in white pine plantations, and it attacks trees of all sizes, though resistance seems to increase with age. The pine is of great economic importance, being valued for scenic, recreational, soil retention and watershed purposes. Fortunately there is little demand for black currants on the fruit market, and the excellent progress made in the control of blister rust in those areas where these shrubs have been removed, bears out the wisdom of the new legislation.

Sterility in the Gage and Desert Plums

It is generally considered that the gages and several varieties of desert plums are inherently poor croppers and commercially unprofitable. Consequently little attempt has been made to grow them on a large scale. The recent work of M. B. Crane and A. G. Brown, however (*J. Pom. and Hort. Sci.*, 17, 51; 1939), has shown that the greengages and the majority of desert plums have the capacity to crop heavily if they are effectively pollinated. Complete self-incompatibility is common among these varieties, whilst many are only partially self-compatible. Bryanston Gage, Coe's Golden Drop and Transparent Gage are among those which fail completely to set fruit with their own pollen. Some kinds, however,

such as Laxton's Gage and Early Transparent Gage are self-compatible and also act as effective pollinator for other varieties. Among the wholly and partially self-incompatible varieties, cross incompatibility occurs; both complete and in degree. Sometimes it is reciprocal, but it may occur in one direction of crossing only, the reciprocal pollination yielding a full crop of fruit. For successful cropping, suitable varieties should be planted together to ensure effective pollination. Varieties in the same incompatible group and varieties whose flowering times do not coincide or overlap appreciably should not be planted together. The authors have provided data in this respect for an exhaustive list of gages and desert plums.

Geological Terminology

THE attention of geologists is directed to a most valuable "Lexicon of Geologic Names of the United States" compiled by M. Grace Wilmarth, which has just been published by the United States Geological Survey as *Bulletin* 896 (Part 1, A-L, pp. 1-1244; Part 2, M-Z, pp. 1245-2396). The definitions state briefly the lithology, thickness, age, underlying and overlying formations, and type locality, together with references. Most names have only one entry, which is essentially a digest of the original definition, as in most cases the original definitions are those still in current use. Some names have several entries, corresponding to redefinitions that have been suggested from time to time, while a few have had a long and interesting history, necessitating brief mention of the views of the geologists who have contributed towards present usage. Where there is disagreement as to definition or age the divergent views are fairly summarized. The time terms have also been listed, but the full definitions of the era, system and series terms having been already given in *Bulletin* 789 (1925), only brief definitions of these are given in the "Lexicon", with references to the earlier publication. The stratigraphical papers on which the "Lexicon" is based are those up to the end of 1935, together with some published in 1936. The compiler's hope that these volumes will "prove a time saver for the busy geologist" is certain to be realized—and not only in the United States.

Low Gas Pressure Measurement

MANY of the devices for measuring low gas pressures depend for their calibration on comparison with a McLeod gauge, and any improvement in the accuracy of this gauge is a distinct gain. Dr. Paul Rozenberg, of Columbia University, New York, has with assistance from the Adams Fund for Physical Research, succeeded in increasing the accuracy of the gauge considerably (*Rev. Sci. Instruments*, April 1939). The principal improvements he introduces are: the roughening of the bore of the capillary tubes, the sealing of the closed capillary in such a way that the outside of it remains cylindrical above where the bore terminates, the more accurate estimation of the change of volume of the bore due to sealing, bringing the mercury in the open capillary up to the level of the end of the closed one for reading, and the support of the mercury bulbs by plaster casts to avoid stresses in the glass. At pressures of 10^{-2} , 10^{-3} , 10^{-4} and 10^{-5} mm. of mercury he claims accuracies of 0.2, 0.6, 2 and 6 per cent respectively, and points out that these are higher than those of the absolute micro-manometer at pressures below 5×10^{-3} mm. and of the Knudsen absolute manometer above 10^{-4} mm.

Science and Social Problems

THE first meeting in London of the British Association's new Division for the Social and International Relations of Science was held in the Royal Institution on May 25. Sir Richard Gregory presided and in his introductory remarks sketched the genesis and adumbrated the programme of the new movement. Co-operative work in the special sciences was carried out for sixteen years by the International Association of Academies, and then by the International Council of Scientific Unions, which was formed during the Great War and is still active. Two years ago, on the initiative of the Royal Academy of Amsterdam, an entirely new outlook was adopted by including within the scope of the Council the social significance of the applications of science, thus endorsing the conviction of many that scientific workers can no longer remain indifferent to the social consequences of their discoveries. No definite programme of work has yet been formulated, but the essential idea is to apply the scientific method of inquiry to problems arising from the interactions of natural science and society. The British Association, acting in co-operation with its sister association in America, and through its new Division, is well adapted to promote such inquiries, and with this object in view it is arranging to hold meetings not only at the time of the annual meeting of the Association but also at other times and places as occasion may arise.

Dr. Ernest Barker, professor of political science in the University of Cambridge, then gave an address on "The Impacts of Science on Society". Natural science acts on society in two main ways: first, by developing a special science, or a body of social sciences, explaining society as a natural phenomenon, and thereby helping it to control itself consciously; and secondly, by producing discoveries and inventions which indirectly affect social behaviour and the general structure and functioning of society. The first way is mainly that of the biological sciences. To-day we do not see society as an engineering contrivance based solely upon matter and motion, but as something organic and vital, which evolves, and whose parts are permeated with interflowing dependence. This view has not only profoundly influenced the study of history, the study of law, and the criticism and understanding of art, but also it has altered our outlook on society itself. A society that interprets itself in biological terms behaves differently in virtue of that new interpretation; the difference may work for evil as well as for good—for example, in the direction of a perverted nationalism,—but the application of general biology to human society is not condemned by the possibility, or the fact, of misapplications.

The second way of action is one both of physical and chemical science and of biology. Physics and chemistry have revolutionized the methods and pace of communication, both material and mental; they have revolutionized industrial production and the art of war. The changes thus brought about are greater than the changes due to political causes. Should science attempt to control the changes which it causes? In Prof. Barker's view, science must proceed with the single regard of discovering truth;

if progress were stopped, an evil might be averted but a greater good might be missed; the utmost concession is a slowing down of the impact. It is the business of society, through its leaders, to control the effects, and the one duty of the man of science is to contribute the resources of his own training and technique to the making of a proper and exact estimate of the nature of the changes and of the nature of the relevant remedies.

Biology differs from physics and chemistry in its influence on society, in that its discoveries can be applied most directly, most intentionally and most fruitfully, through the soil and through plants and animals, to the relief of man's estate. The discoveries of genetics and eugenics can improve the strains of plants and animals and the human breed itself. But the improvements arrive very slowly owing to the impediments offered by human nature: "sentiments that team with embarrassing anachronisms, of which we are usually unconscious", embedded habits, traditions, instincts and emotions. Therefore the conscious application of science to the improvement of life will always be a slow-motion picture; the delay, however, may enable science to become sure of its discoveries before they are applied, and thus produce a greater security both of scientific and of human progress.

Sir Daniel Hall, unlike the previous speaker, discussed a concrete theme: "How the application of science to agriculture is impeded". It is necessary, he said, to distinguish between peasant farming, which is virtually self-contained and independent of world markets, and agriculture regarded as an industry, which can look to science for increasing, improving and cheapening its production. There is much peasant farming still in England, where 61 per cent of holdings belong to the 1-50 acre class, and upon which there is relatively little scope for scientific improvements. On farms of all types and sizes there is an average of one master to four or five workers, so that even the larger units of production are very small compared with the units of great urban industries. This fact, together with its consequences, lack of prospects for educated youths without capital, discontinuity of effort, and lack of capital, restricts the application of scientific developments. The importance of time-lag between preparation and production is sometimes exaggerated, but the handicap may be very serious when falling prices intervene. A greater handicap is that of variable weather, which may necessitate waiting for five years or more before the costs of production of a crop can be determined.

The adoption of inventions in machinery is limited by the small size of the farming units; the use of combine harvesters and crop driers is out of the question on most English farms. Equally impracticable are many large works of land improvement and organisation, which affect areas beyond the ownership of a single proprietor, but which science indicates would be practicable on a large scale and a long view. The retail structure of agriculture also precludes the exploration of scientific discoveries and inventions, because there are no great agricultural producers to act as intermediaries in translating a laboratory into a large-scale process.

Basic research is outside the farmer's scope, but he can put into practice some of the findings of research organizations; for example, those relating to the effects of fertilizers, improved yields of new varieties or stock, and disease treatment. State intervention is needed in many fields to secure the prosecution of research for the benefit of agriculture, and to make known its results. If increased and cheapened production is regarded as a necessity in the modern State, intervention of another kind is needed to free agriculture from some of the limitations imposed by its present structure; failing that, there is danger that the factory will replace the farm in the production of essential commodities.

The meeting was very well attended, and at the close Prof. A. Ferguson referred to possible research work that might be undertaken by the Division, such as a study of the development of nationalistic feeling, and the history of Western thought. Such interesting and important studies would be welcomed by many,

but it may be suggested that they should not take precedence over the essential task of attacking concrete problems in a scientific way. Sir Daniel Hall's remarks on the necessity for State intervention in agriculture suggest that a suitable study would be the very old, but still very important, question of land tenure, of public control of the land and its utilisation. Such a study, it might be objected, would inevitably lead to 'impact', that is, collision, with politics, but it need not be treated in a politico-controversial way. What is needed are the reasoned judgments of trained scientific workers, who have no economic, political, social or other axes to grind, who are capable of submerging the embedded sentiments, of which Prof. Barker spoke (except that of justice), and above all, who will take the vow of placing the common good above all the lesser loyalties, like political party, social class, and the 'old school tie'.

E. H. T.

Hydrogenation

DURING May 24-26, a conference was held in Paris under the auspices of the five chemical societies which share the amenities of the *Maison de la Chimie* there. The selected subject was the various aspects of hydrogenation. This is the second occasion on which the same five societies have co-operated. An average attendance of more than three hundred was attracted. The meetings commenced at 4.30 in the afternoon, so enabling the participants to go about their ordinary affairs during the working day. The chief figure at the meeting was Prof. Sabatier of Toulouse, still hale and hearty at eighty-four years of age: his original researches are recognized as having given the first impetus to the study of all subsequent hydrogenation reactions, some of which are technically in the forefront of world interest to-day. The presidents of four of the societies presided in turn over the sittings.

The conference appropriately began with a paper from Sabatier, largely of an historical nature, relating to the addition of hydrogen to unsaturated compounds in presence of nickel. Prof. Paul followed with an account of the Raney nickel catalyst. The evening discourse delivered by Prof. Aubel, of Paris, dealt with the general phenomenon of hydrogenation in biology. On the next afternoon, Prof. N. V. Ipatieff, who now holds a chair at the Northwestern University of Chicago, spoke on the use and advantages of copper and copper chromium catalysts for the hydrogenation of benzene and its derivatives, describing work which

is being followed with considerable interest. The following paper was delivered by Dr. E. F. Armstrong, who dealt fully with the technical and industrial development of hydrogenation, first in regard to fat hardening, which has now largely become standard practice; afterwards he indicated the methods of manufacture of hydrogen and the approximate cost of this gas, describing also the line of attack which is being followed in the conversion of water gas into petroleum hydrocarbons, and of coal, under pressure, into methane.

At the conclusion of the meeting, Messrs. Ipatieff and Armstrong were each presented with a Chevreul Medal in recognition of their labours in their respective fields of inquiry. The meeting ended with a banquet held in one of the large lecture rooms of the *Maison de la Chimie*, which readily lent itself to this conversion and was provided with the necessary auxiliary accommodation behind the scenes. The excellent facilities provided here for our French colleagues are the cause of renewed admiration and envy on every occasion we avail ourselves of them. They enabled a first-class banquet with wines to be staged for the modest charge of 60 francs.

The third day was primarily concerned with the official celebration of the twenty-fifth birthday of the *Société de Chimie Biologique*, but even here the role of active hydrogen was not overlooked, being made the subject of a paper by Prof. Thunberg of Lund.

Work of the Cornish Engineers

IN the form of a reprint from the *Journal of the Royal Institution of Cornwall*, there has been published at the Royal Printeries, Truro, a paper by W. Tregoning Hooper entitled "The World's Debt to Cornish Engineers", one of the aims of which is to commemorate the historic experimental trials of the Austen's 80 in. Cornish pumping engine. At these trials, this engine established a record of accomplish-

ment which demonstrated to men of science, engineers and economists the great potentialities of the power of steam, and the occasion is, therefore, a fitting one to be recalled and celebrated.

In the year 1835, in collaboration with his chief engineer, West, Joseph Thomas Treffry erected a new 80 in. engine and it was stated to have done a duty of nearly 98 million foot-pounds of work per

bushel of coal (94 pounds). This claim was disbelieved and a special trial was arranged to take place before a number of competent and impartial engineers and pitmen. When it was held on October 22 and 23, 1835, the results showed the actual duty performed by the engine to be 125,095,713 ft. lb. This is the highest performance of any Cornish pumping engine, and the most remarkable fact about it is that it was rather more than six times as great as the work done by the best of Watt's engines.

The author of the paper explains the developments which led to this striking result. Newcomen of Dartmouth, working on the ideas originated by Papin, produced his atmospheric engine—the first practicable and effective steam engine to be brought into use. In 1720 he erected at Wheal Fortune, Ludgvan, the first engine in the county of Cornwall of which there is authentic record, and its marked success proved it to be suitable for the drainage of Cornish mines. Newcomen was followed by several members of the Hornblower family, to one of whom the invention of the compound engine is due, the first engine of this type being made in 1776 at Penryn. From this time until the expiry of Watt's patent or monopoly in 1800 there was a pause, and then began a new era of progress, one of the early results being the invention by Trevithick of the Cornish boiler, the construction of which has remained unaltered to this day. Its introduction must have contributed greatly to the success of the Cornish

engines which were being installed in the mines in replacement of the much less economical Watt engines.

Doubts continued to be expressed as to the performance of the Cornish engines and one engineer "proved by theoretical principles that the highest possible duty that such engines could do was only 44,000,000". Wicksteed, principal engineer of the London Waterworks, carried out further trials and it was found that, in practice, the Cornish engines and engines were exceeding this figure by more than one hundred per cent. In addition to many other interesting details regarding these engines, the paper gives accounts of their adoption in many parts of the country and abroad, notably for the drainage of the Haarlemmer Meer in Holland. One of these engines has recently been placed in a state of preservation by the orders of the Dutch Government. Many items of special interest to engineers are touched upon, such as Trevithick's intuitive perception of the principles of thermodynamics—a subject on which in his time nothing was experimentally known. In his correspondence with Gilbert, his remarks show how far he had anticipated the principles which were definitely established by Carnot many years later. The author concludes with a plea for the support of the Committee for the Preservation of Cornish Engines so that it will be enabled to preserve for all time some of those splendid engines which still remain as monuments to the Cornish engineers.

Psychological Treatment of Crime

THE report to the Home Office on "The Psychological Treatment of Crime", by Dr. Norwood East and W. H. de B. Hubert deals with an investigation carried out over a period of four years by a retired prison medical officer and prison commissioner, and an assistant physician in the department of Psychological Medicine at St. Thomas's Hospital and psychotherapist at Wormwood Scrubs Prison*.

The selection of cases for treatment depended, in the first place, on prison medical officers, who were invited to send in reports about prisoners whom they considered suitable for psychological treatment. Such reports, together with any relevant information available, were first examined by the senior investigator, and prisoners selected by him were transferred to Wormwood Scrubs. Here each case was first studied by the senior medical officer of the prison, and then by him in consultation with the senior investigator before determining the treatment. This procedure, it is stated, was found effective and satisfactory. Nevertheless, it is possible that the inquiry might have taken a different course had a psychologist been consulted earlier. The individuals chosen were mostly those who had failed, or seemed likely to fail, to respond to ordinary discipline and training, but who yet showed willingness to co-operate with the psychotherapist; no general classification, however, determined the selection of any case, since personal factors were always given careful consideration.

* Home Office. Report on the Psychological Treatment of Crime. By Dr. W. Norwood East and W. H. de B. Hubert. Pp. III+166. (London: H.M. Stationery Office, 1939.) 2s. 6d. net.

No reason is given for the fact that the experiment was restricted to youths and men, though one of the investigators at least found it necessary to extend his research in one instance to a control group of women prisoners. Among their recommendations, the investigators include the appointment of a woman psychotherapist at a prison for women. Of the interesting facts that emerge in the course of the report are several that point to the need for early diagnosis and guidance; among boys sentenced to detention at a Borstal institution but deemed unlikely to benefit from their experience without previous treatment, there were a surprising number who had been sent to an institutional school on account of misbehaviour in early life. Another group of ex-Borstal boys afterwards committed to prison and recommended for treatment included a number suffering from some psychotic disorder. Prisoners subject to more or less severe symptoms of cyclothymia were often found to have committed their crimes at the time of the mood-swing. Hysteria seems to be the commonest, and obsessional behaviour the rarest, affective disorder among the prisoners.

The report as a whole emphasizes that while such treatment is not suitable for all, yet much might be done for a considerable number by psychiatric treatment and control. The most novel change recommended is the establishment of a special penal institution serving four functions: (1) a clinic and hospital for psychotherapeutic treatment, (2) a psychiatric institution for selected cases, (3) a prisoners' colony, and (4) an observation and treatment centre for difficult adolescents.

Science News a Century Ago

Mode of Operation of Poisons

In a paper entitled "Experimental Researches on the mode of operation of Poisons" read to the Royal Society on June 6, 1839, J. Blake gave an account of experiments undertaken to show with what rapidity the blood is circulated through the body. He summarized his conclusions as follows:

"(1) The time required for a substance to penetrate to capillary vessels may be considered as unappreciable. (2) The interval elapsing between the absorption of a substance by the capillaries, and general diffusion through the body, may not exceed nine seconds. (3) An interval of more than nine seconds always elapses between the introduction of a poison into the capillaries, in veins, and the appearance of its first effects. (4) If a poison be introduced into a part of the vascular system nearer the nervous centres, its effects are produced more rapidly".

The Great Lakes of North America

AN American correspondent of the *Athenaeum*, writing from New York on June 7, 1839, referred at some length to the theories of rain put forward by the meteorologist J. P. Espy (1786-1860). He then went on to remark: "The water subject reminds me of an interesting statement respecting our great north-western lakes, which appears in the last Report of the *Michigan State Geologist*—a region, by the way, which has been but two or three years a *State*. Such facts show that practical science, as I have hinted before, like practical literature, is really exciting some attention amongst us. The following is the only authentic tabular view of these waters I have seen; it may be of novelty to some of your readers.

	Mean Length	Mean Breadth	Area Sq. Miles
Superior ..	400	80	32,000
Michigan ..	220	70	22,000
Huron ..	240	80	20,000
Green Bay ..	100	20	2,000
Erie ..	240	40	9,600
Ontario ..	180	25	4,500
St. Clair ..	20	14	280

"The same tabular statement exhibited also the depth and the elevation of each above tide water.

	Mean Depth Ft.	Elevation Ft.
Superior ..	900	506
Michigan ..	1,000	578
Huron ..	1,000	578
St. Clair ..	20	570
Erie ..	84	563
Ontario ..	500	232

"It is computed that the lakes contain about 14,000 cubic miles of water, a quantity more than half of all the fresh water on the earth."

American Convention of Civil Engineers

THE *Mechanics' Magazine* of June 8, 1839, had a note to the effect that the American civil engineers, after various preliminary meetings, resolved to form a society similar in its aims to the Institution of Civil Engineers, in London. The Franklin Institute, Philadelphia, offered its co-operation, the headquarters of the convention were to be at the Franklin Institute and the *Franklin Journal* was to be the recognized organ of the new body. Mr. Benjamin H. Latrobe, of Maryland, was elected president.

Societies and Academies

Dublin

Royal Irish Academy, April 24.

W. H. MCCREA: Matrices of quaternions and the representation of Eddington's *H*-number. An 'algebra' consists of the body of theorems which can be proved true of a set of 'elements' or 'quantities' obeying stated rules of addition and multiplication. For example, we have the well-known algebras of real numbers, of complex numbers, and of Hamilton's quaternions. It is known that under certain conditions the quantities of one algebra may be represented by 'matrices' composed of the quantities of another algebra. In recent years Sir Arthur Eddington has given a formulation of quantum theory and relativity theory based upon the algebra of what he calls '*H*-numbers'. The main object of the present paper is to show how Eddington's algebra may be represented by matrices of quaternions.

Edinburgh

Royal Society of Edinburgh, March 6.

ENID CHARLES: Differential fertility in Scotland. (2). The mining and metal industries were associated with either average or very high gross reproduction rates. Low fertility was associated with (a) textile industries, (b) commerce and finance, (c) personal service. In the predominantly agricultural counties, high rates were found in the north-eastern district and Wigtown, low rates in the typically crofting counties and those with large sheep farms. Some correspondence was found between high fertility and intensity of cultivation. All regions with a high proportion of women gainfully employed exhibited low fertility. In general, high fertility of married women was associated with a high nuptiality rate.

R. S. BARCLAY and W. O. KERRMACK: The fertility of Scottish married women, with special reference to the period 1926-1935. An investigation has been made of the applicability to Norway and Scotland of the 'Diagonal law', previously found to hold in respect of the specific legitimate fertility rates of certain European countries. The specific legitimate fertility rates for Scotland, 1931, have been employed to calculate standardized general legitimate fertility rates for various regions of Scotland for the period 1926-1935. The results are summarized in various tables and maps.

H. P. DONALD: Sources of variation in human birth weights. On the basis of birth weights of 3,000 full-term infants, it is concluded that those born in summer are slightly heavier than those born in winter. The effect of sex is greater than that of month of birth, is about the same as that of birth order but accounts for comparatively little of the total variation. Age of mother and time between births had no demonstrable effect. By far the greatest source of variation arose from differences in the family averages, an intra-familial correlation of 0.5 being found. This is of significance in connexion with infant mortality, and mental and physical development.

E. L. INCE: Relations between the elliptic cylinder functions. As the elliptic cylinder functions may be regarded as generalizations of the circular functions, the question arises as to whether there corresponds to the addition theorems for the circular functions

relations between elliptic cylinder functions of various types. By manipulating the nuclei of the integral equations relative to each of the four types of elliptic cylinder function, relations, though of infinite form, between the functions of any one type and those of each of the others, and likewise expressions for the derivatives have been obtained.

ALAN MCKELLY: The freshwater Mollusca of the Tanganyika Territory and Zanzibar Protectorate. A study of the systematics and local and geographical distribution of East African molluscs carried out under the auspices of the London School of Hygiene and Tropical Medicine. Two species, *Physopsis lobosa* and *Biomphalaria pfeifferi*, are of considerable importance there as intermediate hosts of schistosomes parasitic in man. Their local distribution and diverse means of destroying these undesirable snails are described, and suggestions are made regarding the application of these data to specific infested localities.

HUGO MEHTON: Studies on reproduction in the albino mouse. (2). Maturation of spermatozoa. Active spermatozoa from the vas deferens and cauda epididymis possess a protoplasmic droplet at the posterior end of their middle piece. This is not a remnant of the expelled cellular protoplasm, but is a special substance required for the completion of their maturation process.

F. A. E. CREW and P. C. KOLLER: Cytogenetical analysis of the chromosomes in the pig. The diploid chromosome number in the spermatogonial cells is 48. The largest chromosome is 7.5μ long, the smallest is $1.5-2 \mu$. The rest form a graded series between these extremes. The two sex chromosomes are unequal in size; the Y being $1/3$ of the total length of the X chromosome. The position of the centromere in the X is subterminal; in the Y it is terminal or nearly so. The type and the structure of the sex bivalent suggests that the centromere separates the pairing and differential segments. Chiasma formation is localized in the five larger bivalents, and consequently gene recombination in these bivalents is limited. In one individual a chromosome pair was heterozygous for a small and distal inversion.

Paris

Academy of Sciences (C.R., 208, 1177-1256, April 17, 1939).

E. BORREL: Certain problems of distribution and the virtual probabilities.

J. DRACH: Application of Darboux's method to equations with explicit characteristics, x, y .

L. LECORNU: Propagation of spherical waves.

J. HAAG: Cauchy's formula and the problem of Dirichlet.

A. MAIGE: Cellular autotrophy and heterotrophy and evolution of the plastid.

L. DANIEL: Graft of a hybrid cineraria on *Senecio scandens*.

C. CHABAUTY: Demonstration of a theorem of Thue, independent of the theory of diophantine approximations.

J. LE ROUX: Free mobility in geometry.

A.-Y. AMIN: The F -points of the surface of Del Pezzo in space of five dimensions.

S. MANDLBERGT: Some new considerations on classes of functions of which the derivatives are bounded.

J. DUFAY and D. SMOUKOVICH: Optical density of the Milky Way in a direction perpendicular to the galactic plane, deduced from star counts.

J. LAGRULA: Measurements of the intensity of gravity in Tunisia.

F. CARBENAY: Weakening of high-frequency transmissions on power transport lines.

A. LALLEMAND: Experimental results obtained by photo-electronic photography.

S. PROCOPTU: Determination of the thickness of the thinnest layer of electrolytic iron at which magnetization discontinuities disappear. Magnetic induction and thickness give a straight line relation, magnetic induction being zero at a thickness of 1.75μ .

L. BLOCH, E. BLOCH and L. KOUANG-TAO: Vacuum spark spectrum of silver. A great number of new radiations, often very intense, have been observed.

MME. T. GRIVET-MEYER: Secondary effects of cosmic rays in lead.

C. MAGNAN: Concerning the neutrons emitted during the splitting of uranium under the action of neutrons.

L. GIRAULT-ERLIER: Theory of differential potentiometric titration.

MME. N. DEMASSINUX and B. FEDOROFF: Dehydration of potassium cobalt sulphate and of cobalt sulphate. The changes have been followed by Debye and Scherrer diagrams.

G. LIEBOWITZ: Solubility of ether oxides in solutions of strong acids.

P. CHOVIN: Researches on the Pechmann colouring matters. Mechanism of formation of the mono-acid by hydrolytic scission.

C. COUETOT and J. KROUSTIN: New syntheses in the dibiphenylene-ethane series.

Z.-C. GLACOT and J. WIEMANN: Condensing reductions.

S. GOLDSCHTAUB: Arrangement of the atoms in laurionite, $PbOHCl$.

J. BRICARD: Study of the formation of rime at the summit of the Puy de Dôme.

D. BARBIER and D. CHALONGE: Night temperature of the upper layers of the atmosphere. Comparison of the ozone bands of stellar spectra indicates a very low temperature in the upper atmosphere.

M. and MME. J. FELDMAN: Development of carpospores and the alternation of generations in *Asparagopsis armata* Harvey.

S. SABETAY and L. TRABAUD: Presence of eugenol in the essential oil of jasmine.

G. TRÉGOUBOFF: Plankton larvae of sponges.

G. JORET and H. MALTERRE: Mechanical constitution of soils and the solubility of phosphoric acid.

P. DE BERRIDO-CARNEIRO: Strychnolethaline, curare and curarization.

MME. M. PHISALIX: The white venom of vipers of the Département du Gers has no vaccinating power.

M. PIÉRY, J. ENSELME, MME. J. ENSELME and C. PESCHERA: Experimental study of the biological influence of a prolonged stay at a height. Blood modifications. Geese and rabbit were sent to the scientific station at the Jungfraujoch (3,457 m.) for six months. A lowering of blood carbon dioxide and of the oxygen saturation of the arterial blood, already known, due to decreased partial pressures of these gases, and also an increase in the number of red corpuscles and in the oxygen capacity of the blood, were observed.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ASSISTANT LECTURER IN ECONOMICS in the University of Manchester—The Registrar (June 10).

Academic Appointment in the DEPARTMENT OF PHYSICS in University College, Hull—The Registrar (June 10).

ASSISTANT III for the EXTERNAL BALLISTICS DEPARTMENT of the Ordnance Board, Woolwich, S.E.18—The Secretary (June 10).

ASSISTANT COUNTY EDUCATION OFFICER under the Southampton Education Committee—County Education Officer, The Castle, Winchester (June 12).

FELLOW AND TUTOR IN CHEMISTRY in Jesus College, Oxford—The Principal (June 13).

DEMONSTRATOR IN THE DEPARTMENT OF ZOOLOGY in Bedford College for Women, Regent's Park, N.W.1—The Secretary (June 15).

UNIVERSITY CHAIR OF PATHOLOGY at St. Thomas's Hospital Medical School—The Academic Registrar, University of London, Senate House, W.C.1 (June 15).

ASSISTANT at the London Museum, St. James's, S.W.1—The Keeper (June 15).

JUNIOR ASSISTANT PHYSICIST at the Radium Beam Therapy Research, 1 Biding House Street, W.1—The Honorary Secretary (June 24).

ASSISTANT PHYSICIST at the Radium Beam Therapy Research, 1 Biding House Street, W.1—The Honorary Secretary (June 24).

RESEARCH OFFICERS (2), Grade III, in the AGRICULTURAL ECONOMICS RESEARCH INSTITUTE, University, Oxford—Secretary of the Committee for Rural Economy, School of Rural Economy, Parks Road, Oxford (July 1).

LECTURER IN PATHOLOGY AND DIRECTOR OF THE PATHOLOGICAL UNIT at Prince Henry Hospital, Sydney—The Secretary, Universities Bureau of the British Empire, Gower Street, W.C.1 (August 31).

TECHNICAL OFFICERS at the Air Ministry Headquarters—The Under-Secretary of State, Air Ministry, Berkeley Square House, W.1 (quoting B.197).

A PATHOLOGIST in King Edward VII Hospital, Windsor—The Secretary.

Other Countries

Government of India: Department of Communications. Functions and Organisation of the India Meteorological Department, 1939. P. 23. (New Delhi: Government of India Press.) [1]

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Paleontologia Indica. New Series, Vol. 25, Memoir No. 1: The Cephalopoda of the Neocomian Belemnite Beds of the Salt Range By Dr. L. F. Spath. Pp. vi+154+25 plates. (Calcutta: Geological Survey of India.) 17.15 rupees; 27s. 6d. [1]

Ministry of Commerce and Industry, Egypt: Hydrobiology and Fisheries. Notes and Memoirs No. 21: The Fishery Grounds near Alexandria. 13: Echinoderms. By Th. Mortensen and Ad. Steen. Pp. 37. Notes and Memoirs No. 25: The Fishery Grounds near Alexandria. 14: Turbellaria. By Otto Steinbock. Pp. 15. Notes and Memoirs No. 26: The Fishery Grounds near Alexandria. 16: Cnephids, Stomatopoda, Leptostraca. By Adolf Steen. Pp. 11. Notes and Memoirs No. 28: The Fishery Grounds near Alexandria. Ascidacea. Par Dr. Hervé Harant. Pp. 7+5 plates. Notes and Memoirs No. 31: Plankton of the Egyptian Waters. Two Glaciers from the Plankton. By Dr. F. M. Ghazawi. Pp. 2+5 plates. Rapport sur les pêcheries d'Egypte en 1935. Par Hussein Khouli. Pp. vi+133. (Cairo: Government Press.) [2]

Bulletin of the American Museum of Natural History. Vol. 77, Art. 2: Carnivora of the Tung Gur Formation of Mongolia. B. Edwin H. Colbert. Pp. 47-81. (New York: American Museum of Natural History.) [5]

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Union of South Africa: Department of Agriculture and Forestry Science Bulletin 180 (Chemical Series 155): The Natural Decomposition of Bat Manure. By J. Vorster Nel. Pp. 22. (Pretoria: Government Printer.) 3d. [28]

Proceedings of the U.S. National Museum. Vol. 86, No. 3059: New Sea Star of the Genus *Pennsylvanella* from Japan. By Walker K. Fisher. Pp. 400-472+plates 55-58. (Washington, D.C.: Government Printing Office.) [24]

Statistical Theory of Estimation. By Prof. R. A. Fisher. (Calcutta: University Readership Lectures.) Pp. v+45. (Calcutta: University of Calcutta.) [24]

Report on the Danish Oceanographical Expeditions 1908-1910 to the Mediterranean and Adjacent Seas, No. 11. Vol. 2 (Biology), H. 2. *Siphonophores*, by Henry B. Bigelow and Mary Sears, D. 6. *Phlebobranchs*, by Johan T. Bund; H. 1: Pelagic Polychoetes of the Families *Aphrotrichidae*, *Phyllodoctidae*, *Typhlococciidae* and *Alepididae*, by Blase Wessenberg-Lund. Pp. 144+95+46. (Copenhagen: Andr. Fred. Hest and Son.) 30s. [26]

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Journal of the Indian Institute of Science. Vol. 22A, Part 5: Influence of Certain Anions on the Accuracy of the Titrimetric Method of Estimating Phosphoric Acid in Solution. By A. Sreenivasan. Pp. 79-92. 1.2 rupees. Vol. 22A, Part 6: Supersonic Velocity in Gases and Vapours. Part 8: Supersonic Velocity in Air, Steam, Carbon Dioxide and Carbon Disulphide. By S. K. Kulkarni Jaitkar. Pp. 93-110. 1.2 rupees. Vol. 22A, Part 7: Reactions of Chromates at High Temperatures. Part 8: The 25% Stage in the Decomposition of the Chromates of Calcium, Strontium and Barium. By D. S. Datta, V. T. Athavale and S. K. K. Jaitkar. Pp. 111-118. 15 annas. (Bangalore: Indian Institute of Science.) [26]

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Publications of the Observatory of the University of Michigan. Vol. 7, No. 6: Spectrophotometric Determinations of Stellar Temperatures. 2: The Absolute Color Temperatures of Seven Standard Stars. By Robley C. Williams. Pp. 147-158. Vol. 7, No. 7: Spectrophotometric Determinations of Stellar Temperatures. 2: A Comparison of Relative Color Temperatures. By Robley C. Williams. Pp. 159-170. (Ann Arbor: University of Michigan.) [155]

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(not included in the monthly Books Supplement)

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Freshwater Biological Association of the British Empire. Scientific Publication No. 1: A Key to the British Species of *Ceriodia* (Hemiptera-Heteroptera), with Notes on their Distribution. By T. T. Macan. Pp. 28. (Amblecote: Freshwater Biological Association of the British Empire.) 1s. 6d. [25]

International Tin Research and Development Council. Publication 93: Notes on Soldering of Lead Pipes and Sheet Metals. By W. R. Lewis. Pp. 24. (Greenford: International Tin Research and Development Council.) Free. [25]

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Statistical Year Book, 1939, of the International Tin Research and Development Council. Pp. 206. (Greenford and The Hague: International Tin Research and Development Council.) 8s. [155]

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Planning in House and City

WHILE we may acquiesce in the necessity at the present time of concentrating effort on the gigantic task of national defence, we are nevertheless acutely aware that much is seriously amiss with a civilization in which such use of scientific effort should be necessary. On the credit side, however, it will be granted that the importance of social factors in industrial and national problems is widely recognized both within and without the ranks of scientific workers themselves, and the necessity for reorientation of research effort between the biological and social sciences and the physical sciences now appears to command general assent. There are, moreover, indications that at last some of the new powers that science has put at our disposal are beginning to find expression in ways appropriate to their purpose and less dominated by traditions or ideas of the past. True it is that the development of aviation remains warped by military ideas and demands, but the development of the motor-car, for example, is at last finding expression in its own appropriate forms rather than those dictated by the functions or purpose of the horse-drawn vehicle. Similarly in architecture, there have been some striking examples of the use of the newer materials, free from limitations imposed by traditional ideas or practice.

None the less, it has to be admitted that progress on the whole has been comparatively slight, and it is in the changed attitude to new ideas rather than in actual achievement that the strongest reasons for hope are to be found. When, for example, such a radical proposal as the removal of population from a derelict area like that of Merthyr Tydfil to an entirely new but more suitable site, which offers the community a prospect

of economic development, can be seriously considered instead of being derided or rejected out of hand, progress is being made. The keen interest which is being taken in the location of industry has, of course, been stimulated by the PEP report and by the evidence given before the Royal Commission on the Geographical Distribution of the Industrial Population, but these two inquiries are really the outcome of public consciousness of the importance of this problem.

There are, however, few, if any, problems arising out of the transformation of industry and society under the influence of mechanical science, in which there is greater need for bold and radical action and for the discovery of more appropriate forms of expression for the new forces at our disposal, than in those arising out of the housing of the community, whether in the aspect of building, town planning, the location of industry or provision of services and amenities.

An imaginative contribution to fundamental thinking about the whole problem of the modern city, whether from the point of view of amenities, industry, defence or housing, has been provided by Mr. Lewis Mumford in "The Culture of Cities"*. He makes a strong plea for casting aside all preconceived ideas and for a determined attempt to think out the real purposes which a city, whether as a whole or in the individual units of houses, is intended to serve in the conditions of to-day and with the resources which are at our disposal.

Even those who do not instinctively recognize that, in this way alone is possible a scientific approach to the problem of really effective planning, cannot but be impressed by the picture

* The Culture of Cities. By Lewis Mumford. Pp. xii+586+52 plates. (London: Martin Secker and Warburg, Ltd., 1938.) 21s. net.

which Mr. Mumford gives of the evils which have in the past resulted from unco-ordinated development, the clinging to obsolete methods of construction or attempting to force new materials into the forms used for earlier products and other purposes. Again and again, advances of earlier generations have crystallized in hard forms which prove intractable obstacles to the progress of later generations, and rob them of many of the advantages placed within their reach by progressive knowledge.

The appeal which Mr. Mumford makes in his latest book is for vision and a sense of values. He would have us examine the institutions which make up city life, from the individual household to the school, the scientific society, the church, and determine the exact functions which they are required to fill in the light of medical knowledge to-day, the advances in means of communication, whether of transport or in such fields as the telephone or broadcasting. Too often we maintain forms or institutions long after the needs for which they were originally created have disappeared or are met more effectively in some other way.

It is easy to overlook the exact social significance of some of these changes. Until, however, we realize that the new means of transport and power production, with the telegraph, the telephone, the radio, the teleprinter and television, have enlarged the sphere of activity and at the same time diminished the need for physical movement and close settlement, we cannot begin to determine accurately the functions and needs of city life; and time, energy, money, and human vitality will continue to be expended in activities of no intrinsic value, as in the crowded transport systems of every metropolis and even in other public services such as water and sewage disposal.

Clear-cut conceptions of the purposes our institutions are to serve in this age, not merely in the age in which they were originally designed, form the basis of adequate planning. Of the dwelling-house we must recognize, as Mr. Mumford points out, that certain of its functions, though domestic in origin, may be better served by communal institutions; for example, child-birth and the care of infective illnesses, weddings and funerals. Other functions, notably on the recreational side, have gained in importance, through the advent of radio, television and the telephone, and will continue to do so as leisure develops. When we have agreed on the exact functions which the modern dwelling-house is intended to serve,

we can begin its rational design and eliminate many of the conventional requirements which no longer serve these functions. Moreover, we shall then be free to form an unbiased judgment as to the use which can be made of the new material at our disposal, the possibilities in the way of fabrication of floors, roof and the walls, and the proportioning of mechanical services or utilities and space or storage.

Treatment of the housing problem along such lines as these demands creative as well as scientific thought. Vision and some ordered conception of family and civic life are also demanded, and this is no less true of other civic institutions such as the school, the church, the public assembly hall, the library, and the scientific or literary society. Definite objectives must be visualized in the provision of the best possible environment for human nature and culture, the priority of consuming and creative activities over mechanical processes and the expression of vital standards in terms of leisure, health, biological activity, aesthetic pleasure and social opportunity. One of the great dangers of the present moment is that the opportunities which the necessities of defence impose upon us of altering both the design and construction of towns and cities should be missed or stereotyped for lack of imagination.

Mr. Mumford, discussing the new functions of the city, suggests that under the new conditions it should become, as it has often been in the past, the chief instrument of education, and that what should distinguish the new community is not so much the introduction of any essentially new institution as their adequate organization and incorporation as an essential part of the whole. He urges accordingly that cities should be deliberately designed to serve those purposes, and that their size should be a function of the social relationship to be served.

Essentially we have here a positive conception in place of the merely negative one, which has already led to the recognition that definite steps must be taken to prevent the continued industrial expansion warping or enfeebling the life of the rest of the country. Moreover, it is a conception which guides the planning of the whole of society. Economy must be a regulating principle in all design, for it is only by saving on the means and instruments of life that a community can command the necessary abundance at the higher levels of art, science and education. A modern plan must embrace every human need appropriate to the

structure without waste of space, duplication, or clumsy and indifferent means of circulation.

It follows from this that a first task in the planning and survey required is to educate citizens, to give them the tools of action and to prepare the stage as well as to suggest the socially significant objectives. Ultimately, this is an essential duty of every school and especially every university. With it there must go the further utilization of science through the regional survey, regional exploration and regional construction, if we are to increase the area of rational human control. Nor should our inability to devise at once the appropriate structure for our civilization, as Mr. Mumford further reminds us, be a cause for permanent discouragement. Most of the forces working towards international co-operation are young, while the opposing forces are old and deeply ingrained in institutions and organizations. A generation is too short a space of time for the reorganization of modern society, whether within or across national frontiers.

If therefore we should not be too readily discouraged at the rate of progress, the problem is

too urgent for any opportunity to be neglected. Even while citizens are being educated to appreciate the need for imaginative reconstruction, further obstacles to progress are continually crystallizing out, amenities are disappearing and the problem threatens to become more formidable and intractable. The Brassey report on Highway Development Survey (Greater London) provides already a classic example of the consequences of procrastination or neglect in such matters. Scientific workers undoubtedly have a great part to play in the development of the new and appropriate forms in which the forces they have placed at man's disposal can be utilized for the most effective service of the needs of the community. The achievement of that ideal of fitness for the purpose demands equally, however, the co-operation of art and the humanities, and we may well hope that the very urgency of the present threats to all the richest treasures of our heritage may yet stimulate that co-operation, and issue in the creative expression of a new culture worthy to be compared with any recorded in the long history of mankind.

History and Scientific Endeavour

The Cambridge Ancient History

Vol. 12: The Imperial Crisis and Recovery, A.D. 193-324. Edited by Dr. S. A. Cook, F. E. Adcock, M. P. Charlesworth, N. H. Baynes. Pp. xxvii+849. 35s. net. Volume of Plates 5. Prepared by C. T. Saltman. Pp. xv+243. 15s. net. (Cambridge: At the University Press, 1939.)

THE issue of the twelfth and last volume of the Cambridge Ancient History is so notable an event that a word must be said about the whole enterprise and the way in which the two ancient universities of Great Britain have divided the work of learning between them. Something must also be added, more especially appropriate to this review, about the point of view from which the man of science is inevitably driven to regard the study of history as a whole.

First as to Oxford and Cambridge. While Cambridge has been elaborating this series of forty volumes on ancient, medieval and modern history, Oxford has given us the standard dictionary of the English language and has just completed a revised and enlarged Greek dictionary based on and improving the traditional "Liddell and Scott".

Of these works we have nothing to say at the moment, except that the division of labour speaks well for the co-operation of the two learned bodies concerned and throws a cheering light on the industry and power of organization of both.

The histories which Cambridge has just completed have also a memorable connexion with one of the most learned men whom Great Britain has ever produced. Lord Acton, in 1896, the year after his appointment as regius professor of modern history at Cambridge, was approached by the syndics of the University Press with a suggestion that he should undertake the direction of a history of the world. They can proudly claim that the idea first came from them. Acton replied modestly that such a work was beyond the capacity of any one man. A syndicate of learning was the only conceivable method; but before the end of that year he had himself accepted the editorship of the modern section and had drawn up a plan which the Press approved. He got together a team of assistant editors and contributors and impressed them with his ideals. He died in 1902, the year of the appearance of the first volume. The last of the twelve appeared in 1910, and became at

once the standard book of reference which it has ever since remained. But the wider idea had already taken root and Prof. Bury undertook the planning of a Cambridge Medieval History, of which the first volume appeared in 1911, the year after the completion of the 'Modern' work. 'Modern', it should be understood, begins with the Renaissance and 'Medieval' with the death of Constantine. Owing to the Great War and the death of several of its editors, the Medieval History was not completed until 1936. During its publication, Prof. Bury, with the help of Profs. S. A. Cook and F. E. Adcock, had begun on the third section—the 'Ancient'—which though the earliest in the date of its contents, thus turned out, rather by accident, to be the latest in publication. Its first volume, however, appeared in 1923, thirteen years before the 'Medieval' was finished. It has taken altogether sixteen years to bring the work to a conclusion in the volume which has just been issued. Again, as in the case of Acton, the editor-in-chief of the Ancient and Medieval sections did not live to see his work completed. Dr. Cook's name stands first among the four who have brought the great undertaking into port.

Clearly it is impossible to review in a short space even the fortieth part of this colossal work. One can only mention that this twelfth volume of the ancient history deals with the last hundred and thirty years of the history of imperial Rome before the triumph of Constantine which ushered in the triumph of the Christian Church, marked by Lord Acton as the beginning of the medieval age.

It should not be overlooked that the success of the work and the termination of its scope at 1910 have prompted a continuance. Prof. Harold Temperley has for this purpose stepped into the shoes of Acton and Bury. To many of our younger contemporaries all the history which they wish to learn is post-War or even post-Hitler. To this doctrine Prof. Temperley seems to give his adhesion when he says (in his foreword to the first volume of this new series) "that a survey of the origins of the War exceeds all others in importance, for this period weighs upon us with insistence and has become part of the air we breathe. . . . Upon a right appreciation of the nature and objects of the War depends the future of history in this generation".

No doubt it is important; no doubt, also, it will in the competent and impartial hands of Prof. Temperley and his co-adjutors be a popular and useful corrective to the wild and conflicting theories which fill the Press and din our ears from the radio. Yet one cannot help thinking that there is a profound and rather dangerous fallacy concealed in the seductive words of the editor of the next great historical compilation which is to issue from the

Cambridge University Press. Is it really true that a knowledge—if we could obtain it—of the origin and issue of the last Great War exceeds in importance all else that history has to tell us? No doubt it now seems so to many people who are trembling at the result of the present international bifurcation and strife of nations. But might it not have seemed equally dangerous and important at many earlier crises in human history had we been there to feel the shock? We know in fact that it did so appear to thoughtful men at the time when the Roman Empire was giving way to the barbarians.

We need some other yardstick to measure the gravity of events; above all, we need a knowledge of and a faith in the permanence and force of other elements in the human and historic story than those which fill by far the larger part of these forty volumes and will apparently be the main if not the only, topic in the new series which Prof. Temperley is devising. The things he is to tell us are of great moment and should undoubtedly be spread abroad by all responsible and impartial agencies like the Cambridge University Press and every institution where the truths of history are handed on to future generations. But let us think for a few moments of the other side of human activity; that, for example, which is represented by the persistent and almost equally colossal work of George Sarton in *Isis* and many other publications. Here we have the growth of thought and the discovery of the universe which is going on even now at an accelerating pace though some countries may be able to expel every impartial man who is struggling to add his mite to the treasure. It may be said, "But if the dogs of war are let loose, all this may be devoured and the human race if it survives will have to emerge again from its cave-shelters in a world of desolation". This is a supposition somewhat on a par with the chance of our planet's extinction by collision with another wandering heavenly body.

We can indeed imagine both these catastrophes, but we do not seriously believe in the measurable probability of either. It would probably be admitted that the recent international discord and warlike preparations have not at all diminished the progress of science. In fact, in many ways they have accelerated it; and it is a tenable proposition that the expulsion of so many Jewish and other men of science from their homes in Central Europe will actually give fresh stimulus to their work and the works of others in the countries of their adoption. The totalitarian States, we must hope, will gradually throw off the incubus of the anti-scientific bias which at the moment is hindering research, diminishing the number of disinterested students, besides inflicting incalculable loss and suffering to those who fall under the ban.

The human spirit has, however, in the past always displayed an unconquerable power for re-establishing itself and making fresh advances. This is the lesson which should be aimed at in all great historical compilations such as that which Cambridge has just completed. In this and many other works the reader is overwhelmed by the mass of learning set out before him. The Cambridge forty volumes make a mighty historical encyclopedia which no one would think of tackling from beginning to end, but in which he would find ample and trustworthy information about any particular subject or person in which his interest was already aroused.

Such preliminary interest and a sketch of the whole in the spirit which we have just indicated, are the things most needed, and in supplying them we would put in an earnest plea for pre-eminence in the treatment of the growth of science or, if you will in a more general sense, the continued growth and enrichment of the human spirit. The notorious political events and figures would still be there, but in a much humbler attitude. We need them as landmarks just as it is useful to remember that Newton's greatest discoveries and the completion of "Paradise Lost" took place almost simultaneously in the year of

the Great Plague of London. So many of these popular and traditionally remembered events were actually plagues in the body politic. Who would not have avoided the Great War had he the power and foresight in 1914, just as now we are all absorbed in an attempt to avert another war, still more terrible if it occurred? But those things which we would not avert, but welcome and prize for ever as constructive achievements of humanity, should stand in the forefront of the picture. The foundation of mathematics and astronomy by the Greeks, their work in sculpture and architecture, the law-making genius of the Romans, the Madonna of the Middle Ages, the scientific synthesis of the seventeenth century, the mind of Goethe and the poems of Wordsworth, the ameliorative medicine and the widening of the universe in our own days—these are the things on which history should work most zealously, and make them stand out as the landmarks of the history to be taught in the generations to come.

The whole of the matter is too vast for us to comprehend; it is indeed infinite. Some selection and therefore emphasis are imperative. A higher degree of truth, and stronger hope for the future, would be the aim and the natural result of such an effort.

F. S. MARVIN.

Ancient Egypt and Its History

The Making of Egypt

By Sir Flinders Petrie. Pp. xv+188+85 plates. (London: The Sheldon Press; New York: The Macmillan Company, 1939.) 12s. 6d. net.

SIR FLINDERS PETRIE is the creator of Egyptian archaeology and is still at work. The advances made have been so gigantic in the period of a single lifetime that the world is liable to forget how very new the study is. In the book before us the author sums up his views of the various influences, immigrations and infiltrations into Egypt—and they were many. He gives us more than eighty plates, showing hundreds of objects of all sorts. These he considers qualified to support his theses, which are based on his unrivalled knowledge of the archaeology. The line drawings especially are of the beauty we have long grown accustomed to associate with his publications.

The various objects are grouped according to the periods of history, so that in looking through them the reader gets an idea of the characteristic products of each age. The scheme of work is ambitious, envisaging, as it does, the whole range

of man and his activities from the time the Nile Valley became habitable down to the Ptolemaic period. A bold attempt has been made to compress all this into the aforesaid 82 plates and 161 pages of text. To these are added three appendixes. They are: an arrangement of the Hyksos kings by a classification of their scarabs; a table of Egyptian skull measurements; a table of periods of history. There is also a complete table of references to the original publication of each of the illustrations.

The author directs attention once more to the existence since Early Predynastic days of a signary in the Mediterranean area, and to the fact that about half of these signs have survived as letters in various alphabets; a curious fact which has never been given the consideration due to it. The conclusion concerning Egypt's share in the world's progress is "that Egypt never originated any new civilization, but was a fertile ground for implanting the products of other lands". The reviewer would add, however, that there has been an artistic sense in Egypt, which lies dormant until brought to life by some movement from outside.

This is more than can be said for some neighbouring countries.

The layman will find much profit and pleasure in studying the plates, but to read the text requires more detailed knowledge than he could possess. The attempt to squeeze so much into so small a space entails a style which at times becomes almost telegraphic in its compression. It also necessitates allusions which are sufficient for the Egyptologist, but must be meaningless to the

public. Again, it induces a statement as of fact of much that really needs a discussion which would result in a probability, or perhaps only in a possibility. The system of dates used is the author's own, which is much longer than anything accepted by others. In putting Menes to 4326 B.C., S. Flinders Petrie puts him a thousand years or more earlier than would anyone else, though even this is a thousand years later than he used to date him.

G. A. WAINWRIGHT.

Universities of the British Empire

The Yearbook of the Universities of the Empire, 1939 (Published for the Universities Bureau of the British Empire.) Pp. xlv+1197. (London: G. Bell and Sons, Ltd., 1939.) 15s. net.

IN its main outlines the *Universities Yearbook* retains the shape given to it twenty-five years ago by its original designers. Its principal features are still: a directory of the officers and members of the staff of each university, general information as to origin, organization, equipment, courses of study, etc., and reports of events of outstanding interest which occurred during the past academic year. The reports, by the way, are in some cases excessively meagre, even such an important university as Bombay, for example, reporting nothing more than the total number of full-time students and the number of degrees conferred.

Preceding the sections dealing with the universities of Great Britain and Ireland, of Canada, of Australia, of South Africa and of India, respectively, are introductory chapters treating briefly of their history, regulations and practice. The first of these, which has a rather jejune appearance, concludes with an interesting account of the genesis of a Consultative Committee of Vice-Chancellors and Principals. That some such body should exist to co-ordinate policy in matters of common concern and stimulate adjustments to the changing social environment and national needs is sufficiently obvious. What surprises one is that it did not exist before 1918. The chapter about the universities of Australia has been extensively revised for the present issue of the *Yearbook* by the Australian Vice-Chancellors' Committee.

In eleven appendixes, covering some two hundred and fifty pages, are assembled an assortment of notes on admission to universities, professional bodies, student organizations and other matters, contributing to make the *Yearbook* a sort

of 'inquire within upon everything' connected with universities. Among them are useful particulars of post-graduate scholarships and grants for advanced study and research and centres of scientific research and information. These reflect the conspicuous defects in the organization of the finance, distribution, direction and co-ordination of scientific research in Great Britain to which Prof. J. D. Bernal has directed attention so forcibly in 'The Social Function of Science'. Another appendix epitomizes returns (not published elsewhere) from universities and university colleges in Great Britain and Ireland of their students from abroad. The total number, 6,214 includes 1,614 from other countries in Europe, 2,180 from Asia, 1,061 from Africa, 1,034 from America and 325 from Australasia. Of European countries the largest contributors were: Germany (532), Poland (195), Holland (77), Hungary (71), France (65) and Norway (64). Students from India numbered 1,350, from China 233, from Egypt 383, from Palestine 146, from South Africa 532 from the U.S.A. 517, from Canada 271.

The body responsible for the production of the *Yearbook* is the Universities Bureau of the British Empire. Full particulars of its constitution appear together with its last annual report, on pages xi-xlv. An important event in the Bureau's history was the secretary's tour of the Canadian universities, which took place in the spring of last year. He visited all of them and discussed with members of their staffs ways and means whereby the Bureau could be of service to them. He returned via the United States, and while there discussed with the presidents of Harvard and Yale, the president of the Carnegie Corporation of New York and the director of the Institute of International Education, the possibility of the visit to England in 1941 of some of the heads of universities in the United States, with a view to their meeting the heads of universities in the British Empire at the congress to be held in Manchester.

Communication :

a Philosophical Study of Language. By Karl Britton. (International Library of Psychology, Philosophy and Scientific Method.) Pp. xvi+290. (London: Kegan Paul and Co., Ltd., 1939.) 12s. 6d. net.

LANGUAGE has become again a central point of interest for philosophers, logicians and psychologists. Historically this has always been the case when thinkers begin to question the reality of values and the import of the ultimate principles of explanation of the world. The Greek sophists, the medieval nominalists, Hobbes, the eighteenth century sensualists, and the modern positivists are in the direct lineage of the contemporary analytical philosophers who make of language the leading real problem of knowledge. From this angle, Mr. Britton's book is of particular importance, in so far as it retraces in an orderly fashion the manifold cross-currents which enrich the field of logical controversy.

It begins with a discussion of four principal kinds of language: the language of empirical propositions, necessary principles, moral judgments, and poetry; and it endeavours to show that all these can be explained in terms of the informative and of the emotive function of language. When a language refers to what we may experience, it is informative; otherwise it is emotional. It is easy to confuse informative and emotive uses of words; and the chief object of analysis would be to distinguish these clearly. One of the results of the analysis is to show the place of necessary rules in linguistic behaviour, never to indicate the mutual relevance of psychology and logic. Mr. Britton discusses these problems with competence and skill. He also discusses the views of many recent writers, including Russell, Moore, Wisdom, Empeon, Sheffer, Lewis, Wittgenstein and Carnap. Hence the interest of this volume, which may be read as an excellent introduction to the theory and practice of modern logical analysis.

T. G.

The 1938 Mental Measurements Year-book of the School of Education, Rutgers University
Oscar Krisen Buros, Editor. Pp. xv+415. (New Brunswick, N. J.: Rutgers University Press, 1938.) 3 dollars.

THE output of mental tests is now so great that no worker in educational psychology can hope to know more than a small fraction of them. The seriousness of the problem for the conscientious teacher of educational psychology or director of research in that subject is not lightened by the consideration that most of the tests produced are of little or no value, for it has become almost impossibly difficult for him to discover what are the useful new tests and which are worthless.

The fact that this Year-book lists 312 new tests makes it useful to every worker in educational psychology. If it merely did that, it would only be one more of the too numerous psychological publications which preserve equally the valuable and the worthless in psychological production. In fact, it does much more since it contains a critical evaluation

of all the tests and the publications on educational psychology which are described. This feature makes it invaluable. It is excellent to see at the end of the description of a test: "these tests serve to increase the number of mediocre tests that are now on the market, without making any scientific contribution to the development of group testing of intelligence". Whether or not this criticism is just in the particular case to which it is applied, it shows the right spirit. Let us hope that this Year-book marks the end of the period of merely listing psychological work without attempting to distinguish the bad from the good.

R. H. T.

The Wild Asses :

a Journey through Persia. By W. V. Emanuel. Pp. 352+12 plates. (London: Jonathan Cape, Ltd., 1939.) 12s. 6d. net.

HERE Mr. Emanuel records a journey through Persia of a mixed party, described on one occasion by Reuter as of "undergraduates". Though the author repudiates this designation, it does in some degree characterize them and their spirit of adventure. They belonged to the National Union of Students. Their route lay across Europe to Russia, and through the Caucasus into Persia, which they traversed to Meshed; and there they crossed the Afghan frontier for a brief stay at Herat. On their return they crossed the great Salt Desert of Persia, to their edification, if discomfort. Although this record is not intended to be in any sense a scientific study—anything in that nature is precluded by the rapidity with which the party travelled—the author has a keen eye for the distinctive characters of both peoples and places; and the freshness of his point of view and the acuteness of his observation give his book something more than a passing interest. It may be noted that the points which impressed him most in Persia were the sophistication of Persian people and society and the penetration of the Germans everywhere, especially in business, education and military matters.

Quelques Techniques actuelles en physique nucléaire
Méthode de la Trochoïde; Électrons positifs; Spectrographie de Masse; Isotopes; Compteurs de Particules à Amplification linéaire; Compteurs de Geiger et Müller. Par Prof. Jean Thibaud, Louis Carta et Paul Comparat. Pp. vi+276+12 plates. (Paris: Gauthier-Villars, 1938.) 100 francs.

THE greater part of this volume is devoted to a critical study of methods in mass-spectrography, and more particularly of the methods and results of the work of the last four or five years. This section, therefore, forms a valuable and needed supplement to the standard treatise of Aston. The remaining sections deal in considerable detail with the construction and uses of counters and counting circuits. Within these somewhat severely prescribed limits the treatment is remarkably complete, and it is typically French in its lucidity. The book, which is lavishly illustrated, is a notable addition to the literature of the experimental part of nuclear physics.

Elementary Mathematical Statistics

By Prof. William Dowell Baten. Pp. x+338. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 15s. net.

BOOKS concerned with statistics fall roughly into two classes, those which aim at providing a variety of methods for the analysis of data without making any serious attempt to prove the formulæ given, and those which concentrate on the proofs of the propositions under discussion.

Dr. Baten's work falls into the latter class. It will undoubtedly be criticized as too narrow by those who desire a compilation of methods, and such criticism would not be entirely unjust, as exact tests of significance, experimental design and analysis, orthogonality and degrees of freedom are either mentioned very briefly or entirely omitted. The discussion of correlation is very full, but leaves one wondering whether a discussion of regressions would not have been of more value. To the research worker and the student, therefore, the book is not to be recommended for uncritical use. To the teacher, however, it should prove of value, as the approach to many of the questions raised is of attractive simplicity. Where it is necessary to provide algebraic demonstrations to students with limited mathematical knowledge this book should be a useful guide.

K. M.

A Guide to Chemical Laboratory Practice:

for Beginners. By Prof. H. Bassett. Pp. viii+94. (London: Macmillan and Co., Ltd., 1938.) 2s. 6d.

IN this book an attempt is made to supply the information which is usually provided by the demonstrators in the elementary laboratory. In this way time and trouble may be saved. Some of the information may seem rather trivial, as when the student is warned not to stumble and fall when carrying a desiccator; but most of the hints given are useful. Every teacher knows that it is of the utmost importance to instil into beginners those habits of neatness and orderly work without which no real progress can be made in practical chemistry, and this modest volume will certainly assist in this way if students can be persuaded to read it and carry out the good advice which will be found in abundance on its pages.

Principles of Electricity and Electromagnetism

By Prof. Gaylord P. Harnwell. (International Series in Physics.) Pp. xiii+610. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 30s.

PROF. HARNWELL'S book is an interesting, and on the whole successful, combination of the classical-theoretical and modern-practical treatments of electromagnetism. We have, for example, in Chapter I the conventional elementary treatment of electrical images, while Chapter V treats at some length of current-voltage relations in non-ohmic circuit elements, including the interesting ceramic material, thyratron. A good deal of space is given to conduction in gases and to thermionic vacuum tubes, and in

general any topic taken up is given a space very nicely proportioned to its present-day importance rather than to its historical interest. British students will find the book more suitable for reference than as a regular companion in a degree course—and its strongest appeal will be to the physicist with marked bias towards the practical side of his subject or even towards the more academic side of electronic techniques.

Logical Aspects of Educational Measurement

By B. Othanel Smith. Pp. x+182. (New York: Columbia University Press; London: Oxford University Press, 1938.) 12s. 6d. net.

THE author of this book has attempted to clarify his ideas about the meaning of measurement in education, in which he has found most help from the well-known writings of Dr. Norman Campbell. Approximately the first five chapters are devoted to the logical foundations of measurement, the last four to questions more particularly concerned with educational measurement.

The logical treatment is nothing like so rigorous as that found, for example, in the paper by Mr. J. Guild on "Are sensation intensities measurable?", in the current Report of the British Association for the Advancement of Science, but it follows somewhat similar lines. Mr. Othanel Smith concludes that quantitative units have not been established in educational measurement. The requirement of *order* has often been fulfilled, but not that of *addition*. Just now in educational measurement, he thinks, it is more important to concentrate on the operational interpretation of *order* and *equality* than to seek for an additive structure.

Nauka Polska:

jej Potrzeby, Organizacja i Rozwój (Science and Letters in Poland: their Needs, Organization and Progress). Tom 24. Pp. x+587. (Warsaw: Kasy imienia Mianowskiego, 1939).

UNDER the able editorship of Prof. S. Michałski *Nauka Polska* each year acquaints Polish men of science with the tendencies and general advances over a wide field. In the latest volume there are four articles (three short and one fairly long) entitled respectively, "Science and the Irrational Element", "Humanities and the Vital Needs of the Nation", "Visual Thinking" and "Scientific Life in Modern Cracow". In the second of these, the author, Prof. K. Dobrowolski, discusses the part that each branch of the natural sciences can have in enhancing national and cultural life.

Most of the volume is taken up with numerous shorter items, reviews and a bibliography of the "Science of Science". Some of these shorter notes, such as that describing the foreign literature available for students in Polish libraries, are of direct interest to British readers, and it is perhaps significant that some thirteen English books are among the thirty reviewed in this issue of what may be regarded as a most influential scientific publication in Poland.

Use of Oxygen on the Mount Everest Expedition, 1938

By Peter Lloyd

THERE were two types of oxygen apparatus available to the Mount Everest Expedition of 1938. One was the open type, used by the 1922 and 1924 expeditions, in which the climber breathes a mixture of oxygen and air. The other was a closed circuit apparatus in which pure oxygen is breathed. Now the essence of the oxygen problem is the fact that the apparatus cannot be effectively tested except at very high altitudes. Serious oxygen lack does not make itself felt below about 23,000 ft., so that a test in the Alps is not conclusive even with the closed apparatus, and with the open apparatus it would be useless. Similarly, a test in a pressure chamber is of little value since it cannot include the vitally important acclimatization factor. There was therefore no possibility of making a comparison of the two units in Europe, and it was decided by the leader of the Expedition that both must be taken.

The open apparatus was similar in principle to that devised for the 1922 expedition¹. The oxygen was contained in two Vibrax steel cylinders of 500 litres capacity at 120 atmospheres pressure, and was fed through an adjustable spring-loaded governing valve to a small canvas bag acting as a reservoir, and thence to the mouthpiece. A pressure gauge was fitted, but no flowmeter, and the governing valve was intended to be set and looked at the required delivery rate. If the lung ventilation of a man doing hard work at 29,000 ft. above sea-level (245 mm. mercury) is taken as 60 litres a minute, then an apparatus of this type delivering oxygen at the rate of 2 litres a minute (as measured at 760 mm. mercury) will raise the partial pressure of oxygen in the inspired air from the original 51 mm. to 71 mm., corresponding to an atmospheric pressure of 341 mm., or an altitude of 20,800 ft. Similarly, a climber at 25,000 ft. (285 mm. mercury) with the same oxygen delivery and lung ventilation will have an oxygen pressure in his inspired air corresponding to that obtained at 17,500 ft. Since at 20,000 ft. an acclimatized man can still move almost as fast as at Alpine altitudes, it is generally assumed that a delivery rate of 2 litres per minute is about right, and at this rating the apparatus with its charge of 1,000 litres would last a little more than eight hours. The total weight was 25 lb., the charged oxygen cylinders accounting for 19 lb.

The closed unit was similar to that taken by the 1936 expedition² and was of the type which

is used for rescue work in mines. It had been improved as a result of tests carried out by Dr. Warren in 1937, in the course of which he used the apparatus on the Matterhorn and the Wellenkuppe. The oxygen was contained in a single cylinder of 750 litres capacity, and from the cylinder the gas passed through the reducing valves into a low-pressure reservoir. The user drew oxygen from this reservoir through his face mask, covering nose and mouth, and the expired gases passed back into the reservoir through a canister packed with soda lime in which the carbon dioxide was absorbed. There were, in effect, three separate automatic valve systems; the pressure-reducing valve which lowers the pressure to about 2 atmospheres and from which a weep of $\frac{1}{4}$ a litre a minute is fed into the reservoir, the breathing valve which opens when the flexible reservoir begins to collapse under external atmospheric pressure, and the lightly spring-loaded mica valves on the flexible connexions to the face piece, which control the direction of flow through the circuit. All these had to work correctly if the apparatus was to succeed. In addition, there were two hand-operated valves, one the screw-down valve on the main supply and the other a by-pass by means of which the supply of fresh oxygen to the reservoir could be supplemented. As on the open apparatus, a pressure gauge was fitted to indicate the residual pressure in the cylinder.

Every effort was made to lighten the construction, even at some sacrifice of rigidity, but the apparatus weighed 35 lb. for a supply which was calculated to last 5 $\frac{1}{2}$ hours. This was a weight which a fit man could easily carry over moderately difficult ground, but it might become an impossible burden on steep rocks or if the climber were weakened by lack of food or any other cause. Of the 35 lb. weight, only 14 $\frac{1}{2}$ lb. was in the charged oxygen cylinder, 10 lb. was in soda lime and the remaining 10 $\frac{1}{2}$ lb. was in the frame, the canister and the valve gear. But although the quantity of oxygen was small, virtually all of it could be effectively used, while with the open apparatus most of the oxygen would go to waste in the expired air. It was thought that the high oxygen pressure obtained and the greater efficiency of utilization would outweigh the obvious disadvantages.

A preliminary test on the closed apparatus was done on the journey out to Tibet, at Thapgu, in Sikkim (12,800 ft.). In the main, the results were

satisfactory, but it was found that in still air the oxygen may get so overheated by the reactions in the soda-lime that conditions become thoroughly unpleasant for the wearer of the apparatus.

The first high-altitude test in the closed apparatus was done by Dr. C. B. Warren on the snow slopes above the North Col (23,000 ft.). He found that, although the unit seemed to be in perfect mechanical order, it tended not to stimulate but rather to suffocate him. He was actually moving more slowly than the other climbers, and was forced to stop after every dozen steps to recover his breath.

When the camp on the North Col was re-occupied about ten days later, this gave me a chance for a comparative trial of the two forms of apparatus between Camps iv and v (23,000–25,700 ft.). The open unit was tried first, and it was found that within half an hour the breathing technique had been mastered and the tricks of the apparatus had been learnt. The oxygen was drawn into the lungs through a rubber mouthpiece which was held between the teeth. The technique consisted in biting the rubber to prevent an outflow of gas when breathing out and releasing it when breathing in. When the flow of oxygen was stopped by biting the mouthpiece, the oxygen accumulated in the small canvas bag mounted above the cylinders.

The apparatus was perfectly comfortable. As to speed, I found that I was moving as fast as the fastest member of the party and therefore much better than without the help of the oxygen. But the main difference was the absence of strain or fatigue. The day before, climbing from about 21,000 ft. to 23,000 ft., I had felt really tired, whereas on this day climbing from 23,000 ft. to 25,700 ft. and down again left me comparatively fresh.

Partly to economize oxygen, and partly to test the effect of suddenly removing its stimulus, I turned off the supply at every halt, but this did not seem to produce any reaction whatever. On the other hand, when the first cylinder was running out and I was climbing with a rapidly decreasing supply, the effect was immediately noticeable. The oxygen flow had been set the previous night to a rate corresponding to 2.2 litres a minute at one atmosphere, and at this setting the first cylinder lasted until ten minutes below Camp v. The oxygen supply was turned off six hundred feet above Camp iv and the descent completed without it.

On the following day I took the better of the two closed units and started off with a Sherpa, intending to climb about 1,500 ft., and to compare my times and sensations with those of the previous day. But it soon became evident that there was

something very wrong. Mechanically everything was perfect, and the valves were opening and closing like clockwork, but inside the mask was nearly suffocating, and I had to stop frequent to take a dose of fresh air. If the whole of the system was filled with fresh oxygen, then for time conditions were pleasant enough, but very quick deterioration followed. The absorptive seemed to be satisfactory, for the soda lime canister was warm—uncomfortably warm in fact—but the effects of the overheating were much more serious this time than they had been under similar conditions at Thangu. The mica valves on the mask were tested and found to be functioning, as the breathing valve controlling the supply to the reservoir was short circuited by opening the by-pass valve, but nothing that I could do improved the results in any way.

The open apparatus was used again on an attempt on the summit involving three days' climbing, the first day up to Camp v, the second up to Camp vi, and the third for the attempt. It worked perfectly for the second ascent to Camp v, and just over one cylinder was used. On the following day we set off over heavily snow-covered rock for Camp vi, which had been pitched at 27,200 ft. Thanks to the oxygen apparatus, which was working perfectly, I was feeling very fit and reached Camp vi half an hour or an hour ahead of the others who were not using oxygen. The camp was magnificently situated on a gently inclined scree slope, and I was interested to find the scree in several places cemented together with ice, which is not known to have been found before at this height*. Even here I felt absolutely no ill-effect on turning off the oxygen supply when I stopped climbing.

The story of our attempt to reach the main ridge of the mountain on the following day has already been told. We were forced to retreat after advancing only a short distance above the camp. In spite of oxygen, I seemed to feel the early morning cold as much as my companion Tilman and I made no more impression than he did on the rocks we were trying to climb. On easy ground however, it increased climbing speed, as was immediately evident when we were roped together.

It is not an easy matter to do scientific work above 23,000 ft., for Everest has a way of sapping one's energy and leaving little inclination for detailed work. As a result, the tests which were done on the oxygen apparatus are neither so complete nor so precise as one would like them to have been, and our conclusions cannot have the force of proofs. The failure of the closed apparatus in two independent tests on the North Col has yet

* In "Everest 1933", p. 348, L. B. Wager reports the greatest height at which ice was found as 25,700 ft. Some névé was seen at about 28,000 ft.

to be satisfactorily explained, but the fact of its failure, coupled with the mechanical troubles which were experienced with it, give powerful backing to the arguments which have already been advanced against it. A closed apparatus was brought back from Everest, and was tested again under actual climbing conditions to ascertain whether there had been any mechanical fault which might have caused the failure. Some repairs were necessary, but the canister was not exchanged, and neither the breathing valve on the flexible reservoir nor the mica valves on the face-piece were touched. The test showed that at these low altitudes (up to 2,000 ft.) the apparatus worked perfectly well.

Perhaps the hardest thing of all is to estimate the advantage conferred by the use of oxygen. Comparison of climbing speeds is difficult and dangerous, but from the trials of 1938, it would seem that from 23,000 ft. to 28,000 ft., the use of oxygen in the open apparatus at 2 litres a minute

has only a slight effect on natural climbing speed. The reduction of strain and fatigue, however, provides ample justification for its use at this height. Above 28,000 ft., the increase in climbing speed becomes more and more apparent. The maximum advantage is obtained, as one might expect, on easy ground where the climber moves with steady rhythm. More difficult climbing requiring greater exertion results in an increase in the rate of breathing, and with the open apparatus this implies a fall in the partial pressure of oxygen entering the lungs.

We suffered in 1938 from the necessity of taking two different forms of apparatus each with different sized cylinders, but it is hoped that the results we obtained will enable a future expedition to make a definite choice.

¹ See Prof. G. I. Finch's account in "The Assault on Mount Everest", p. 264; also P. J. H. Unna, "The Oxygen Equipment of the 1933 Everest Expedition", *Alpine J.*, 34, 235.

² See "The Medical and Physiological aspects of the Mount Everest Expeditions", by C. B. Warren, *Geog. J.*, 90 (August 1937).

A Hundred Years of Photography

THE satisfactory recording of a scene by photographic means first became possible in 1839, when Daguerre published details of the process which bears his name. The 'base' consisted of a silver or silvered metal plate iodized on the surface, and the exposure amounted to about ten minutes in bright sunlight. 'Development' took place in mercury vapour, which acted preferentially upon the exposed portions, yielding a direct positive. A serious disadvantage of the process was the fact that only one picture was obtained, and there was no known process of copying originals. Fox-Talbot in 1840 carried the art a stage further by obtaining negatives on paper, using silver iodide as sensitive material, developing in gallic acid, waxing the paper to make it transparent and making prints by exposing in front of a piece of paper sensitized with silver chloride.

The chief drawback at this time was the length of exposure necessary. Scott-Archer in 1851 considerably increased the speed with his wet collodion process. This latter process was the first successful attempt to use a protective colloid for suspending the light-sensitive substance. The wet collodion process was very successful and its chief drawback was the fact that the plate had to be exposed while still wet, thus necessitating the preparation of the plate 'in the field' immediately before exposure.

The next important step was taken in 1871, when Maddox used gelatine instead of collodion as

protective colloid and produced the first dry plate. The dry plate was not successful until later, when it was found essential to remove the salts formed by the reaction between silver nitrate and soluble halide. In addition to a gain in speed, the dry plate had an enormous advantage over the wet plate for field work, but the wet plate is still extensively used to-day in the photo-engraving industry.

The spectral sensitivity of the silver halides is confined to the blue and violet end of the visible spectrum, but it was discovered in 1873 that the addition of certain dyes conferred added sensitivity in the direction of increasing wave-length. Since then a systematic search has been made, and is still going on, for other sensitizing dyes giving greater sensitivity and extending the spectral range of the added sensitivity. It is possible to-day to sensitize to all wave-lengths up to about 11,000 Å.

Since the discovery of the dry plate, no fundamental changes have taken place in photography. All the advance has been towards improved photographic quality (for example, latitude and gradation, speed, graininess and spectral sensitivity). The inherent sensitivity of the silver halides to ultra-violet, X-rays and γ-rays has found its application in scientific work. Indeed, during the last fifty years, photography has been an invaluable tool in scientific research. One has only to recall the part played by photography in

astronomy and spectroscopy to realize how difficult, and in some cases almost impossible, much of the work would have been without it. On the other hand, the manufacture of photographic emulsions is still largely governed by trial and error, though of course a great deal of knowledge has been gained empirically. The gelatine used is a natural product which contains compounds essential to the production of a satisfactory emulsion, and although something is known of the nature of these compounds their significance is not yet fully understood. Photography has gained much from the advance in organic chemistry, which has paved the way towards the synthesis of sensitizing dyes. Enormous numbers of dyes have been prepared and tested for the sake of a small percentage which have proved useful. The mechanism of dye sensitization is not yet understood, but by a systematic study of the behaviour of dyes sufficient empirical knowledge has been obtained at least to guide the search for new dyes into more fruitful channels.

It is a far cry from the *thé* Daguerreotype plate of 1839 requiring 10 minutes' exposure in sunlight to the plate or film of 1939 requiring 0.01 second under similar conditions of lighting and lens aperture, and it appears to-day that the speed cannot be greatly increased while retaining other factors such as grain within reasonable limits. The same could, however, have been said five years ago, yet the speed of the fastest available material has been increased several times since then.

Even a brief review such as this would be incomplete without a word on colour photography. A practical method of additive colour reproduction was conceived so early as 1868, but could not be developed into a practical process until satisfactory panchromatization was achieved. The mosaic screen processes of to-day are the outcome of these early theories and have reached their present stage of perfection largely by the increase in speed and colour-sensitivity of photographic materials in general. Subtractive colour processes have within the last few years received added impetus by the development of colour former and developer coupling methods, as well as improvements in emulsion-making technique. Most of the practical advance in colour photography has taken place during the last thirty years, mainly because improvement was not possible in any colour process until efficient sensitization in the red region of the spectrum had been achieved.

The pioneers of photography were concerned with discovering a process by which the beautiful little pictures shown on the screen of the camera obscura could be permanently recorded, but the art has proved of such important application in the field of scientific research that we may well

pause to commemorate the centenary of photography.

The Royal Photographic Society held a series of special centenary lectures during last winter session; celebrations were held in Paris earlier this year, and on May 17 a joint meeting of the Royal Society of Arts and the Royal Photographic Society was held in the lecture hall of the Royal Society of Arts, London. This joint meeting was particularly appropriate, because it was out of the Royal Society of Arts that the Royal Photographic Society, the first photographic society in the world was formed in 1853. Dr. Olaf Bloch opened the proceedings from the chair and the first speaker was Mr. Peter le Neve Foster, the great-grandson of Peter le Neve Foster who, as a member of the Royal Society of Arts, was partly instrumental in the formation of the Royal Photographic Society. The speaker referred to papers on photographic subjects read before the Society between 1840 and the formation of the Royal Photographic Society.

The next speaker, Miss M. T. Talbot, gave a very interesting sidelight on the character and family life of her grandfather William Henry Fox Talbot, who may be called the pioneer of photography in Great Britain. He was the originator of the negative-positive process, whereby any number of copies could be obtained from one original.

Mr. Dudley Johnston then spoke on behalf of the Royal Photographic Society and stressed the cordial relations that had always existed between that body and the Royal Society of Arts. He gave an outline of the history of the formation of the Royal Photographic Society, which arose out of the exhibition of photographs held in 1852 under the auspices of the Royal Society of Arts. He read extracts from correspondence between the early organizers who were responsible for the formation of the Royal Photographic Society, from which it appeared that Fox-Talbot generously relinquished his patent rights on the calotype process in favour of the amateur photographer in order to make the formation of a photographic society possible.

Mr. A. J. Bull then gave a demonstration of Fox Talbot's photogenic paper, and the wet-collodion process originated by Scott-Archard in 1851 and still extensively used in the photo-engraving industry.

A number of exhibits of historic interest were on view. Some early cameras of Fox-Talbot were supplied with a hole and cork in the front, so that the operator could remove the cork and apply his eye to see how the exposure was getting on. Of scientific interest was the result of an attempt by Sir William Crookes to photograph the moon in 1855. In addition, photographs made by the early processes, fine as some of them were, showed the enormous progress that has been made in the last hundred years.

Submicroscopic Morphology of Protoplasm and its Derivatives*

CYTOPLASM

CYTOPLASM is neither a true liquid nor a true solid, but has an interesting combination of characters which place it between the two states. It may contain as much as 97 per cent water, and in some circumstances exhibits streaming, or flow; in contrast, it has some measure of rigidity, tensile strength, and elasticity. It is not perfectly elastic, however, but undergoes plastic deformation; the surface is sticky, and the material may be drawn into fine threads. To these properties must be added thixotropy (a change from the semi-solid to the semi-liquid state caused by stirring), imbibition, semipermeability, and optical anisotropy. Earlier attempts to explain the properties of cytoplasm, for example, the 'alveolar', 'granular', and 'fibrillar' hypotheses, have proved inadequate, and have been discarded in favour of a gel structure: whereas the former postulated structural units of microscopic dimensions, the latter involves a structure beyond microscopic resolution. A colloid is described as having a dispersed phase in a continuous dispersion medium. Ostwald describes nine possible combinations, since either of the two phases may be liquid, solid, or gaseous, and eight of these are recognized in Nature (that is, all except the gas-gas combination). A consideration of the properties of each fails to explain all the properties of cytoplasm, and it would appear that the substance cannot be an ordinary colloid with dispersed particles.

Within limits, the shape of the particles does not affect the properties of a dispersoid, but if they are filamentous, as indeed is known to be the case in cellulose and proteins, they will be in frequent contact with one another, and form a continuous framework, that is, a reticular system instead of a corpuscular one, so that both phases are continuous and mutually interpenetrating. It is essential that the 'framework phase' be solid, though the second phase may be either solid, liquid, or gaseous. In order to follow so far as possible the terminology of Nägeli, who laid the foundations on which the

present conceptions have been built, the framework phase is called the 'micellar framework', and the meshes of the network the 'intermicellar spaces'. The material occupying these spaces is called the 'imbibition medium', as distinct from the dispersion medium of ordinary colloids. Whereas reduction in size of the particles of a corpuscular dispersoid would, when molecular dimensions were reached, result in a true solution which would not have colloidal properties, a similar reduction in the dimensions of a micellar framework would simply mean a decrease in thickness of the micellar threads, leading ultimately to a molecular reticulum which would retain many of the properties of a colloid, and if the points of attachment were sufficiently numerous would still be a gel. It may now be considered how the known constituents of cytoplasm can be fitted into such a plan.

In addition to water and inorganic constituents, the cytoplasm consists of proteins, phosphatides, and lipoids. The fats, which may be taken as representative of the last group, are formed from fatty acids esterified with glycerol. The molecule may be pictured as a three-pronged fork (Fig. 1a), the prongs representing lipophilic, fatty acid chains. They have neither hydroxyl nor carboxyl groups, and, in consequence, are immiscible with water. The phosphatides, by way of contrast, are of a polar character. For example, lecithin is a glycerol ester with two fatty acid chains and one hydrophilic choline phosphate group. As the hydrophilic and lipophilic groups are mutually repellent, the molecule may be compared with a tuning fork having two lipophilic prongs and a hydrophilic handle (Fig. 1b). The proteins are polypeptide chains of indeterminate length with various side chains, which may be hydrophilic, lipophilic, acidic, or basic, according to the protein. These chains have three important characteristics:

(a) A repetition of similar links, comparable with the metameric segmentation in zoology; (b) a great variety of composition due to differences in possible arrangement of the side chains; and (c) a reversible contractibility which is probably important in vital processes.

Of the three constituents mentioned, the protein chains alone have a structure capable of forming a molecular reticulum. Moreover, this framework is capable of carrying the other constituents of the cytoplasm in association with suitable side chains. Indications of 'possible

* Prof. A. Frey-Wyssling, professor of botany in the Swiss Federal Institute of Technology, Zurich, delivered a series of three lectures at University College, London, on March 6, 7 and 9. The contents of the first two, dealing respectively with the submicroscopic structure of cytoplasm and chloroplasts, are summarised in this article; the principal contents of the third lecture, which treated the submicroscopic structure of cell walls, are covered by the article which appeared in *NATURE*, 148, 899-904 (1938); the lecture is to be published by Prof. Frey-Wyssling in the October (1939) number of *Science Progress*. Details of the subject, with an extensive bibliography, are given in Prof. Frey-Wyssling's book, "Submikroskopische Morphologie des Protoplasmas und seiner Derivate" (Berlin: Gebrüder Borntraeger, 1938).

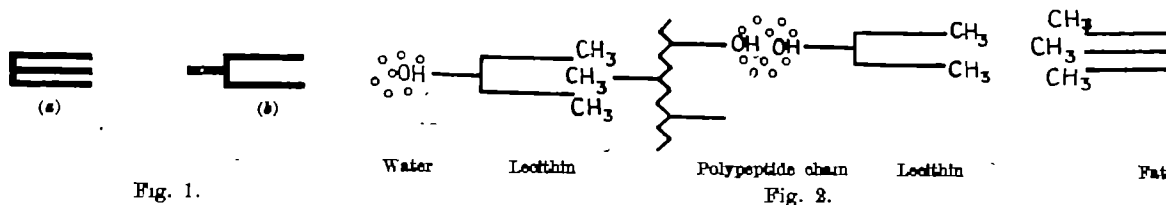


Fig. 1.

Fig. 2.

combinations of this type are suggested in Fig. 2. Fig. 3 indicates types of union such as might occur at points of attachment of the chains themselves. Type I, between two lipophilic groups ($|\text{—CH}_2\text{—H}_2\text{C—}|$) is a homopolar cohesion bond of the kind found in paraffin wax; it would be affected by changes in temperature. Type II, between hydrophilic side chains ($|\text{—OH} \dots \text{HO—}|$) represents a heteropolar cohesion bond, or secondary valency bond; it may be loosened by heteropolar agents, and is capable of swelling. Type III, between acidic and basic side chains ($|\text{—COO}^- \dots \text{NH}_3^+ \text{—}|$) forming a salt by ionic valency bonds, is affected by changes in hydrogen ion concentration. Type IV is a primary valency bond, and this particular type is dependent on redox reactions. A loose reticulum of the kind illustrated in Fig. 4, held by such bonds, would be sensitive to many kinds of change in environmental conditions.

The property of semipermeability may be controlled by lipoids incorporated in the protein network. These must be accumulated in the peripheral zone, because dyes which cannot penetrate the plasmatic surface spread freely in the cytoplasm when introduced by micro-injection. The high water content of cytoplasm together with mechanical rigidity, elasticity, and tendency to retain shape, are readily explained on the basis of a reticular framework, but would be difficult to account for on other systems. The properties of plasticity, viscosity, and protoplasmic streaming are less easily explained. It may be assumed

that under certain conditions some of the bonds are loosened for a short time so that the micelle threads may slide over one another, and find new points of attachment. Not all the bonds would be loosened at the same time, for the polypeptid chains move in parallel groups as shown by the optical anisotropy, and this arrangement is responsible for the stickiness, tensile strength, and the possibility of being drawn into threads. Finally Seifriz has shown that protoplasmic movement has a pulsating rhythm, and it is suggested that this is associated with the periodic contractions of the polypeptide chains.

CHLOROPLASTS

Following the lines which appear to have been so successful in the investigation of cytoplasm, the molecular constitution of the main constituents of the chloroplasts was studied. Approximately half the chloroplast consists of protein, rather more than one third of lipoids, and about eight per cent of inorganic substances. The pigments (chlorophyll *a* and *b*, xanthophyll and carotin) constitute only a very small proportion (for example, 1.5 per cent in tobacco leaves). It would appear probable that the proteins form a micellar reticulum as in the cytoplasm, and that the smaller molecules of the lipoids are lodged within the reticulum. The pigments are probably associated with the lipoids. The chlorophyll molecule may be likened to a signet, or rubber stamp, the disk representing

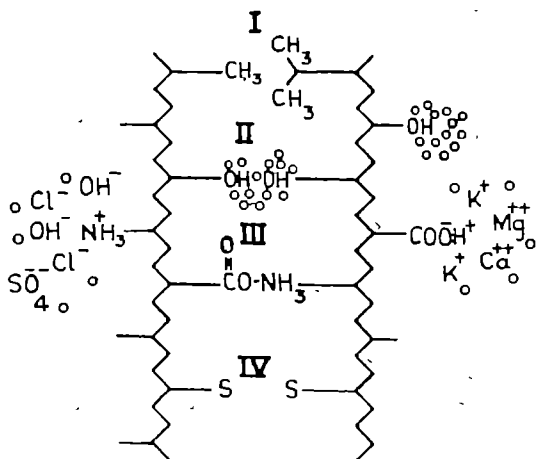


Fig. 3.

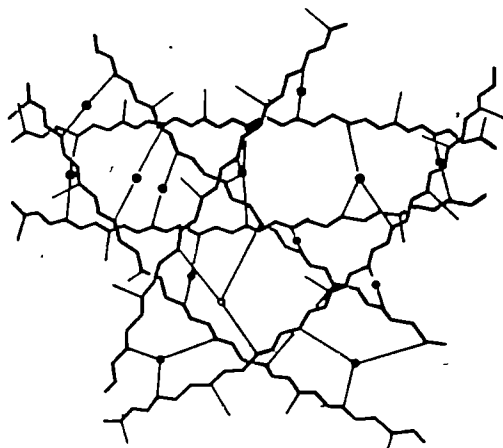
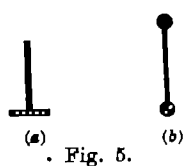


Fig. 4.

so-called porphine ring, which is hydrophilic, and contains the nitrogen and magnesium of the chlorophyll, and the handle representing a lipophilic chain (Fig. 5a). The carotinoids are hydrocarbons ($C_{40}H_{56}$), and are completely lipophilic. The xanthophylls are alcohols with one or more OH groups, and their affinity for water varies accordingly. Fig. 5b is a diagrammatic representation of the molecule.

Some indications of the probable arrangement of these units within the chloroplast are afforded by the optical properties. From observation of double refraction, and of the changes of this property with change in the imbibition medium, it is inferred that the chloroplast is composed of submicroscopic layers, and that



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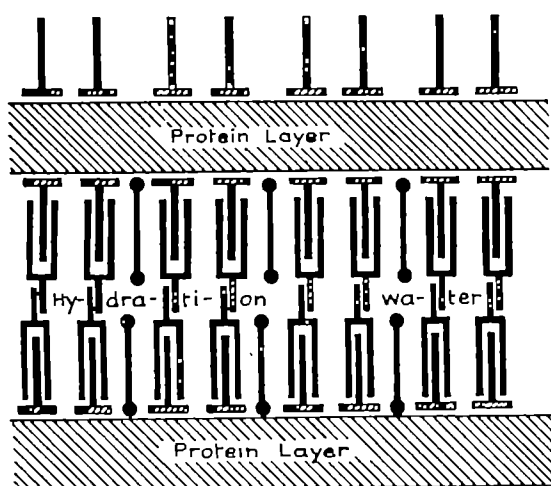


Fig. 6.

one type of layer consists of regularly orientated lipid molecules. Since about half the chloroplast is protein, perhaps this alternates with the lipid layers. Menke has actually observed a microscopic layering in some instances, and it would therefore appear likely that this suggestion is correct. Chlorophyll exhibits fluorescence when dissolved in alcohol or acetone, but the property is lost when water is added, because the molecules tend to form aggregates in which the lipophilic portions are directed towards one another and away from the water. Chlorophyll also exhibits fluorescence in the living chloroplast, and when in the form of mono-molecular layers on aluminium hydroxide, or with layers of lecithin. It is concluded that in the chloroplast chlorophyll occurs in layers, and, as already mentioned, in association with the lipoids.

Studies of the absorption of light by chlorophyll in the living chloroplast and various solvents,

however, indicate that in the chloroplast it must occur in contact with an aqueous phase. Fig. 6 shows a possible arrangement of the units involved which satisfies all the requirements mentioned, including the association of the chlorophyll with the lipoids as required for fluorescence, and with an aqueous phase as required for light absorption. Moreover, the scheme is quite compatible with the findings of plant physiologists. Although some assert that the chlorophyll is concerned in the reduction of the carbon dioxide molecule, there is much evidence that its function is the capturing of energy from light. There is no stoichiometric relation between the carbon dioxide assimilated and the chlorophyll present, but for the assimilation of one molecule of carbon dioxide some 2,000 molecules of chlorophyll are involved. This number is called the assimilation unit, and it is estimated that even if the suggested layered system is complete within grana of about 0.5μ diameter, every chlorophyll layer might well contain about a hundred assimilation units.

Prof. Baur, of Zurich, has obtained traces of formaldehyde photolytically from carbon dioxide esterified with higher alcohols when brought together with a fluorescent pigment and a redox system. The method has striking parallels with the scheme outlined in Fig. 6. Molecular layers of chlorophyll mixed with cetyl alcohol in molecular proportions of about 1 : 30 were fixed by adsorption on threads of cellulose acetate. This system was dipped in a solution of methylene blue buffered with calcium carbonate, which acted as a redox medium (similar to the small amounts of ascorbic acid or iron compounds in the living chloroplast) in an atmosphere of carbon dioxide. In this system the chlorophyll appears simply to capture light, and may be replaced by other fluorescent dyes. It is important to notice also that the chemical reactions occur in a lipid medium, as, for example, cetyl alcohol. Although Baur's system has an efficiency greatly removed from that of the chloroplast, it offers valuable contributions to fundamental knowledge.

GENERAL CONCLUSIONS

Evidence from chemistry, physics, and botany, indicates that many important constituents of plants are built of 'mixed systems'. The loose reticulum of the cytoplasm is as yet not well understood, but more is known of the cell wall with its 'rodlet mixed system', and the chloroplast with its layered, or 'platelet mixed system'. Such systems are not uncommon in other biological fields. Rodlet structure is found in the framework of chitin, silk fibroin, keratin, collagen tendons,

muscle myosin, etc., and a stratified structure with alternating lipid and protein layers in the sheaths of myelinated nerves, the rod-shaped cells of the retina, and the red blood corpuscles. It is interesting, moreover, to trace a 'linear principle' through chain-molecules, micelles, and fibrils, to fibres in the mechanical tissues, and a 'foliar principle' through molecular layers of pigments associated

with layers of lipoids and proteins, in discoid grana in disk-shaped plastids which are exposed to light in a flattened leaf. The study of morphology must be pursued not simply to the somewhat arbitrary limit of microscopic resolution, but to the molecule, in which any change results in a change in the nature of the material itself.

S. H. CLARKE.

Obituary Notices

Mr. E. H. Richards

IT is with deep regret that we record the death of Eric Hannaford Richards, of the Rothamsted Experimental Station, Herts, which occurred at Bovey Tracey on May 16.

Richards was born on June 28, 1878, at Hanwell, Middlesex, only son of Joseph Peek Richards, medical superintendent of the Middlesex County Asylum in 1867-92, and educated privately. In 1902 he joined the staff of the Royal Commission on Sewage Disposal, working under Dr. George McGowan, and was put in charge of the Commission's large-scale experiments at Dorking on different methods of sewage purification. These were brought to a successful conclusion. In 1909 he was transferred to Belfast to study methods of dealing with the excessive growth of seaweed in Belfast Lough: this was done in association with Prof. Letts of Queen's University. He then returned to Dr. McGowan's laboratory at Ealing, where he remained until 1913.

In that year, the Hon. Rupert Guinness (now Lord Iveagh) decided to arrange for investigations into the possibility of utilising organic waste materials as fertilizers. His experience of the Bagshot sands at Woking had impressed upon him the need for making greater use of organic manure, while the growing tendency to substitute motors for horses was decreasing the supply of the stable manure which had hitherto been the mainstay of market gardeners, potato growers and dairy farmers around London. He saw, therefore, the need for opening up new supplies, and he provided the funds for the Rothamsted Experimental Station to carry out a full investigation. E. H. Richards was chosen for this work, and he fully justified the selection.

For the first few years, in collaboration with me, Richards studied the changes taking place in the making and storing of farmyard manure and showed how the losses occurred, and how also they might be reduced. Information was also obtained about the decomposition processes that occurred during the making and storing of the manure. This side of the work was greatly developed by an investigation made in association with H. B. Hutchinson on the factors determining the rate and extent of the microbiological decomposition of straw. The essential conditions were an adequate supply of nutrients, particularly of nitrogen, which was generally deficient in the straw

itself; not too acid a reaction; and proper supplies of moisture and of air. The important practical result emerged that straw and other vegetable matter could be fairly rapidly decomposed with production of a humus manure by the simple expedient of adding a source of nitrogenous food for the micro-organisms bringing about the decomposition, and ensuring that the heap did not become too acid. The principles of compost-making were thus for the first time set out, and, although others have applied them in various ways, no new fundamental principles have been found.

One method of using the new principles, and the simplest that has yet been devised for use under British of similar conditions, was developed by Adeco, an organization set up for this purpose by Lord Iveagh; it has been so successful that some 100,000 tons of manure are said to be made annually in this way, chiefly by private gardeners and market gardeners in Great Britain and by planters overseas. The method is also used in France for the making of mushroom beds. It is, however, less suitable for farmers, though modifications are from time to time devised which cheapen it.

In recent years Richards was also engaged on an investigation into the purification of effluents from sugar beet factories and milk factories. This was carried out for the Department of Scientific and Industrial Research in association with D. Ward Outler and his colleagues in the Microbiological Department at Rothamsted, and with S. H. Jenkins, who supervised the large-scale experiments, while Richards himself had as collaborator N. W. Barritt. This work led to the discovery of the conditions necessary for decomposition and purification of the effluents, and methods were then devised whereby these conditions could be secured in factory practice. The whole investigation affords an excellent example of successful collaboration of three groups of workers for the solution of a difficult technical problem.

All his life Richards had suffered from a deformity which might have crushed the spirit of a less courageous man. But his spirit was indomitable, and he let nothing stand in the way of the work he had set himself to do. He had perforce to renounce some of the pleasures of life, but he had the satisfaction of gaining in the highest degree the respect and affection of all who were associated with him. He was a loyal

colleague and a considerate supervisor, but as he was insparing of himself so he expected and obtained the best that his associates could contribute to the work they had in hand.

E. J. RUSSELL.

Rev. W. J. O'Leary, S.J.

FATHER W. O'LEARY, S.J., whose death occurred recently, was born in Dublin in 1869, son of Dr. W. O'Leary, M.P., a well-known Home Ruler. After the usual course of study—in Louvain and Dublin—he was occupied chiefly in teaching physics and astronomy in one or other of the Jesuit colleges in Ireland.

Father O'Leary's work on pendulums aroused his interest in seismology, as the result of a visit to Prof. F. Milne's observatory at Shide, I.O.W. He designed a form of inverted pendulum seismometer in which he replaced the suspension suggested by Tchebicheff by one designed by himself. The shaft of the pendulum was supported on a steel plate which was suspended in a concrete pit by three steel wires. The pendulum thus suspended was extremely sensitive and almost unstable. A suitable arrangement of levers and pens traced a record on smooth paper moving on a rotating cylinder. The weight of the 'bob' was one and a half tons. This instrument gives a very wide and clear record. In connexion with this he designed a recording clock on the free pendulum principle. It is of interest that Father O'Leary made and mounted every part of both seismograph and clock himself—with the exception of the castings for the bob. The instrument constructed by him in 1916 is still functioning in the Rathfarnham Castle observatory, and the steel wires have not been replaced. It is the only one of its kind in existence.

On the death of Father Pigot, director of the Riverview College Observatory at Sydney, Father O'Leary was appointed to succeed him in 1929. Until last year he held this post, when he retired, but still continued his work. In addition to his seismological activities, he did valuable work on the observation of variable stars, and designed a special form of blink comparator for this purpose. His work also included observations on solar radiation.

With the exception of a text-book on mechanics and the results of his observations, Father O'Leary published very little. The detailed description of his free pendulum clock, a piece of original and first-class work, awaits publication. It has only been described in the patent specification.

Father O'Leary was a past president of the New South Wales branch of the British Astronomical Association. He was well known to members of the British Association, before whom he preached on more than one occasion. The end came with great suddenness. For some time his heart had been giving him trouble, but this did not interfere with his work, and only the night before he had been working as usual in the observatory. A most kindly and popular man, he will be missed not only as a scientific worker, but still more as a friend.

H. V. GILL.

Sir George Kenrick

BY the death on May 28 of Sir George Kenrick, the educational world has lost a man whose record for public service is remarkable even in a city, Birmingham, which is outstanding in its reputation for the production of leaders in civic work.

Sir George was born in 1850, and after a training as an engineer in the Nettlefold works, he entered the well-known firm of hollow-ware manufacturers founded by his grandfather. At thirty years of age he was elected a member of the Birmingham School Board. He was elected to the City Council in 1903 and was made chairman of the Education Committee, a post which he held for eighteen years. Together with George Dixon, he founded the Birmingham Day Training College for Teachers, giving £5,000 for its endowment. In 1886, as a member of the Council of the Birmingham and Midland Institute, he gave £1,000 towards the equipment of its metallurgical department. When Mr. Joseph Chamberlain announced his scheme for the creation of a University of Birmingham Kenrick subscribed £10,000. He went, with the late Profs. Poynting and Burstell, on a tour of inspection of American universities to acquire first-hand knowledge of the development of engineering departments in the United States with a view to the creation of such a department in the new university. He became chairman of the Building Committee which was responsible for the buildings on the new site at Edgbaston. When the formal opening of the new buildings by King Edward VII was arranged for 1909, it was fitting that George Kenrick should be Lord Mayor, and his services to education were recognized by the King in the conferment of a knighthood. When Mr. Joseph Chamberlain made a second appeal for funds for the University, Sir George again made a donation of £10,000, and in 1914 on the death of Prof. J. H. Poynting he gave £18,000 to endow the Poynting chair of physics.

So far back as 1881, George Kenrick introduced compulsory physical training into the elementary schools of Birmingham—the first attempt made by any school board to introduce physical training as part of the curriculum. Nor did his interest end with the training of the children, for he founded and endowed the Birmingham Athletic Institute for young men and women. He himself was a devotee of outdoor sport—fishing and shooting, cricket, lawn tennis, cycling and walking (even in old age he scorned an overcoat). He was an enthusiastic gardener; and, as a keen entomologist, he had made a fine collection of Lepidoptera in his extensive travels in India and the Americas. He had literary leanings, was specially interested in Shakespeare, and had a fine library.

In disposition, though modest and retiring, Sir George was characterized by quickness of judgment, untiring energy and tenacity of purpose. The city of Birmingham recognized its indebtedness and admiration for his services by conferring on him the highest honour at its disposal, that of an honorary freeman, in 1923. He was unmarried.

G. A. S.

News and Views

Sir Thomas Holland, K.C.S.I., F.R.S.

THE Albert Medal of the Royal Society of Arts for 1939 has been awarded to Sir Thomas H. Holland, "for his services to the mineral industries". Sir Thomas Holland is principal and vice-chancellor of the University of Edinburgh, and in the course of a long and distinguished career has rendered eminent services to industry and industrial research, both at home and in the Empire. Outstanding among the results of his overseas activities is his close connexion with the development of Indian industry, which to-day is based upon the recommendations of the Indian Industrial Commission over which he presided in 1918. He has held many high appointments in institutions connected with science, geology, mining, metallurgy and petroleum, and was chairman of the Council of the Royal Society of Arts during 1925-27. The Albert Medal was instituted in 1862 as a memorial of H.R.H. the Prince Consort, for eighteen years president of the Society, and is awarded annually for "distinguished merit in promoting Arts, Manufactures or Commerce".

Use of Oxygen in Climbing

PROF. YANDRELL HENDERSON's article on "The Last 1,000 ft. on Everest", published in *NATURE* of June 3, p. 921, gives expression to the physiologist's doubts about the possibility of climbing to 29,000 ft. without the use of oxygen. Prof. Henderson attempts the difficult task of analysing the fall in climbing speed with increase in altitude and suggests that it reaches zero at 29,000 ft. If this conclusion is correct, it is folly to attempt the ascent of Mount Everest without oxygen, but mountaineers may answer that information about climbing speeds at great altitudes is too scanty to justify any precise estimate of limiting altitudes and may point out that, so far, climbers have done as well without oxygen as with it. The most compelling argument in favour of the use of oxygen would be the production of a really effective apparatus. On this point Prof. Henderson is emphatic that the so-called open apparatus is valueless and that a closed unit, involving absorption of carbon dioxide, is essential. But in spite of the possible theoretical advantage of the latter type, it has never been successfully used for climbing at high altitudes. The open apparatus, however, as is pointed out in an article on p. 961 of this issue, by a member of last year's Everest expedition, has twice been used with some success. For the future, it is clear that there is ample room for improvement in methods of oxygen administration in climbing. Increase in efficiency of utilization is desirable provided that it does not sacrifice other essential qualities, but another and perhaps easier line of attack is the reduction of weight, by mechanical improvement of valves and cylinders.

Scientific Psychology in France

THE centenary of the birth of Théodule Ribot, and the jubilee of the foundation of the chair of experimental psychology in the Collège de France, of the Laboratory of physiological psychology at the Sorbonne, and of the famous thesis, "*L'Automatisme psychologique*", submitted by Pierre Janet, will be celebrated by a gathering at the Sorbonne on June 22, under the presidency of the Minister of National Education. Among those who will take part will be E. Faval, head of the Collège de France Prof. P. Janet, and Prof. H. Piéron, who succeeded Binet as director of the laboratory at the Sorbonne. A jubilee volume, in which many psychologists are collaborating, is to be published in honour of Ribot, Binet and Janet, who were the pioneers of scientific psychology in France in its chief lines of advance, namely, physiological psychology and laboratory investigations, the study of the child, pathological psychology and the study of mental anomalies. The general principle of the comparative method affirmed by Ribot has dominated the development of scientific psychology in France, and has contributed notably to the application to teaching and to industry of the science of the mind. The secretary of the committee responsible for the commemoration is Prof. H. Piéron, Collège de France, Paris.

Philosophical Approach to Religion

THE sixteenth Unity School was held at Jordans Hostel in Bucks on May 12-15. The general subject was "The Philosophical Approach to Religion", and an address introducing the subject was given by Mr. F. S. Marvin on the evening of May 12, when he reaffirmed his belief in positivism, possibly modified in certain aspects to relate it to certain more recent ideas. In the discussion, Lord Samuel put forward a view involving in one aspect the idea of causality leading to a creator God. On May 13, Dr. Helen Wodehouse, Mistress of Gorton, in an address characterized by beauty of expression, introduced the question of what is the philosophical approach to religion. The discussion was opened by Prof. J. H. Muirhead, and the Rev. J. H. Brittain contributed some remarks on the historical element in current religion. Prof. John MacMurray gave a stimulating discourse in opening a session on "Religion as the Basis of Reality" and sought to find the essence of religion in personal relationship. He also made some comments on the differences between the scientific and the religious attitudes; discussion of this subject was continued on May 14, when Dr. C. H. Deech spoke on the effect of the development of science on religion. In a concluding address on the future prospects of religion, Prof. Harvey considered a number of factors that have to be taken into account, and put forward some tentative conclusions. Though

the discussions sometimes seemed to show difference rather than unity of opinion, at the last meeting it was felt that there was common agreement in rejecting the objects of devotion put forward by the military States and in seeking to unite men to serve some worthier purpose, which has been known by various names. Valuable interludes were provided by Dr. R. N. Salaman, who spoke on the Society for the Protection of Science and Learning, and by Mrs. Beer, who described a recent visit to Germany and Austria. Further information on the Unity Schools can be obtained from Mr. F. S. Marvin, Pantiles, Coneydale, Welwyn Garden City, Herts.

Experimental Work on A.R.P.

DR. R. E. STRADLING, chief adviser for research and experiment, A.R.P. Department, Home Office, delivered the first of three lectures arranged by the Institution of Civil Engineers on air raid precautions. After referring to the creation some months ago of the special Research Branch of the A.R.P. Department of the Home Office, and to the recent appointment of a Civil Defence Research Committee under the chairmanship of Dr. E. V. Appleton, which would ensure that the full resources of the scientific world would be enlisted in the services of that section of Government activity, Dr. Stradling dealt with the question of protection from the effects of the high-explosive bomb. On detonation, a very high pressure is produced which causes the metal case to expand to possibly one and a half times its original size and then burst into fragments. In addition to the formation of splinters, the expanding gases have two effects: actual movement of gas giving the effect of a very 'high wind', and a wave sent out through the air which is similar to a sound wave. The first effect causes major destruction on a surprisingly local scale; about 30 feet from a large bomb, the effect has practically disappeared. Outside that zone the acoustic type of wave can spread a very long distance. Its effects on a structure can be disastrous, but more especially on those portions which have a high natural frequency, such as windows and the like. Experiments show that the effect is dependent upon the structure itself, as well as upon the form of the wave. Due to the adoption of basements as shelters, the question of earth movements around an exploding bomb is also of importance. There is a zone around the bomb in which few normal structures can be expected to stand, but it is very limited in extent. The wave which is effective at longer distances is somewhat similar to a very slight earthquake and has little effect upon a normal building. Further lectures in the series will be given by Colonel F. J. Wyatt, on camouflage, on June 12; by D. Anderson, on the design of bomb-proof shelters, on June 20; and by Brigadier C. A. Bird, on the work of the military engineer in war, on June 27.

Roman Frontiers in the East

SIR AUREL STEIN has recently completed a survey of the boundary line of the ancient frontier of the Roman Empire in Iraq and Transjordan. This is

a part of a projected survey of the eastern frontier of the Empire, of which the Syrian section, with which Sir Aurel Stein's work connects, has been surveyed by Father Poidebard. Sir Aurel Stein's expedition was supported by the British Academy and the Society of Antiquaries of London and carried out with the co-operation of the Royal Air Force and the Iraq Petroleum Company. In a summary account of the survey (*The Times*, June 1) Sir Aurel states that he traced the line of forts along the south and north sides of the Jebel Sinjar. Between Nisibin and Mosul he found the old defences, which had commanded the road of invasion between Mesopotamia and northern Syria. Turning thence to Kirkuk, he visited and determined to his satisfaction the exact site of the battle of Arbela in Alexander's campaign, and along the middle Euphrates had made the remarkable discovery of a comparatively well-preserved castle, which was clearly Roman, and had at its side a barrage, which bore the stamp of Roman work. This affords evidence of the protection given to the trade route so far down as central Mesopotamia, possibly in the reign of Septimius Severus. The Roman track was traceable from the air and in places even on the ground. The last month of survey work covered the Via Nova, constructed in the reign of Trajan from the port of Aqaba on the Red Sea to Petra and the great centres of Syria. This route has now been determined and mapped for a distance of about 120 miles. Several old Roman milestones, from which the inscriptions had almost disappeared, were found in the Wadi Yitm. The distances between the milestones is remarkably accurate. Thence the road climbs to the top of the chain of mountains above the rift valley of the Wadi-el-Arabah, south of the Dead Sea, and follows the line of cleavage to Petra.

Finds from British Bronze Age Barrows

FINDS from the recent excavation of two bronze age round barrows, one at Stockbridge Down, Hampshire, and one at Reffley Wood, King's Lynn, Norfolk, are now on exhibition in the Prehistoric Saloon of the British Museum (Bloomsbury). Both barrows belong to the Early Bronze Age and date from about 1700 B.C. The Hampshire barrow was excavated by Dr. N. Gray Hill, and that at Reffley Wood by Mr. P. L. K. Schwabe and Mr. I. J. Thatcher. While the sites exemplify the two types of ground on which such barrows are found, namely, chalk down and sandy heath, in their characteristics they exhibit a striking similarity. In each the body had been laid approximately in the centre in the contracted position and accompanied by earthenware beakers. At Stockbridge the skeleton was in a remarkably good state of preservation and was accompanied by an almost intact beaker, but at Reffley Wood the skeleton had disappeared and no complete beaker was found, although the whole area under the mound was strewn with fragments. At both sites there were secondary interments in the mound, belonging to the later period of the Middle Bronze Age about 1400 B.C., when cremation was

practised. In both barrows examples of the small segmented Egyptian faience beads were associated with the secondary burials. About eighty finds of Egyptian beads have now been made in Britain. The segmented type occurs in Egypt in the Eighteenth Dynasty from about 1800 B.C. onward, and is especially abundant at Tell el-Amarna (1380-50 B.C.). These beads have also been found in Hungary, Moravia, and Holland, and are thought to have reached Britain through Greece, travelling across Europe along the amber trade-route.

Journal of Endocrinology

A new journal, to be devoted to endocrinological subjects, under the title *Journal of Endocrinology*, has recently been founded. Its scope will be the publication of communications which advance knowledge concerning the internally secreting glands, the mode of their actions, the nature of their secretions, and the disorders of their functions. It is hoped that strong support will be given by contributors from abroad. There may be some who question the desirability of any step which might seem to accentuate the division of the field of medical and biological sciences into specialised departments and groups, but there can be little doubt as to the necessity for this new journal. The large and rapidly increasing amount of work on endocrinology published by British investigators, and the lack, hitherto, of a British journal specifically devoted to this subject, has led to the overcrowding of journals having other and more general interests. As a result, there has been increasing difficulty for endocrinologists who have work to publish, as well as for those who need ready access to the published work in this field. The foundation of this new journal was preceded by consultation with the editorial boards of a large number of journals, and it is significant that, without exception, these boards were in favour of the project. The control of the journal is vested in a Council of Management, and it will be edited by Prof. E. C. Dodds, who will be assisted by an editorial board consisting of Dr. P. M. F. Bishop, Prof. C. R. Harington, Prof. G. F. Marrian, Dr. A. S. Parkes, Dr. F. G. Young, and Dr. S. Zuckerman. Dr. R. L. Noble has been appointed as assistant editor. The journal will be published, in the first place, four times a year, and the subscription is 30s. or six dollars. The first number is due to appear during this month.

Society of Rheology

THE Society of Rheology was founded in 1929 to further the study of the deformation and flow of matter in the broadest sense. The tenth annual meeting was held at the end of last year. At the banquet it was pointed out that expenses were not being met, and a discussion took place on the status of the Society and its publications programme. The policy favoured, almost unanimously, was to continue publication of the *Rheology Leaflet* and to enlarge it to include invitation review papers, while ordinary research papers would be published, as at present, in the *Journal of Applied Physics*. It was agreed that abstracts and bibliographies should be limited to

those covering specific topics (not specified in the report) and that no attempt should be made at any complete covering of rheological literature. The co-operation of members was sought for increasing membership, but it was not mentioned how far this drive was to be international. The obvious method of circularising authors of papers on rheological subjects, which does not seem to have been carried out in the past, was not mentioned. Rheology is one of those fields which include several sciences—physics, chemistry and physical chemistry and, of late years, biology. Its importance and scope are only now beginning to be generally recognised. Given the necessary increase of support, the Society should then fulfil a very useful function. It would be especially valuable if its finances reached the point where it became possible to list (without full abstracting) all papers bearing on the subject. Now the Society is staking its reserves on the drive for increased membership in such manner that they will be exhausted in two years if the drive fails. It is to be hoped that the Society will receive the required support. Those interested should apply to the American Institute of Physics, 175 Fifth Avenue, New York. The subscription for associate members, who will receive the *Rheology Leaflet*, is 2.50 dollars.

University of Minnesota Hydraulic Laboratory

IN *Engineering* of May 26 is an illustrated article on the large hydraulic laboratory recently completed on the Mississippi River at St. Anthony Falls, Minneapolis, for the University of Minnesota. The laboratory is on Hennepin Island, which is joined to the banks of the river by a dam constructed for the purpose of power development at the falls, and it is designed to operate practically entirely by water diverted above the falls. There is a natural drop of fifty feet and the laboratory can handle for experimental purposes rates of flow in excess of 300 cusecs. Flows up to this amount can be accurately measured by volumetric basins. The laboratory consists of five units, namely, the main experimental laboratory, the hydraulic machinery and pump laboratory, the turbine testing laboratory, the large-scale volumetric tanks, and the lecture room and administration rooms. In the first of these units is a river model section where at present there is under construction a working model, 160 ft. long and 36 ft. wide, of the Mississippi in the vicinity of St. Anthony Falls. The lecture room has been arranged so that large quantities of water can be handled readily at the platform. Below the platform runs the main overhead supply flume of the laboratory, while above it is a head control room containing a constant-level reservoir situated in the tower above the auditorium. The experimental flume which runs through the main laboratory can be used for experiments with ship models.

Improvements in Submarine Telephony in 1938

IN the *Engineering Supplement* to the *Siemens Magazine* of May, an account is given of three submarine cables laid last year to the order of the

British Post Office and manufactured by Submarine Cables, Ltd. The first is an additional cable between Nevin (North Wales) and Howth (Eire). The second connects Dartmouth (Devonshire) and Guernsey and the third is laid between Guernsey and Jersey. The cables are of the concentric type insulated by paraffin and, with the exception of the sheathing, which is made suitable to the conditions prevailing round the British Isles, are similar to the cable laid three years ago from Australia across the Bass Strait. The *C.S. Foraday* left Greenwich in July 1938 carrying the Anglo-Eire and the two Channel Islands cables, weighing in all 1,440 tons. When the cable had been laid for ten miles from Nevin, a dense fog came on which completely obscured the buoys marking the course, but nevertheless the ship proceeded on its course and luckily sighted a marked buoy when the fog cleared. The submarine cables are operated by two carrier frequency systems the terminals of which are at Dublin and Nevin, with intermediate repeaters at Howth. The two concentric cables carry eighteen telegraph and fifteen telephone circuits. The laying of the Channel Islands cables presented little difficulty. A single core cable, which had formerly been part of an Atlantic telegraph cable, was relaid in 1914 between Compass Cove, near Dartmouth and Plemont, Jersey. In 1931 this was diverted into Saints Bay, Guernsey, to provide a telephone channel between England and Guernsey. The new cables provide two telephone circuits between England and Guernsey, and six telephone circuits between England and Jersey.

Progress of the Grid

THE report of the Central Electricity Board for the year 1938 is very satisfactory, although there was a slight reduction in the rate of increase at which electric power is being generated. For the first time since 1932, this rate of increase fell below 10 per cent per annum. The aggregate production is still substantially in excess of the estimates adopted by the Board and those made by the commissioners when planning the various grid schemes. The total output of electricity from public supply stations was 24,400 million units, an increase of nearly 1,500 million units over the previous year. Apparently the stimulus provided by the re-armament programme made up for the loss in demand of the shipbuilding, textile and other industries. At the end of 1938, the grid comprised 4,378 miles of transmission lines, nearly 3,000 miles of which operated at 132 kilovolts, the remainder operating at 66 kilovolts or less. The number of selected stations remained constant at 137 and their total installed capacity was more than 8½ million kilowatts. During the year, the Board investigated special air raid precautions. It was decided to provide a pool of switchgear, transformers and other equipment, which could readily be made available to replace, temporarily, apparatus that might be damaged. The research work into surges, defective lightning arresters and other troubles arising from atmospheric effects was continued throughout the year. Alterations were also made on switchgear

so as to increase their rupturing capacity. The average cost of fuel per ton was 14s. 9d. in 1937 and 20s. 3d. in 1938. This increased cost of fuel more than counterbalanced the benefits which would otherwise have accrued to electricity consumers from the improved efficiency of generation.

Electric Development in South Africa

THE rapid economic development of South Africa during the last twenty years is illustrated by the remarkable growth that has taken place in the development of electricity both for industrial and domestic purposes. The extent to which the Union of South Africa is electrified is shown by the sales of electrical energy being 1,670 units per head of population per annum (excluding natives). This figure is twice that for the United States of America and nearly four times the corresponding figure for Great Britain. In a paper on "South African Activity" by H. A. Eastman, published in the *Electrical Review* for June 2, some of the reasons for this rapid and continuing growth are given. Three fifths of the total demand for electricity is due to the requirements for gold mining purposes. When the numerous mines in process of development are brought to the production stage, this will be greatly increased. The use of electricity for other industries and for domestic purposes is also increasing. The average price received by the generating stations is 0.6d. per unit. The Electricity Act which came into force in 1922 provided for the establishment of an Electricity Control Board, which is the licensing and controlling authority for all private electricity undertakings. It also controls the Electricity Supply Commission, the members of which are appointed by the Government, but which, nevertheless, is free from parliamentary control. The Electricity Supply Commission operates its undertakings at neither a profit nor a loss and adjusts its charges accordingly. Other licensees are required to refund each year to their consumers, *pro rata* to their payments, 25 per cent of the surplus profits of the undertaking for that year.

Baking Quality Tests for Flour

IN 1934 the Imperial Bureau of Plant Breeding and Genetics published its first bibliography of papers on baking quality tests, which was an immediate success, and in a new supplement recently issued (Imperial Bureau of Plant Breeding and Genetics. Bibliography of Baking Quality Tests, Supplement. Pp. 32. Cambridge: School of Agriculture, 1939. 1s. 6d.) the Bureau has fully maintained the high standard it set itself in the earlier publication. A list of more than three hundred and thirty titles to original papers is given here, set out in alphabetical order. The list is remarkably complete and no really important communication appears to have been overlooked. One excellent feature of this bibliography which greatly commends it is the translation of the titles of the foreign publications into English. At the present time, extensive investigations are being made in Great Britain and abroad on the physical

properties of dough and its connexion with the baking quality of flour. The baking test, as such, has admittedly many disadvantages, and it is the ultimate aim of workers in this field to supplement the baking test by some other and better standard, and the Imperial Bureau of Plant Breeding and Genetics has rendered a most useful service to those engaged in this particular line of investigation by the publication of this supplement. The bibliography shows almost at a glance where further information may be obtained of what is being done in this highly important and interesting field.

Predatory Birds and their Economic Status

THE British Field Sports Society is pursuing an enlightened policy in endeavouring to educate gamekeepers and others in the identification of predatory birds and in recognising the economic standing of each species, so that only those seriously harmful to game and other wild birds should be destroyed. In a foreword to a pamphlet of 83 pages, just published by the Society and entitled "Predatory Birds of Great Britain" (price 2s. post free), an appeal is made to gamekeepers and their employers to see that the law regarding the protection of such birds is known and enforced, and the knowledge is made easy by lists embodied in the pamphlet showing the amount of protection given in each British country to each predatory bird. The main part of the pamphlet, by Eric Parker, consists of short descriptions of the birds themselves, with illustrations by G. E. Lodge, and brief notes upon range and feeding habits. The last set out very fairly the main character of the birds' food, though we note that the little owl is condemned, contrary to the findings of the Report of the British Trust for Ornithology, that the author does not realize that the damage done by rooks depends not so much upon their numbers as upon the kind of farming where they occur, and that the black-headed gull in Scotland is condemned on the strength of one opinion for its destruction of eggs and young birds. That is an opinion not shared on balance by Scottish county councils, which, by the way, obtain county orders from the Secretary of State for Scotland and not from the Home Secretary.

Agricultural Progress

THE current issue of *Agricultural Progress* (16, Pt. 1, 2s. 6d.), the official organ of the Agricultural Education Association, which is the most influential body of agricultural teachers and research workers in Great Britain, contains much interesting and instructive matter. The early days and later growth of the South-Eastern Agricultural College at Wye are described in the series dealing with the development of agricultural educational and research institutions, whilst the articles on the teaching of agriculture in schools, county instruction in farm machinery, and the educational value of tours for agricultural students, afford evidence of the real advances that are taking place at the present day on the practical side. Two particularly important topics are very fully dealt with. Mastitis disease, which causes

serious losses to the milk industry, is discussed from the point of view of the veterinary surgeon, the cheesemaker and the bacteriologist. Methods of field laboratory diagnosis are explained. The other subject is afforestation, and while one author backs up his protest against the afforestation of farm-land with numerous examples of the way in which the Forestry Commission has operated in Suffolk, one of the Forestry Commissioners puts forward the other side of the case. Other articles deal with such matters as the foot-rot diseases in cereals, manganese deficiency in relation to soils and crops, and the separation and analysis of soil clay fractions. A considerable space is devoted to book reviews. *Agricultural Progress* will in future be published twice yearly, in February and September.

Higher Education in Belgium

THE "Fondation Universitaire" was created in 1919 with funds appropriated from the final closing balance of the Commission for Relief in Belgium, of which Mr. Herbert Hoover was president. Last year Mr. Hoover accepted a joint invitation from the Fondation and the universities of Belgium to visit that country, and the occasion was marked by eloquent expressions by representatives of Belgian higher education of their sense of its indebtedness to him and to the United States and the value of the consequent cultural relations between the two countries. One of the principal functions of the Fondation is to make higher education available to poor students by means of loans, generally of 1,500-4,000 francs a year. The Fondation relies for the recovery of the loans on the sense of honour of the recipients. That this confidence is not misplaced is strikingly shown in its recently published annual report by a chart exhibiting the amounts of loans granted and refunds received from 1919 until 1938. In recent years the receipts have equalled or exceeded the grants, the annual total being in the neighbourhood of 800,000 francs. The Fondation's resources are also used for encouraging Belgian students, by means of bursaries, to study abroad, for subsidizing publications and scientific societies, for promoting international exchanges between professors and, since 1936, for the maintenance of a Bureau of University Statistics in which has been merged a commission for the study of overcrowding of the universities and unemployment of 'intellectuals'. This body has formulated recommendations for reforming the content of primary and secondary education, making more stringent the tests for promotion from one class to another, for determining what a secondary school-leaving certificate should imply and for restricting to persons intellectually fit for them admission to institutions of university rank.

The Czechoslovak Research Council

THAT the leaders of science in Czechoslovakia have made every endeavour to continue scientific investigations during the past fateful year is indicated by the fifteenth annual report of their National Research Council. At the annual general meeting in March,

Prof. B. Némec referred to the interruption of scientific work occasioned by the country's loss of territory and institutions. Research activities were therefore upon a restricted basis though, he emphasized, it is necessary for a small nation to maintain its cultural activities at the highest possible level. He urged that renewed efforts be made to utilize all the country's remaining scientific institutions and resources for the continuance of all programmes of research. Dr. Ulrich, secretary of the Council, stated that donations were received from industries, corporations and private individuals so that as many students as funds permitted are being supported in the continuance of their work. Investigations in all branches of the natural sciences are still in progress at the universities and at approved institutes. This report also contains a brief account of work completed during the past year by research workers supported by the National Research Council, and the hope may be expressed that it will now continue uninterrupted by further disturbances.

Medical Research in India

SUMMARIES of some of the medical research work in progress in India are contained in the annual reports of the Indian Institute for Medical Research, Calcutta, and of the Haffkine Institute, Bombay, recently issued. In the former, studies on the cholera vibrio and production and therapeutic value of an anti-cholera serum, and on an anti-typhoid serum, have been pursued. Researches on malaria and kala-azar, and the problem of a nutritional survey of Indian food-stuffs and dietaries, have also been undertaken. The Haffkine Institute is the centre for the preparation of anti-plague vaccine, of which more than thirteen million doses were issued during 1937, and work is in progress to improve the efficiency of this vaccine. A survey of the rat population of Bombay in connexion with the epidemiology of plague brings out the interesting fact that the brown and black rats, forming 70 per cent of the rat population of the city, are now highly resistant to plague, though formerly highly susceptible. In the Anti-Rabic Department, more than three thousand cases were treated, with a mortality of 0.08 per cent.

Division of the Circle

In the *Askania Review*, the journal of the Askania-Werke A.G. of Berlin, the well-known makers of instruments, there is an interesting and instructive article on 'The Divisions of the Circle'. It is pointed out that all topographic services of the Reich are adopting the division of the circle into 400 grades instead of 360 degrees. A history of the adoption of these units is given. The Babylonians knew that the sun completes the zodiac once within 360 days approximately, so that 1° is approximately the sun's daily travel. The adoption of 360° is advantageous inasmuch as the figure is readily divisible by 2, 3, 4, 5, 6, 8, 10, 12, etc. The resulting arcs of the circle or the angles of 180° , 120° , 90° , 72° , 60° , 45° , 36° , 30° , etc., are of great importance in connexion with regular diagrams as well as in technique. Since the absolute angular unit defines the angle by the

ratio of the arc length to the radius, it has no 'physical' dimensions. In Germany, therefore, it is not given any special name. In other Anglo-Saxon countries it is usually called the 'radian'.

Medical Supervision of University Students

In his inaugural thesis (*Thèse de Paris*, No. 136; 1939), Dr. L. Katz maintains that there is an increasing tendency in modern universities not only to provide a professional centre for students but also to supervise their mode of life, work and health, so that they can pursue their studies under the best conditions. It is in the United States that the oldest and most important university health centres have been founded, the object of which is threefold, namely: (1) to provide the students with a personal medical service including medical examination on joining, medical supervision in the course of their studies and sometimes in the treatment of illness, and medical supervision of sport; (2) to supply all students with an elementary knowledge of hygiene; and (3) to insure a hygienic condition of the universities and the life and work of the students. In European countries a similar movement is on foot, though it has not reached the same development as in the United States. The medical centres in European universities, especially in France, confine their activities to prevention and education.

The Nations and Child Welfare

THE Child Welfare Information Centre of the League of Nations has issued a "Summary of the Legislative and Administrative Series of Documents" received and published in 1938 (League of Nations Pamphlet, 4, 1; 1939. London: Allen and Unwin, Ltd., 1s.). This summarizes the principal administrative measures taken or enacted by Governments all over the world, and the progress made in the different countries in the sphere of maternal and child welfare, and of the training and status of social workers specializing in that sphere.

Conference on Spectroscopy

THE seventh spectroscopy conference will be held at the George Eastman Research Laboratories of the Massachusetts Institute of Technology during July 17-19. Papers and discussions on analysis of material by the emission spectrum, absorption spectrophotometry, photographic photometry, biological and chemical effects of spectral radiation, and industrial applications of spectroscopy, are being prepared. Copies of the detailed programme of the conference will be sent on request to anyone interested, but as the attendance at the conference is limited to two hundred, those expecting to attend from a distance are urged to signify in advance their intention of being present. No fee is charged. The usual summer courses on practical and applied spectroscopy will be offered at the Institute during June 12-July 22. Further information can be obtained from Prof. George R. Harrison, Department of Physics, Massachusetts Institute of Technology, Cambridge, Mass.

Earthquake in Greece

ACCORDING to a *Times* message, a severe earthquake was felt on Wednesday, May 31, with most damage being done near Kalavryta, about midway between Patras and Corinth on the Island of Morea in the south of Greece. The epicentre appears to have been near lat. $38^{\circ} 1' N.$, long. $22^{\circ} 8' E.$ Earthquakes are not uncommon in Greece though some areas are more seismic than others. Recently earthquakes appear to have occurred mostly near Chalcis, north of Athens, but the present shock may indicate that seismicity has again moved south. There is apparently a seismic zone stretching in an east-west direction across Greece and passing through the present epicentre, for Davison noted 306 shocks during 1896 near the Island of Zante, and there was a very severe shock near Corinth on April 22, 1928. Miss Bellamy has also recorded 27 distinct shocks from epicentres between lat. $37.5^{\circ} N.$ and $38.5^{\circ} N.$, long. $21.5^{\circ} E.$ and $23.2^{\circ} E.$, during the years 1913-30. In the present instance, a considerable amount of damage was done to property at Kalavryta, but no casualties are reported.

Comets

COMET PONS-WINNECKE (1939 c) is rapidly approaching the earth and will soon be visible in a small telescope. An ephemeris is given below from which it will be seen that the nearest approach to the earth will be about July 3, when it will be a little more than 10 million miles away. Towards the end of June it will be close to the moon and will probably be difficult to see as the moon will then be near the full.

	α 1950-0	δ 1950-0	r	Δ
June 13	15h. 16.3m.	$34^{\circ} 33'$	1.112	0.201
20	31.7	21 24	1.103	0.154
30	06.6	11 06	1.105	0.117
July 2	16.6	19 26		
4	25.1	27 37		
6	40.6	35 18	1.114	0.119

Dr. M. Davidson and also Dr. E. Bucher have computed a general orbit for Comet Jurlof-Ashmarof-Hassel (1939 d). It is now established that it has a long period, probably several hundred years.

Announcements

A JOINT meeting of the Division for the Social and International Relations of Science of the British Association and the Manchester Literary and Philosophical Society will be held in the Physics Department of the University of Manchester on June 21, beginning at 11 a.m. Sir Richard Gregory will give an introductory address on "The Aims of the Division", and will be followed by Prof. H. Levy, who will deliver the Alexander Pedler Memorial Lecture on "Social Relations of Science: Principles and Methods of Analysis". In the afternoon, an old-established industry and a new industry which has arisen out of scientific research will be discussed. Dr. F. C. Toy will speak on "The Influence of Science on the Cotton Industry", and Dr. V. E. Yarsley and Mr. E. G. Couzens will speak on "The Plastics Industry". Admission to the meetings will be free without ticket.

THE new buildings of the Department of Glass Technology of the University of Sheffield will be opened by the Right Hon. Lord Riverdale, chairman of the Advisory Council for Scientific and Industrial Research, on June 12.

At a meeting of the General Council of the British Standards Institution held on May 9 Sir Percy Ashley, formerly secretary and now a member of the Import Duties Advisory Committee, was elected chairman of the Institution for the ensuing year. The annual general meeting will be held at the Dorchester Hotel, Park Lane, W.1, on June 15 at 11.15 a.m.

THE Imperial German Academy at Halle, has awarded the Cothenius Medal to Dr. Alfred Vogt, professor of ophthalmology at Zurich, for his pioneer work in certain branches of his speciality.

DR. RAJCHMAN, director of the Section of Hygiene of the League of Nations since 1921, has retired and has been succeeded by Dr. Gautier of Geneva.

THE DECHEMA, the German Chemical Engineering Society, has removed its offices (Dechema-, Achema- and Standard-office) from Berlin to Frankfurt a.M., Dechema-Haus, Bismarckallee 25. A branch office will remain in Berlin, Haus des Vereins Deutscher Chemiker, Potsdamer Str. 111, Berlin W 35.

THE Mullard Wireless Service Co., Ltd., of 221 Tottenham Court Road, W.1, has sent us a leaflet describing a new Mullard cathode ray tube unit. This unit employs a high-vacuum cathode ray tube with four deflection plates. Owing to the reduction of plate and stray wiring capacities to a minimum, it is suitable for use at all frequencies up to those corresponding to ultra-short radio waves.

AN arrangement has been concluded whereby Johnson, Matthey and Co., Ltd., have acquired a controlling interest in Mallory Metallurgical Products Ltd., and the offices of this company have been removed to those of Johnson, Matthey and Co., Ltd., 78, Hatton Garden, E.C.1. A new factory is being erected at Wembley for the production of the Mallory range of Elkonites and copper alloys for use as electrical contacts, switchgear components and resistance welding electrodes. Dr. L. B. Hunt continues to act as technical manager of the company.

THE Cambridge University Press is about to publish a book by Dr. Lewis F. Richardson entitled "Generalised Foreign Politics". This is a more complete version of Dr. Richardson's address to the British Association last year, in which he applied mathematical methods to problems of international relations.

ERRATUM. In NATURE of May 27, p. 885, col. 2, line 16, for "square centimetre" read "square metre".

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 985.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The F_2 Region as an Indicating Mechanism for Solar Activity

THE fact that F_2 region critical frequencies and solar activity correlate in a general way is well known. Moreover, I have shown¹ that the effect of changes in ionization which occur throughout the year can be eliminated in such a way as to bring out a clear-cut correspondence between these critical frequencies and smoothed average sunspot numbers. In an effort to find a more sensitive index for correlation purposes, a study has been made using both whole disk and central zone character figures for calcium and hydrogen flocculi as well as relative sunspot numbers. It has been found that the central zone indexes are better than those for the whole disk. When the monthly averages of the character figures for calcium flocculi are used, it is found that no smoothing is necessary, provided the effect of changes that occur throughout the year is eliminated.

The data used in this study consisted of monthly average values of the central zone character figures for calcium flocculi, and the monthly average for undisturbed days of the critical frequency values, giving equal weight to all hours of the day. The calcium character figures were obtained from the bulletins of the International Astronomical Union, while the radio data for Washington, D.C., have been published by the National Bureau of Standards in

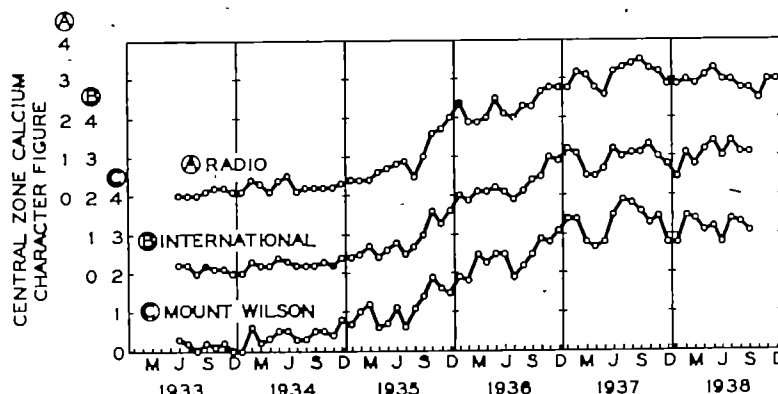


Fig. 2.

CENTRAL ZONE CHARACTER FIGURES BASED ON OBSERVATIONS OF CALCIUM FLOCCULI AND RADIO MEASUREMENTS.

various issues of the *Proceedings of the Institute of Radio Engineers*.

The radio data show a progressive variation from one month to the next during periods of constant solar activity. This variation may be separated from that due to solar activity by plotting the data for each of the twelve months separately. This is done in Fig. 1, where for each month the radio data are plotted against the character figure for that month.

Having obtained the straight lines of Fig. 1, we now use these curves and the radio data to obtain a radio character figure for solar activity. This character figure is plotted in Fig. 2 along with the calcium figures for: (1) the average of several observatories (international) and (2) the value obtained at Mt. Wilson. It is seen that the general trend of all three curves is substantially the same. The curves for the Mt. Wilson data and the radio data indicate a maximum in 1937, while the middle curve indicates a less pronounced maximum for 1938. In this respect the curves for Mt. Wilson data and the radio data are alike. In general, it may be concluded that the radio data give a reasonably good measure of solar activity.

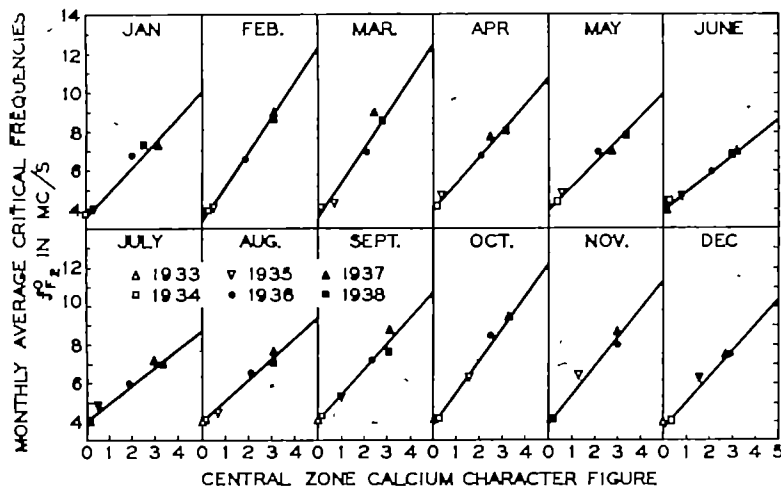


Fig. 1.

MONTHLY CORRELATION CHARTS: AVERAGE CRITICAL FREQUENCIES AND CENTRAL ZONE CALCIUM CHARACTER FIGURES.

From one point of view we may regard the F_2 region of the ionosphere as an indicating mechanism for solar activity. In the case of the character figures, the calcium flocculi observations are made directly in the sunlight. In the case of the radio observations, the solar effect causes the ionization of the F_2 region and the measurements are

made by observing the critical frequencies of this region. Since the critical frequencies are a measure of the ionization, it is seen that this whole process is merely a different way of measuring solar activity. Of course we would not be justified in using this method if other factors entered in such a way as to confuse the result. It is believed that the correlation results shown in this note indicate that other factors, if present, can be ignored, at least to the first approximation.

From the point of view of the ionosphere, there are a number of interesting points which for completeness should be discussed. Limitation of space, however, requires that this phase of the subject be discussed elsewhere. It may be pointed out, however, that for constant solar activity at other times than at minimum activity, the monthly average critical frequencies have two maxima, one in February-March and one in October. This may be seen in Fig. 1. A similar effect is well known for magnetic activity:

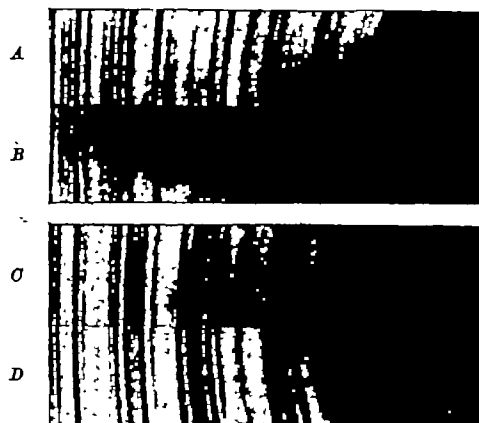
W. M. GOODALL.

Bell Telephone Laboratories,
Deal, N.J.
March 31.

¹ "On the Ionization of the F_2 Region." *Proc. Inst. Radio Eng.*, 26, Nov. 1937.

Position occupied by the Activator in Impurity-activated Phosphors

ALTHOUGH it is often assumed that the activator in impurity-activated phosphors is in solid solution in the matrix of the material, direct evidence of this



X-RAY PATTERNS OF ZINC ORTHOSILICATE (A) PURE, AND (B) CONTAINING MANGANESE; CALCIUM TUNGSTATE (C) PURE, AND (D) CONTAINING LEAD.

has hitherto been lacking. Recently, G. R. Fonda¹, in a general paper on fluorescence, mentions briefly that he has found an expansion of the lattice due to manganese in the case of zinc orthosilicate, but gives no experimental details.

During the past twelve months, we have investigated an extensive range of impurity phosphors by the X-ray method and have been able to demonstrate in several cases a measurable change in the lattice dimensions of the matrix material due to the presence of the activator. Among the phosphors for which lattice changes have been detected may be mentioned zinc beryllium orthosilicate, calcium tungstate and zinc orthosilicate.

The X-ray patterns were taken in a 10 cm. diameter diffraction camera of the type described by Bradley

and Jay², with knife edges arranged to cast a shadow at an angle of 170° . A and B in the accompanying reproduction illustrate the difference between pure zinc orthosilicate and a zinc orthosilicate containing $2\frac{1}{2}$ per cent manganese by weight added as manganese nitrate. The displacement of the lines away from the knife edge shadow from the positions for the pure material, corresponding to a lattice expansion will be noted. The magnitude of the lattice expansion can be seen from the accompanying table, in which the interplanar spacings for two or three lines at the high diffraction angle end of the X-ray patterns for three different percentages of manganese are recorded. It is clear that this is the kind of lattice change that be expected from the replacement of zinc atoms by manganese atoms, and the activated phosphor can be regarded as a solid solution of manganese orthosilicate and zinc orthosilicate.

INTERPLANAR SPACINGS NEAR DIFFRACTION ANGLE 85° FOR ZINC ORTHOSILICATE ACTIVATED BY VARIOUS PERCENTAGES OF MANGANESE (COPPER $K\alpha$ RADIATION).

Copper $K\alpha$ radiation	0% manganese	1% manganese	$2\frac{1}{2}$ % manganese
a_1	0.7723 ₂	0.7738 ₂	0.7783 ₂
$a_1 a_2$	0.7739 ₂	0.7745 ₂	0.7753 ₂
$a_1 a_3$ (mean)	0.7867 ₂	0.7873 ₂	0.7878 ₂
$a_1 a_4$ (mean)	0.7911 ₂	0.7917 ₂	0.7923 ₂

Calcium tungstate is representative of a class of phosphor in which the deliberate introduction of an activator is not essential for the production of luminescence. Lead is, however, sometimes used as an activator in calcium tungstate, the effect being to shift the centre of gravity of the fluorescent bands towards longer wave-lengths. The X-ray pattern in C and D clearly show the solid solution effect in the case of calcium tungstate activated by approximately 3 per cent by weight of lead.

It is hoped to publish the results in more detail elsewhere.

H. G. JENKINS.
A. H. McKEAG.
H. P. ROOKSBY.

Research Laboratories,
General Electric Company, Ltd.,
Wembley.
April 20.

¹ *Trans. Inst. Elec. Eng.*, 57, 677 (1938).

² *Proc. Phys. Soc.*, 44, 563 (1932).

Luminescence and Photoconductivity of Solids

WHEN ultra-violet radiation is absorbed by atoms in a solid, one of two things may happen. Electrons may be freed from the parent atoms or impurity centres, in which case these electrons are able to take part in conduction processes and are said to be in the conduction band. On the simplest view, it follows from this that photoconduction is to be associated with a hyperbolic decay law. On the other hand, electrons may be raised to states lying below the conduction band, in which case the electrons are still bound to the parent atoms and are unable to take part in conduction. Electrons in this condition are said to be in excitation states, and the phosphorescence decay law should then be exponential.

We have carried out measurements on the photoconductivity and phosphorescence decay curves of a large number of luminescent solids, and from the results have obtained direct evidence of excitation

states in uranyl salts and tungstates, and also in a number of impurity compounds activated by manganese and chromium.

Uranyl salts, as was to be expected, show no photoconductivity, and the exponential phosphorescence decay curves are in agreement with the idea¹ that the luminescence of these salts is a result of the absorption of energy within the co-ordination group of the uranyl ion.

The tungstates of calcium, magnesium and zinc do not show photoconduction under radiations giving rise to strong fluorescence. This new fact, together with the exponential decay², supports the suggestion that the luminescence of these compounds is similar in origin to that of the uranyl salts, and arises from transitions between the excitation states and the ground state of the WO_4 ion.

It has recently been shown by one of us³ that the fluorescence of pure manganous compounds, and of solids activated by manganese, is in many instances due to transitions within the Mn^{++} ion. Our measurements on photoconductivity and phosphorescence have now confirmed this view. Pure manganous chloride ($MnCl_2$) is not photoconducting, neither are the compounds cadmium chlorophosphate, cadmium borate, cadmium silicate, or zinc mesodisilicate when activated by manganese. We have also measured the phosphorescence decay curves for these compounds and find them to be exponential. Other examples of non-photoconducting solids we have found are alumina with chromium impurity (ruby), and pure calcium oxide.

As the fluorescence spectra of the uranyl salts, the ruby, and calcium oxide are of the well-resolved type, it would appear that this type of spectrum is in general to be associated with lack of photoconduction.

It is well known that luminescent energy can be stored in certain phosphors at low temperatures; this energy is released on warming the solid. We find that solids showing this effect of 'thermal glow' to any marked extent are photoconducting solids such as willemite and the zinc sulphides. Non-photoconducting solids show little or no thermal glow.

In zinc sulphide phosphors we find also that it is the long period phosphorescence that is enormously delayed by cooling. The medium period decay of the order of milliseconds takes place rather more rapidly when the solid is cooled to 90° K.

J. T. RANDALL.
M. H. F. WILKINS.

Physics Department,
University of Birmingham.
May 22.

¹ Randall, *Trans. Farad. Soc.*, **35**, 13 (1939).

² Strange, *Trans. Farad. Soc.*, **35**, 96 (1939).

³ Randall, *Proc. Roy. Soc., A*, **170**, 273 (1939).

Spectrographic Analysis of Three Arthropods

Two species of insects and one species of chilopod have been analysed by the methods¹ developed in the spectroscopic laboratory of the Experiment Station of the Hawaiian Sugar Planters' Association. These methods give information only on the metallic and semi-metallic elements present in the sample. Although the analyses are essentially qualitative, clear distinctions between the major, minor and trace constituents can be made.

The specimens analysed were selected to cover a wide range of feeding habits. They included sugar cane beetle borers (*Rhabdoonemius obscura* (Boisd.), segregated according to sex); large common centipedes (*Scolopendra subspinipes* Leach); and cypress cockroaches (*Diploptera dytiscoides* Serville). The beetle borers are plant feeders, spending all their lives except the adult stage within sugar cane stalks. The centipedes are predators, feeding principally on small insects. The cockroaches are omnivorous scavengers; the particular ones analysed were found in dusty soil under stones and bits of refuse. None of these species is indigenous to Hawaii.

The specimens were washed in boiling distilled water and then ashed in platinum for six hours at 500° C. Two-milligram samples of the ash were used in analysis.

A similarity in metallic constitution was found for the three species, the general composition being:

Chief constituents: Phosphorus, silicon, potassium, calcium and magnesium (the chief mineral elements found in plant material).

Less plentiful constituents: Iron, manganese, copper and sodium.

Trace constituents: Zinc, aluminium, strontium, barium and titanium. (No titanium found in the centipede ash.)

Four additional trace elements were found in the cockroach ash, namely, lead, boron, chromium and nickel. In addition, this ash was strongest in iron, silicon, aluminium, and perhaps calcium and potassium. On the other hand, the centipede ash contained the *least* of the chief soil elements, iron, aluminium and titanium, and of the plant material elements silicon, potassium and perhaps manganese. The beetle borer ash was strongest in barium, and showed a trace of tin. No differences between the composition of male and female borers were noted.

The large number of mineral elements present in the cockroach ash, and the heavier concentration of metals in this sample, suggests a correlation between feeding habits and metallic composition.

Ash analysis results for several other species of insects have been compiled by Uvarov².

Thanks are due to Mr. R. H. Van Zwaluwenburg, associate entomologist at the Experiment Station, for suggesting these analyses and for furnishing the specimens.

STANLEY S. BALLARD.

University of Hawaii, and
Experiment Station of the
Hawaiian Sugar Planters' Association,
Honolulu, T.H.

¹ Ballard, *U. S. Phys. Rev.*, **55**, 253 (1937).

Uvarov, B. P., *Trans. Entom. Soc. London*, **76**, 276-281 (1928).

Ionization in the Troposphere

W. KOLHÖRSTER¹ has recently expressed the opinion that G. A. Suckstorff's measurements² have proved the existence in the troposphere of additional ionization caused by radioactive substances to be found in the temperature inversion layers. Suckstorff found in the higher layers of the troposphere enormous oscillations of ionization, amounting sometimes to 50 per cent of the measured value. The amplitudes of these oscillations increased with height; thus, Suckstorff formed the opinion that the oscillations were due to radioactive substances of extra-terrestrial origin present in the upper troposphere.

In order to obtain more information concerning this question, analogous measurements have been carried out. During three balloon flights (March 26, 1936 and June 18, 1936, results still not published; May 14, 1938) the ionization was explored² between 6 km. and 10 km., within which range Suckstorff has detected the greatest oscillations.

Within the limits of observational errors (generally a few per cent) quite smooth curves have been obtained, displaying no irregularities. The most convincing results were obtained in the last flight, when two ionization pressure chambers were used, filled with krypton and nitrogen, respectively, the specific ionization in nitrogen and krypton being quite different for cosmic and radioactive gamma rays⁴. The velocity of the ascent of the balloons was of the same order of magnitude as in Suckstorff's flights (in the first flight it was even less). The apparatus used were at least twenty times more sensitive than that used by Suckstorff. We are compelled to assume that the oscillations observed by Suckstorff were due to some instrumental faults.

As regards the anomalies observed by J. Juilfs⁵ in his measurements carried out in the lower troposphere (up to the height of 5.7 km.), we agree that radioactive substances of terrestrial origin are not unlikely to cause deviations in the ionization curve from its normal shape. It would be highly desirable to have these interesting observations repeated with modern sensitive instruments.

Physical Laboratory,
Main School of Agriculture,
Warsaw.
April 25.

S. ZIEMOCKI.

¹ Kolbster, W., *Naturwiss.*, **27**, 243 (1939).

² Suckstorff, G. A., *Phys. Z.*, **35**, 268 (1934).

³ Ziemocki, S., and Markiewicz-Jodko, K., *NATURE*, **137**, 944 (1936).
Bzostkowski, S., Ziemocki, S., and Markiewicz-Jodko, K.,
NATURE, **138**, 308 (1936). For more details, see *Bull. Acad. Polon.*,
A, 318 (1936), and 273 (1938).

⁴ Juilfs, J., *NATURE*, **140**, 767 (1937). Bzostkowski, S., Ziemocki, S.,
and Markiewicz-Jodko, K., *Bull. Acad. Polon.*, A, 273 (1938).

⁵ Juilfs, J., *Naturwiss.*, **28**, 790 (1938).

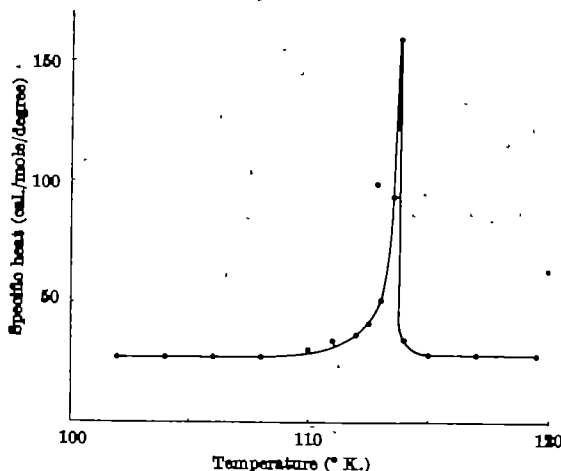
Anomaly of the Specific Heat of Potassium Dihydrogen Phosphate at the Upper Curie Point

THE dielectric properties of Rochelle salt, potassium dihydrogen phosphate and potassium dihydrogen arsenate, depend on the electric field in the same way that the properties of ferromagnetic substances depend on the magnetic field. The spontaneous polarization is large between the two Curie points and depends on temperature. Approaching the higher (normal) Curie point from lower temperatures, the spontaneous polarization vanishes. As a consequence the specific heat shows an anomaly, corresponding to the magneto-caloric effect in ferromagnetics.

This anomaly was found by Kobeko and Nelidow¹ and Rusterholz² in Rochelle salt. Wilson³ and Hicks and Hooley⁴, however, could not detect it. The variation of the spontaneous polarization as a function of temperature is so slow, that the anomaly of specific heat is spread over a wide temperature range and therefore the deviations are small. Although the maximum of specific heat measured by Rusterholz was considerably higher than was expected from the theory, the total anomalous heat capacity $\int \Delta C dT$ agrees well with the values calculated from recent results of the spontaneous polarization (Hablitzel⁵).

As the change of spontaneous polarization of potassium dihydrogen phosphate is larger and more

rapid with temperature, it is probable that the electro-caloric effect will be more pronounced. The specific heat of this salt was therefore measured in a vacuum calorimeter. The salt was heated by a constant flow of radiation and the increase of temperature was measured as a function of time.



SPECIFIC HEAT OF POTASSIUM DIHYDROGEN PHOSPHATE

The results plotted in the accompanying graph show a strongly marked anomaly of specific heat of about 180 cal./mole/degree. The integral $\int \Delta C dT$ representing the energy necessary to destroy the internal field, was found by this method to be 60 cal./mole. With this value and a maximum polarization $P_{\max} = 4.8 \times 10^{-6}$ coulombs/cm.² measured by Busch⁶, the Lorentz value f is found to be 0.5, applying the Langevin-Weiss formula $\int \Delta C dT = \frac{1}{2} f P_{\max}^2$. This is in fair agreement with the value $f = 0.4$ calculated by Busch from dielectric investigations.

The variation of the specific heat as a function of temperature can be calculated from the differential Langevin-Weiss formula. Owing to the rapid increase of P_{spont} as a function of temperature, it is therefore not possible to give an exact maximum value of ΔC , but the agreement between observed and calculated values is fairly satisfactory. It is intended to investigate potassium dihydrogen arsenate and also the effects at the lower Curie point.

Department of Physics,
Federal Institute
of Technology,
Zurich.
May 4.

W. BANTLE.
P. SCHERRER.

¹ Kobeko and Nelidow, *Phys. Z. Sowjetunion*, **1**, 382 (1932).

² Rusterholz, *Helv. phys. Acta*, **8**, 39 (1934).

³ Wilson, *Phys. Rev.*, **54**, 1103 (1938).

⁴ Hicks and Hooley, *J. Amer. Chem. Soc.*, **60**, 2204 (1938).

⁵ Hablitzel, *Helv. phys. Acta*, in the Press.

⁶ Busch, *Helv. phys. Acta*, **11**, 200 (1938).

Crystal Structure of Diphenyldiacetylene

DIPHENYLDIACETYLENE¹ ($C_6H_5-C \equiv C-C \equiv C-C_6H_5$) crystallizes from acetic acid in monoclinic prisms. From rotation-, Weissenberg- and Laue-diagrams the symmetry and dimensions of the unit cell have been determined.

$a = 6.61 \text{ \AA}$; $b = 6.04 \text{ \AA}$; $c = 14.92 \text{ \AA}$; $\beta = 105^\circ$.

With two molecules per unit cell the density should be 1.163, observed density 1.16. The most probable space group is C_{2h}^2 ($P_{21/c}$).

As C_{2h}^2 has four equivalent sets of two-fold positions, the centres of symmetry of the two molecules may be put at 000 and 011. By the method of trial and error the following details were found. The long axes of the molecules form angles of 42° , 38° and 78° with the a , b and c axes respectively. Within the limits of error the molecules are flat with straight carbon chains; the planes of the phenyl rings of the two sets of molecules are not parallel with each other or with one of the basal planes. The lengths of the primary bonds are in accordance with experience. The smallest distance between carbon atoms of two different molecules is 3.45 – 3.65 Å.; it occurs between carbon atoms of the phenyl groups. It thus seems that the forces of cohesion are acting mainly between these.

A Fourier synthesis is in progress with the aim of specifying the shape of the carbon chain, especially the length of the 'single' bond in the middle of the molecule. It will be interesting to compare the complete structure with the results of Robertson and Woodward's investigation¹ of the structure of tolane ($C_6H_5-C\equiv C-C_6H_5$).

E. H. WIEBINGA.

Laboratories for Inorganic and
Organic Chemistry,
University,
Geneva.
April 28.

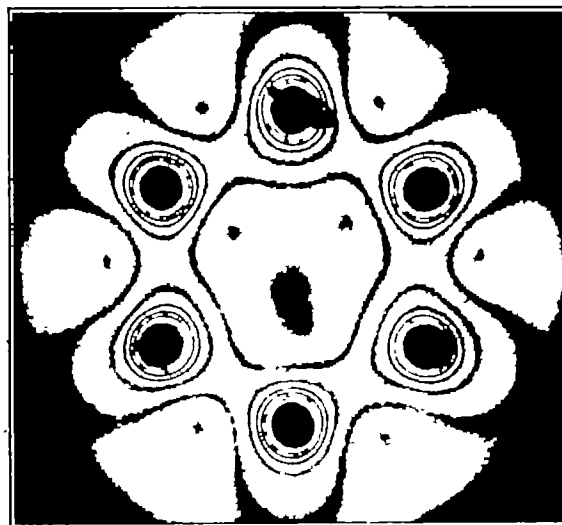
¹ Robertson and Woodward, *Proc. Roy. Soc., A*, 164, 436–446 (1938).

Centrifugal Stresses in Rotating Disks

In recent experiments at this laboratory, the photo-elastic method has been successfully applied to the determination of centrifugal stresses in rotating disks. The new technique depends upon the double structure of Bakelite BT-61-893¹. Bakelite consists of two phases, one of which (the A phase) fuses at relatively low temperatures. If a sample is heated, the viscosity of the A phase is rapidly lowered until it becomes virtually negligible at about 115° C., whereas the C phase is little affected. At this temperature the modulus of elasticity is reduced to 1/640 of its value at room temperature and the stress-optical coefficient is increased twenty-five times. If the specimen is subjected to external load at this temperature, and allowed to cool slowly to room temperature while still under load, the deformation and photo-elastic optical effect are 'frozen in'. This is brought about by the solidification of the liquid A phase within the space lattice formed by the C phase. Subsequent removal of load leaves the deformation and optical pattern virtually unaltered.

Use is made of these properties by spinning (at constant speed) a Bakelite model of the rotor to be studied, raising its temperature to about 110 – 115° C., and slowly cooling to room temperature. The specimen may then be removed from its mounting and studied while at rest. This technique eliminates the tremendous handicaps of the stroboscopic method, which has the disadvantage of requiring high speeds, high intensity of illumination, and extremely accurate synchronization. A stroboscopic study also requires the construction of a mounting which permits the viewing of the central portion of the

disk during rotation—a great hindrance because the axis of rotation and the axis of the polariscope must be practically coincident. The increased optical sensitivity at an elevated temperature makes possible the use of relatively low speeds and small models (the accompanying photograph was made of a model $5\frac{1}{4}$ in. in diameter and 1 in. thick; speed, 1,800 r.p.m.). The technique is applicable to all problems of centrifugally induced stress distributions where the speed of the rotor is constant.



A more detailed account of these investigations will be published upon completion of the current experiments.

R. E. NEWTON.

Washington University,
St. Louis, Mo.
April 22.

¹ For a complete account, see Hetényi, M., 'The Fundamentals of Three-Dimensional Photoelasticity', *J. App. Mech.* (Dec. 1938).

Does the Rabbit Chew the Cud?

SOME years ago my attention was directed to a paper by Morot (1882)¹ (carefully abstracted by A. V. Wills²). It seems to have been overlooked in physiological literature. Since his results seemed strange, I carried out some experiments to test them.

Morot stated that rabbits produce two sorts of faeces, the first during the night—soft, mucous; the second during the day—of the familiar appearance. The night faeces are taken directly from the anus, and without being chewed, swallowed like pills. These pills, which are regularly met with in the stomach (a well-known fact), are only seen free when the animals are prevented from getting at their anus.

That Morot's claims were correct was shown in two ways. I provided a rabbit with a wooden collar, which allowed it to jump around a little. In a cage with wire mesh floor two sorts of faeces immediately appeared in a day-night rhythm. Nine rabbits were fed simultaneously with fig seeds and killed intermittently. It appeared that the food in about twenty-four hours had passed through the intestines twice. An especially convincing case was presented by a rabbit, which was killed at 3 o'clock in the morning.

It had 'stomach buns' both in the rectum and in the stomach, and in both was found a nematode, *Passalurus ambiguus*, being a common caecum and colon parasite. Morot was of opinion that the difference in consistency of the two sorts of faeces is due to the food having passed once or twice. But since the two sorts were still produced by a collared rabbit even after a month, the difference in consistency must be due to an intestinal rhythm in the rabbit itself.

In the physiological literature it is commonly known that rabbits are coprofagous¹; but it has not been commonly acknowledged that this is really a fully normal and regular physiological process. Some points in literature seem to show that similar processes are found in guinea pigs and other herbivorous rodents². Further investigations are to be directed towards the meaning of this peculiar process in the form of analyses of the contents of digestible matter, salts and vitamins in the two sorts of faeces. An analysis of the intestinal rhythm would seem to be of great interest³.

HOLGHE MADSEN.

State Veterinary Serum Laboratory,
Copenhagen.
March 28.

¹ Morot, Ch., "Des pelotes stomacal des lapins," *Mém. Soc. centr. méd. nat.*, 18, Sér. 1 (Paris, 1882).

² Wille, V. A., "Does the Hare Chew the Cud?" (London, 1932).

³ Winterstein, H., "Handbuch vergl. Physiologie", 2., "Physiologie des Stoffwechsels", 1-1493 (1911).

⁴ Krsywanek, W., "Vergleichende Untersuchungen über die Mechanik der Verdauung" (2-4), *Arch. Tierheilk.*, 55, 532-536, Fig. 15; 537-556, Fig. 25; 56, 49-61, Fig. 6 (Berlin, 1927).

⁵ Hemmingen, A. M., and Krarup, N. B., "Rhythmic Diurnal Variations in the Ocular Phenomena of the Rat and their Susceptibility to Light and Dark", *Exp. D. Vidensk. Selsk. Biol. Medd.* (XIII), 7, 1-61 (1937).

THE curious food pellets described by Morot and mentioned in Dr. Madsen's letter must be familiar to all laboratory workers who have occasion to open the rabbit's stomach. They have frequently been seen in the parasitological department of this Laboratory during the course of work carried out on the stomach worm *Gnathidium strigosum*, and we have wondered how it could be possible for the mucous membrane of a large hollow organ to form such perfectly rounded pellets.

The explanation given by Morot and confirmed by Dr. Madsen was new to us and at first we were inclined to regard it as too fantastic for serious consideration; the pellets frequently constitute more than one third of the stomach contents and refection to such a degree seemed too improbable for us to believe it without further proof. In view of the importance of the rabbit as an experimental animal and the significance of information on such a point to workers in nutrition or in parasitology, one or two observations were made at this laboratory to ascertain whether there was a sound foundation for Morot's theory.

Although in arranging these experiments we did not expect to be able to confirm Morot and Madsen's observations, we acknowledged in the end that in all probability their conclusions are correct, and that, presumably, for reasons of the digestion of cellulose, the rabbit is in the habit of swallowing large amounts of its own faeces in bolus form directly from the anus, so providing an example of physiological refection to a more marked degree than had previously been thought to exist.

This point in the special physiology of the rabbit is of considerable significance for the correct interpretation of metabolism experiments in which the animal has been used, and there can be little doubt that the observation brought forward by Morot and Madsen will invalidate some and perhaps many of the conclusions that have been arrived at in past metabolism experiments on this animal.

A series of observations on the fate of ingested copper recently carried out on the rabbit at this laboratory might be cited as a case in point. It was found that the excretion of copper in the faeces following an experimental feed, was spread over a period of between four and five weeks, and it has been tentatively concluded that in all probability the copper is temporarily stored in the intestinal mucous membrane and gradually passed into the intestine by a process of exfoliation of the cells. I now appear that a more rational explanation would be the repeated refection of the copper-containing faeces.

The few observations made at this laboratory may be briefly stated as follows:

Examination of the stomach pellets in a few rabbits showed them to be of varying sizes ranging from 0.2 to 1.0 cm. in diameter, more or less spherical soft in consistency, coated with a thin layer of mucus and so well separated from one another that they fall apart when shaken out of the opened stomach. They occur almost invariably at the cardiac end composing up to one half of the stomach contents but a few pellets may sometimes be found mixed with the general mass.

An observation made on three muzzled and three control rabbits kept in individual cages overnight showed that two kinds of faeces had been passed in both experimental and control groups, which was contrary to the refection theory.

Rabbits are almost invariably infected with coccidia in the mucous membrane of the intestine and frequently in the liver, but not in the mucous membrane of the stomach. Examination of the stomach pellets, however, showed them to contain large numbers of coccidial oocysts, not quite so many as were found in the faeces of the same rabbit, but eight or ten times as many as could be found in the general mass of the stomach contents. This was greatly in favour of the refection theory.

Examination of the stomach contents forty-eight hours after an experimental feed containing *Lycopodium* spores¹ showed many spores still to be present. As the stomach of a control rabbit fasted overnight contained very little food indeed, this observation is also suggestive of refection.

None of the observations, however, quite ruled out the possible explanation of the presence of oocysts or spores in the stomach as the result of the casual refection that might occur in an animal confined to a small cage. Another observation was therefore made on a series of six rabbits that were first fasted for 48 hours; three of these were then fastened into rubber bags leaving only their heads uncovered and all were given food *ad lib.* Post-mortem examination on the following morning revealed the presence of numerous stomach pellets in all three of the control rabbits, and the complete absence of stomach pellets from the stomachs of the rabbits that had been tied into bags. Numerous coccidial oocysts were also found in the stomach pellets of the control rabbits but oocysts were absent from the stomach contents of the other three, which appeared to prove the faecal origin of the pellets.

We were therefore led to conclude that the rabbit practises physiological refection to a very marked degree, between one third and one half of the stomach contents normally being of faecal origin. This observation has an important bearing on the interpretation of results of metabolism experiments in the rabbit.

I look forward with much interest to the publication of Dr. Madsen's further observations.

E. L. TAYLOR.

Veterinary Laboratory,
Ministry of Agriculture,
Weybridge.
May 15.

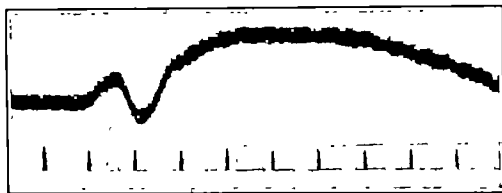
* NATURE, 126, 435 (1935)

Owls and Infra-Red Radiation

In a paper published in 1934, F. L. Vanderplank¹ records certain observations which are interpreted as showing that the tawny owl, *Strix aluco* L., is able to perceive infra-red rays visually, and thus to see in total darkness the small animals on which it preys.

To test this possibility we have carried out the following experiments on the eye of a tawny owl.

(1) In the intact animal (under urethane anaesthetic) we recorded, with an oscillograph and suitable amplifying system, the retinal potential produced in response to stimulation by white light, using an electric bulb as source. There is a large and clearly marked response, as in other animals.



RETINAL RESPONSE OF THE DARK-ADAPTED EYE OF THE TAWNY OWL TO SUDDEN ILLUMINATION OF APPROXIMATELY SIX FOOT-CANDLES.

Electrodes on the cornea and in the mouth.
1 cm. = 150 microvolts. Time, 0.02 sec. intervals.

No potential could be detected, even with the highest possible amplification, in response to stimulation by infra-red radiation from a large black body at 40°–400° C. close to the eye.

(2) We placed the eye of a tawny owl, immediately after removal from the animal, between a source of infra-red rays and a sensitive Moll thermopile. The sclerotic and retina were removed, so that the cornea, lens and humours were in the path of the rays. When the eye was interposed, we could detect no response from the thermopile, and if any transmission occurred it was less than 0.5 per cent.

We obtained consistently negative results in both experiments, using a black radiating body as source at temperatures from 40° C to about 400° C. Transmission through the mammalian eye² practically ceases for wave-lengths longer than 15,000 Å., and we conclude that the eye of the tawny owl, like that of other animals that have been examined, is opaque to long infra-red rays. Even if the retina should be sensitive to long infra-red rays, none can reach it in the undamaged eye.

Our experiments lend no support to the view that the owl can see a small animal in darkness by its own infra-red radiation.

L. HARRISON MATTHEWS.

Dept. of Zoology,
University of Bristol.

BRYAN H. C. MATTHEWS.

Dept. of Physiology,
Cambridge.

¹ Vanderplank, F. L., *Proc. Zool. Soc. London*, 506–507 (1934).

² Bogenhan, O., and Wotthauer, A., *Klin. Monat. f. Augenheilk.*, 79, 455 (1927).

Specificity of the Evocator in *Hydra*

Tissue from *Hydra viridis* boiled in water for ½–1 minute and implanted into the blastocoel of *Triton* gastrulae evokes the formation of neural tissue and in some cases neural tubes¹.

Thirty years ago, Browne² observed that the implantation of peristome tissue, or the material of a regenerating hydranth, or tissue from a bud in *Hydra viridis* resulted in the outgrowth of a new hydranth. Grafts of tissue from other regions of the *Hydra* body and wounds gave negative results. These results were confirmed by Rand, Bovard and Minnich³ for *Hydra oligactis* (fused).

Child⁴ has produced supernumerary hydranths in another hydrozoan, *Corymorpha*, by lacerations and by the grafting of various regions of the stem. Santos⁵ has produced supernumerary heads in planarians by the implantation of cephalic ganglion region. Supernumerary heads have developed in planarians following such diverse stimuli as laceration, faradic stimulation and cautery⁶.

In view of the reactions of *Corymorpha* and of the planarians, and since *Hydra* is known to possess an extremely high regenerative potency, it was believed that supernumerary hydranths could be produced by some means other than the transplantation of the tissues noted by Browne (*loc. cit.*). The techniques which had yielded successful results on planarians were used on *Hydra oligactis*.

A toothpick, the tip of which had been sharpened to a very fine point, was dipped into 70 or 80 per cent ethyl alcohol and the tip was then applied to the tissue of the mid-region of individuals of *Hydra*. In others, the tissue in the same region was lacerated with a finely pointed ophthalmic knife, and in a third group a heated micro-cautery needle was lightly touched to the *Hydra* tissue. Supernumerary hydranths did not develop in any of the 150 treated animals which continued to live after the injury without any apparent ill-effects.

Why *Hydra* should react only to a specific stimulus is not clear to me. Other agents which have been used successfully on other forms will be tried on *Hydra*.

E. D. GOLDSMITH.

Washington Square College,
New York University, and the
College of the City of New York.
April 21.

¹ Waddington, C. H., and Wolaky, A., *J. Exp. Biol.*, 12, 92 (1935).

² Browne, H. N., *J. Exp. Biol.*, 7, 1 (1909).

³ Rand, H. W., Bovard, J. F., and Minnich, D. B., *Proc. Nat. Acad. Sci.*, 19, 555 (1926).

⁴ Child, C. M., *Physiol. Zool.*, 2, 342 (1929).

⁵ Santos, F. V., *Physiol. Zool.*, 4, 111 (1931).

⁶ Goldsmith, E. D., *Proc. Nat. Acad. Sci.*, 20, 555 (1934).

Presence of Cancer-producing Substances in Roasted Food

A SERIES of mice was painted every second day for a long time in the ordinary manner in the occipital region with an alcohol or petroleum extract (a) of horse muscle, treated at a temperature of 275° C., (b) of browned butter, or (c) of roasted coffee. As controls we employed (a) a series of mice painted in the same manner with an alcohol or petroleum ether extract of horse muscle dried on a water bath or in a hot current of air, untreated butter and unroasted coffee, and (b) a number of untreated animals.

The experimental series have so far comprised 241 animals—149 males and 92 females. The spontaneous frequency of malignant tumours among the females is 10 per cent at most. Among the males this frequency is, as usual, much lower.

So far, no malignant tumours have been observed in the male mice painted with extract of either roasted or unroasted food. On the other hand, a giant-cell spindle-cell sarcoma was produced in the painted region in a series of mice which had been painted for a long time with pure cholesterol, treated at 275° C., emulsified in coco-nut fat. Further, certain chronic changes of great interest, which will be described later, were observed in the animals treated with roasted food.

Twenty-three of the female mice treated with extracts of roasted food survived a period of application of 11 months. In this period we observed nine malignant tumours in the mammary glands, all of the adenocarcinoma type (= 40 per cent), namely, two after the application of petroleum ether extract of roasted coffee, one after browned butter, two after petroleum ether extract of roasted muscle and four after the application of an alcohol extract of roasted muscle. The average time for the appearance of these tumours was 360 days. In the control series (26 animals) only one case of mammary cancer (= 4 per cent) was observed during an observation period of 378 days.

The statistical probability of such a distribution of the tumours (9 tumours in 23 animals treated with an extract of roasted material and 1 in 26 animals in the control series) occurring simply by chance is not more than 0.0026, that is, the chance of this occurring in such series is only one in 380. Moreover, as the tumour frequency has increased to 40 per cent, as compared with the maximum expected incidence of 10 per cent, the probability that chance has played a part is much less, and on that account I consider that I am justified in concluding from the results of these experiments that extracts of roasted food contain one or more carcinogenic substances.

These substances may be thought to reach the mammary tissue by resorption from the skin. However, very little change was noticed in the skin during the entire period of application. Cramer and Horning¹ and Burrows² have produced mammary cancer in mice by the application of estrone. Attempts to demonstrate the presence of an estrogen factor in the extract, however, have not yet given any positive results. Another possibility is that the carcinogenic factor reaches the organism *per os*, as the animals very quickly lick off the painted extract. The isolation of the active substance is in progress. A full report will be published in the *Proceedings of the Royal Physiographical Society of Lund*.

The present investigation was suggested by the observations of Kennaway^{3,4} and Kennaway and

Sampson⁵ that heating human skin, muscle, yea and cholesterol in a hydrogen atmosphere to 700° 920° C. produces carcinogenic substances with local effect.

E. M. P. WIDMARK.

Institute of Medical Chemistry,
University of Lund, Sweden.
April 15.

¹ Cramer, W., and Horning, R. S., *Lancet*, 239, 247 (1936).

² Burrows, H., *Am. J. Cancer*, 24, 613 (1935).

³ Kennaway, R. L., *J. Path. Bact.*, 37, 233 (1934).

⁴ Kennaway, R. L., *Brit. Med. J.*, 11, 1 (1925).

⁵ Kennaway, R. L., and Sampson, *J. Path. Bact.*, 31, 609 (1923).

Influence of Lactate on the Absorption of Glucose from the Intestine of Adrenalectomized Rats

IN experiments designed to throw light on the mechanism of sugar absorption and its control by the adrenal cortex, it was previously found¹ that with adrenalectomized rats sodium pyruvate restore the normal sugar absorption from the intestine. Similar experiments using the same methods have now been carried out with sodium lactate which was administered continuously in doses of 15–20 mgm a day subcutaneously. It was found that it shows the same effect as pyruvate does, restoring the low glucose absorption of the adrenalectomized rats to the normal level. (Normal absorption in forty-five minutes, 80.0 per cent of the injected glucose, with adrenalectomized rats 42.3 per cent, after lactate administration 73.7 per cent.)

L. LILJET.

Physiological Laboratory,
University, Fribourg,
Switzerland.
May 1.

¹ Liljet, L., *Verh. schweiz. Physiol.*, Feb. 1939.

Relation between the Secretory Cells of the Pars Nervosa of the Hypophysis and Classical Neuroglia

GEMSH¹ has shown that the glial cells of the pars nervosa—the pituicytes of Bucy²—are responsible for the secretion of the anti-diuretic principle of the posterior lobe. I have presented additional evidence³ which demonstrates that these cells elaborate the pars nervosa hormones. By the use of silver carbonate methods for neuroglia, developed by the Spanish school, Bucy showed that the pituicytes, like neuroglial astrocytes in the central nervous system, possess cytoplasmic processes, one or more of which end on connective tissue either in the form of pia, of that around blood vessels, or of septa. The pituicytes, however, are impregnated most satisfactorily by methods which demonstrate consistently neuroglial oligodendrocytes (these have cytoplasmic processes but no vascular attachments in contradistinction to astrocytes) and mesodermal microglia. Astrocytes are usually not impregnated by these methods.

In order to establish a clearer concept of the relationship between pituicytes and neuroglia, I have compared the morphology, genesis, and cytoplasmic inclusions of pituicytes with those of neuroglia.

From this study it has become evident that (a) pituicytes possess the distinct, ovoid cytoplasmic inclusions (gliosomes) characteristic of astrocytes and oligodendrocytes, but which are absent from microglia; (b) pituicytes, like astrocytes and oligodendrocytes, are spongioblastic in origin, being derived from the ectodermal supportive spongioblasts which line the lumina of the infundibular cavity and its extensions in the pars nervosa. The same 'pituoblast' is proposed for those spongioblasts which have quitted the ependymal epithelium and are migrating out to, and implanting attachments (foot plates) on, the peripheral connective tissue. Since oligodendrocytes are derived from those spongioblasts which never acquire foot plates, it follows that pituicytes are more closely allied to astrocytes. They are totally unrelated to mesodermal microglia. It appears, then, that pituicytes,

astrocytes and oligodendrocytes constitute a closely inter-related morphological, but not functional, unit.

It is interesting to note that Nageotte⁴, Mawes⁵, and Achúcarro⁶ have attributed glandular functions to neuroglia. The evidence is not conclusive, but the fact that one group of the glial unit—pituicytes—has endocrine functions, renders the hypothesis more plausible.

MERVYN GRIFFITHS.

Montreal Neurological Institute.

April 25.

¹ Garsh, *Proc. Soc. Exp. Biol. and Med.*, **37**, 396 (1937).

² Bucy, *J. Comp. Neurol.*, **55**, 505 (1940).

³ Griffiths, *Nature*, **141**, 286 (1938); *Proc. Linn. Soc., N.S.W.*, **63**, 81 (1938).

⁴ Nageotte, *C.R. Soc. Biol.*, **63**, 168 (1910).

⁵ Mawes, *C.R. Soc. Biol.*, **69**, 45 (1910).

⁶ Achúcarro, *Trab. Lab. Invest. Biol. Univ. Madrid*, **11**, 187 (1913).

Points from Foregoing Letters

FROM a study of the correlation between indexes of solar activity and the critical frequencies of the F_2 region of the ionosphere, W. M. Goodall concludes that a monthly average character figure based on radio observations gives a reasonably good measure of solar activity.

The position occupied by the activating atoms in the crystal lattice of certain impurity-activated phosphors has been studied by the X-ray method by H. G. Jenkins, A. H. McKeag and H. P. Rooksby. In the case of zinc orthosilicate, for example, the addition of manganese causes a displacement of the X-ray lines which corresponds to a lattice expansion, and the lattice change is of the kind to be expected from the replacement of zinc atoms by manganese atoms.

J. T. Randall and M. H. F. Wilkins describe experiments on the photoconductivity and luminescence of uranyl salts, tungstates, and a number of compounds activated by manganese. The results give direct evidence of the existence of excitation states in these solids.

S. S. Ballard reports the spectrographic analysis of the total ash content of three species of arthropods. Nineteen metallic and semi-metallic elements were encountered during the investigation. A correlation between metallic composition and the feeding habits of insects is suggested.

From the results obtained in three balloon flights, S. Ziemecki concludes that oscillations of ionization found by G. A. Suckstorff in the higher troposphere are due rather to instrumental faults than to substances of extra-terrestrial origin. The anomalies found by J. Juilfs in the lower troposphere are likely to be due to radioactive substances of terrestrial origin.

The variation with temperature of the specific heat of potassium dihydrogen phosphate shows, according to W. Bantle and P. Scherrer, a strongly marked anomalous increase at the upper Curie point.

By the method of trial and error, the crystal structure of diphenyldiacetylene has been roughly determined by E. H. Wiebenga. A refinement of the parameter values will follow by the application of Fourier synthesis.

A new technique for determining centrifugal stresses in rotating disks by means of the photo-elastic method is described by R. E. Newton. The disk is made of Bakelite (BT-61-893), heated to 115° and allowed to cool while rotating at constant speed. In this way the photo-elastic optical effects are 'frozen in' and can be observed in polarized light when the disk is at rest.

Holger Madsen confirms Morot's statement that rabbits form two sorts of faeces, one of which is formed during the night and swallowed like pills directly from the anus. The difference of consistency is due to an intestinal rhythm in the rabbit itself. E. L. Taylor also confirms Morot's statement that the pellets found in the rabbit's stomach are of faecal origin; he considers it to be an outstanding example of physiological refection and thinks that its function may be the digestion of cellulose. He also directs attention to the important bearing which the observation has upon the interpretation of metabolism experiments carried out in the rabbit.

L. Harrison Matthews and Bryan H. C. Matthews find that infra-red rays produce no response in the retina of the tawny owl, and that the cornea, lens and humours transmit so small an amount as to be opaque to the rays for visual purposes. From direct experiments on the eye, they find no confirmation for the suggestion that in darkness owls can see infra-red radiation from animals on which they prey.

E. D. Goldsmith points out that thus far he has been unable to produce supernumerary hydranths in *Hydra* by either laceration of the tissue, local applications of ethyl alcohol, or micro-cautery. These techniques had previously yielded supernumerary heads in planarians.

By painting mice with petroleum ether or alcohol extract of roasted food, E. M. P. Widmark found that adenocarcinoma of the mammary glands was produced in a much higher frequency than the total incidence of spontaneous mammary cancer.

L. Laest finds that sodium lactate restores the normal glucose absorption from the intestine of adrenalectomized rats in a similar way as was found previously for pyruvate.

Research Items

Anthropometry of Syrian Males

MEASUREMENTS, as well as other observations of 1483 Syrian males, have been made by W. M. Shanklin (*J. R. Anthropol. Inst.*, 68, 2, 1938). Syria has been a battleground of the nations from time immemorial. Of the invasions of the mountains less is known than of those of the coastal regions; but within historic times one large mountain group, the Druzes, has migrated into southern Lebanon and the Jebel Druze in the Hauran. Like the coastal plain, the desert border has been frequently invaded. Question is raised whether the living races of to-day show traces of their complicated ancestry, and if there is any correlation between the diverse geographical areas and population. In this study the material is examined from the point of view of the religions represented and geographical areas—Shiite Moslems, Sunni Moslems, Christians, and Alouite and Druze, secret sects with Moslem origins. The geographical areas are mountain, desert-border, and desert. Summarizing the results of 15 measurements and 6 indices, as well as the other observations, it is shown conclusively that there are significant differences between the mountain groups and the desert border groups, while both of these differ from the Syrian Bedouin. The major differences are a progressive lengthening of the head, and a decrease of the cephalic index (maximum, Mitwali, 87; minimum, Rwala, 75), in passing from the mountain region to the desert border and the desert. Other changes in the same direction are a progressive narrowing and lengthening of the face and a lengthening of the nose. Convex noses, rarely seen in the desert, are frequently found in the other groups. There is also a progressive darkening of the skin towards the desert, and an increase in the percentage of blood-group O. The line of cleavage for Syrian racial differences is thus along geographical and not religious lines. The nomadic peoples of the desert are clearly Mediterranean in the larger sense. The border peoples represent a transition to a brachiocephalic stock, which cannot be considered 'Armenoid'.

Boat Oculi, Survival

In a further study of the survival of oculi on boats, Mr. James Hornell records additional examples from Portugal, the coasts of the Mediterranean, Madagascar, Zanzibar, the Swahili coast of East Africa, and the Far East (*J. R. Anthropol. Inst.*, 68, 2; 1938). In Portugal its use, though lingering in the fishing centres, is on the decline. There are several distinctive substitutes for the oculus, the most common being a star, usually five-pointed. Apart from these substituted devices, the same type of oculus with minor variations occurs along the whole coast line of Portugal south of the Tagus. The custom was encountered nowhere on the Spanish coast except at Malaga. In Sicily and in Malta the oculus is in common use as a device against the evil eye. In the Adriatic the true oculus is rare, though it does occur; but a large red disk on each bow is common around Venice. At ports lower down the coast the oculus is supplanted by a comma-shaped wooden boss on each bow. No trace of the oculus is found in the Red Sea

or Persian Gulf, owing to observation of the precept of the Koran against representation of the human figure, or parts of it. It is only when the Swahili coast is reached that the oculus is again encountered. Here the *mitope*, the only indigenous sea-going craft and many of the small craft of Pemba and Zanzibar are 'eyed', and commonly the eyes are duplicated in the stern. In Mayotte, the island nearest to Madagascar, the oculus is common, both on the bows and the quarters. In Madagascar itself the oculus, not found on the outrigger canoes, occurs on vessels of typical Arab design and on two-masted coasters of lighter type. Omitting India, where the oculus has already been noted, it appears in Burma, but has disappeared in Indonesia and the Malay Peninsula, where the Mohammedan religion has spread. It appears to have occurred sporadically in Selangor and Sumatra, and continues to flourish in Bali. An old tradition is preserved with fidelity in Botol Tobago. The statement made previously that the oculus is universal on the Chinese junk is incorrect. It is never seen on the boats of northern China.

Population Problems in the United States

THE Population Association of America arranged a symposium on "Intrinsic and Environmental Factors in American Population Growth", which was held at the American Philosophical Society, Philadelphia, in November 1938; and the results have recently been published (*Proc. Amer. Philos. Soc.*, 80, No. 4) as a series of papers by leading American students of population questions. The contributions include "Agriculture and Current Population Trends" by Conrad Taeuber, "Social Environment and Population Growth" by Warren S. Thomson, "Intrinsic Factors in Population Growth" by Frank W. Notestein, "Psychological Factors and Fertility" by John C. Flanagan, "Childlessness" by Clyde V. Kiser, "Cultural Patterns in Rural America" by O. C. Taylor, "Reflections of an Anthropologist on the Future of Population" by H. L. Shapiro, "Population Study and Related Sciences" by A. J. Lotka. The whole constitutes a valuable survey of population trends and problems in the United States, supported by extensive statistics on many points. These statistics are frequently derived from special investigations. Among the conclusions which emerge are the importance of contraception in lowering the birth-rate and the fact that the birth-rate has declined below the replacement level. In the professional group the reasons for family limitation are mainly financial, the cost of higher education and the health of the wife. One writer concludes from results derived from questionnaires that contraception is not responsible for any major share of permanent childlessness. The population is expected to reach its peak by 1980. There was a considerable movement back to the land during the depression years 1930-35. Migration from farms has taken place not only in regions where agriculture is non-commercial, but also in areas where commercial agriculture is dominant. In the latter areas smaller families appear to be a part of the culture complex.

Phosphorylations in the Cell

H. KALOKAR (*Enzymologia*, 5, 365; 1939) has shown that accumulation of phosphoric acid esters takes place in fresh kidney extracts under aerobic conditions so long as suitable concentrations of sodium fluoride are present. These esters do not normally accumulate owing to the activity of phosphatases, of which a group—the 'acid' phosphatases—are poisoned by fluoride. Fluoride, however, diminishes the respiration and this must have an inhibitory effect on the synthesis of the esters, which depends partly on the respiratory activity of the tissue. The specificity of the enzymes involved is shown by the facts that addition of α -glycerophosphate inhibits only the phosphorylation of glycerol, whilst the addition of hexosediphosphate inhibits only the phosphorylation of hexoses. M. Silverman and C. H. Werkman (*Enzymologia*, 5, 385; 1939) observe that phosphorylation of vitamin B₁ to form cocarboxylase takes place when a suspension of propionic acid bacteria (*Propionibacterium pentosaceum*) is incubated for two hours at 30° C. in a medium containing hexosediphosphate and synthetic vitamin B₁.

Nitrogen-containing Substances of the Intestines

K. RI (*J. Biochem.*, 29, 265; 1939) examined the large intestine and duodenum of healthy adult dogs for nitrogen-containing substances with the following results. The amount of choline, humine, purine-nitrogen, arginine, leucine, valine, isoleucine, phenylalanine and aspartic acid contained in the muscle layer of the duodenum was found to be larger than that of the muscle layer of the large intestine. The amount of glutamic acid and serine, however, contained in the duodenum was less than that of the large intestine. The duodenal mucous membrane was found to contain more choline, arginine, histidine, tyrosine, glutamic acid and glycocoll than the mucous membrane of the large intestine, and more humin, alanine and isoleucine were found in the mucous membrane of the large intestine than in that of the duodenum. Experiments showed that the chemical constituents of the digestive organs were distributed quantitatively, differing somewhat according to the various regions. Histidine, for example, was found in abundance in the duodenal mucous membrane and isoleucine in the duodenal muscle layer and in the mucous membrane of the large intestine.

Hypoglycemia and Anoxemia

H. E. Himwich, S. J. Martin, F. A. D. Alexander and J. F. Fazekas (*Endocrinology*, 24, 536; 1939) studied the activity of the autonomic system of dogs during hypoglycemia and anoxemia. Electro-cardiographic changes showed that in both conditions an initial transitory sympathetic influence was followed by parasympathetic predominance. This increased activity of the autonomic nervous system was associated with a depressed metabolism of the brain, as indicated by diminished cerebral utilization of oxygen. It is concluded that with depression of the brain metabolism the predominant and ultimate effect on the autonomic nervous system was a release of parasympathetic influence.

Alimentary Canal of Molluscs

The structure and function of the alimentary canal in different groups of molluscs have already been dealt with in several accounts in recent years.

This work is continued in a communication by Dr. Vera Fretter who has investigated these problems in the Tectibranchs, *Philina aperta*, *Scaphander lignarius*, *Haminea hydatis* and *Actaeon tornalis* (*Trans. Roy. Soc. Edin.*, 1939). All these have radulae, but the last has no odontophore so that the method of feeding is similar. *Actaeon* also differs from the others in lacking a pair of salivary glands which secrete a fluid containing an amylase and a glycogenase. Again, this species lacks a crushing gizzard. The stomach of all of them has a bilobed digestive gland opening into it; this produces a proteolytic enzyme with an optimum of pH 6.3 and a diastatic enzyme and a glycogenase with an optimum between pH 6.3 and pH 7.0 and a lipase. These enzymes produce soluble products and small particles which are ingested by the digestive cells of the digestive glands wherein digestion is completed. The gland exhibits a cyclical series of changes which includes secretion, and in *Philina* and *Scaphander* the latter phase of activity is associated with the expulsion of excretory matter. This gives rise to a characteristic type of faecal pellet. As in Gastropods purines tend to replace urea, it is suggested that in this group a terrestrial mode of life is preceded by a uricotelic metabolism.

Neocomian Cephalopods of India

The Cephalopoda of the Neocomian Belemnite beds of the Salt Range are described by Dr. L. F. Spath (*Palaeont. Indica*, N.S., 25, No. 1, pp. 154, pls. 25; 1939). They are found condensed into the basal beds or lower part of the Belemnite marls, and include eighty-one species of ammonites and three of belemnites; of the former only seven can be definitely identified with species already known; the latter belong mainly to the genus *Hibolites*. The ammonites show that the deposit is of Infra-Valanginian and Valanginian age, and indicate the existence of six zones, but the succession does not appear to be complete. They belong mainly to the families Olcostephanidae, Berriasellidae and Neocomitidae, and their affinities are with the fauna of the great equatorial belt (Tethys and extensions). The author believes that the distribution of oceans and continents was already essentially the same as at the present day, except for the more extended Tethys, and he visualizes an equatorial zone extending 45° of latitude north and south of the equator. While the fauna of the Belemnite beds consists essentially of cephalopods, it includes also a few representatives of reptiles, fishes, brachiopods, pelecypods and one gasteropod.

Greenkeeping Research

The spring number of the Journal of the Board of Greenkeeping Research (St. Ives Research Station, Bingley, 3s. 9d. post paid, 1939) contains an account, by R. B. Dawson and N. L. Ferguson, of the production of the St. Ives strain of creeping red fescue grass. This strain is a propagation of a uniform population of *Festuca rubra genuina* var. *glaucescens*, selected from sea marsh turf at Cark in Cartmel, Lancashire. The new strain offers greater leafiness and density of growth than existing commercial strains of the same species, and it has also good winter colour and reasonable resistance to fungal disease. Much of the St. Ives Station's work has centred around the treatment of lawns with appropriate fertilizers; but R. B. Dawson and R. B. Ferro show that this is inadequate without mechanical aeration.

by scarification. A paper on the Belfast Airport, by S. P. Mercer and P. A. Linham, describes some fascinating ecological transformations from dredged mud to turf which can support a load of four tons per square foot. The original soil had a salt content of about 0.4 per cent, and its relative acidity was pH 8. Many species of grass were tried upon the drained soil, but a mixture of 40 parts by weight of perennial ryegrass seed to one part of yellow suckling clover gave the best results. Sowings of *Poa maritima* were also used for initial colonization of bare mud. The interesting and complex life-history of an oil beetle, *Meloe proscarabeus*, is also described by Miss B. Lovibond. The species does not seem to cause much trouble upon lawns, except the distaste for its occasional presence in large numbers.

Melanism in Pheasants

THE two inter-fertile species of pheasant, *Phasianus versicolor* and *P. colchicus*, are subdivided into about 42 subspecies. The origin of one of these, sometimes called *P. colchicus* mut. *tenebrosus*, the black pheasant, is uncertain. J. H. Bruckner (*J. Hered.*, 30, 45-52; 1939) has reported some interesting breeding results. Melanism is dependent on one incompletely dominant gene. The F_1 hybrids between melanic pheasants and the common ring-neck pheasant, *P. colchicus*, are remarkably similar in the distribution of markings to *P. versicolor*. Bruckner suggests that *P. colchicus* may be the older or 'wild type', and that natural selection has selected the least melanic types to produce *P. versicolor*. Modifiers of melanic distribution are known in *P. colchicus*, and hybrids between melanic forms and *P. colchicus* range greatly in the amount of melanism.

Earthquakes during March 1939

ACCORDING to E. Peterschmitt, of the Bureau Central Séismologique de Strasbourg, there were a hundred earthquakes and strong tremors recorded by people and instruments during March 1939. There was not a day on which no earthquake was experienced somewhere in the world, and the greatest number on any one day was eight, on March 17. Of the hundred shocks recorded seventeen were of sufficient strength to have the epicentre determined accurately either by isoseismal lines or from instrumental recordings. Probably the strongest was on March 20, on the Island of Kiou Siou, Japan, and the next in order of magnitude were March 1, strength V, near Ebingen, Jura Souabe; March 5, strength V, La Cote-Saint-Andre (Isère, France); March 12, strength V, Province of Aquila, Italy. These were closely followed by March 20, strength IV, Barcelonnette (Hautes Alpes, France), and Susa (Torino, Italy), epicentre Mont Viso, 44.8° N., 7.1° E.; and March 30, strength IV, in the Ossan Valley.

Coastal Fogs in Scotland

A COMPARISON between the frequency of fog in each month of the year at Scottish lighthouses and inland observing stations in the period 1925-34 and similar data for the period 1889-1900 discussed by Buchan, is the subject-matter of Professional Note No. 88 of the Meteorological Office, by P. E. Dixon. The procedure at lighthouses is to log the number of hours on each day during which, in the opinion of the lightkeeper, there is sufficient atmospheric obscurity to necessitate the sounding of a fog signal, and the personal equation is a factor. At the climatological

stations, on the other hand, a more important disturbing factor is the seasonal variation of the time of sunrise in relation to the morning hour of observation. As the period between sunrise and one or two hours after sunrise is a critical one in regard to early morning fogs due to cooling of the lower atmosphere by radiation, this disturbing factor is apt to give rise in fog statistics to a spurious seasonal variation due to the fact that in winter the common hour of observation of 9 h. G.M.T. is favourably placed for the observation of this class of fog, whereas in summer it is much too long after sunrise and will have allowed most of the fogs to have cleared away as a result of prolonged sunshine. It appears from a chart (Plate IV) showing the average annual fog duration at the lighthouses in 1925-34 as a percentage of the average for the earlier period, that 1925-34 was in most areas much the least foggy; but when considering the exceptions, it is clear that these arise mainly because of increased industrial activity, resulting particularly in an increase of winter fogs so great as more than to counteract the general tendency, due to meteorological causes, for the 1925-34 period to be less foggy. This is particularly well shown in the Firth of Forth, and the Moray Firth, where the prevailing winds carry atmospheric pollution from industrial areas out to sea. The tendency for fogs with clear skies to thicken just after sunrise owing to an increase in pollution is well shown by the observations at fixed hours at Aberdeen, where the average number of fogs in 1927-36 increased from 0.4 to 7.0 between 7 h. and 9 h., whereas in summer the corresponding figures were 2.6 and 1.1.

Mechanism of Formation of Polythionic Acids

H. Stamm and H. Wintzer have shown (*Ber.*, 71, 2217; 1938) that the primary product in Wackenroder's reaction (the reaction between hydrogen sulphide and sulphur dioxide in aqueous solution with formation of polythionic acids) is thiosulphurous acid, $\text{H}_2\text{S}_2\text{O}_3$. Although this compound cannot be isolated, its chemical nature can be investigated by the aid of the hydrolysis of dimethyl thiosulphite. In a further communication (*Naturwiss.*, 27, 317; 1939) the authors conclude that the reactions of this substance which are important as regards the formation of polythionic acids are the following: $\text{H}_2\text{S}_2\text{O}_3 \rightarrow \text{H}_2\text{S} + \text{SO}_2$ (1); $\text{H}_2\text{S}_2\text{O}_3 + \text{H}_2\text{S} \rightarrow 3\text{S} + 2\text{H}_2\text{O}$ (2); and $\text{H}_2\text{S}_2\text{O}_3 + 2\text{HI} \rightarrow \text{I}_2 + 2\text{S} + 2\text{H}_2\text{O}$ (3). These reactions proceed quantitatively under suitable conditions. Reactions (2) and (3) show that the thiosulphurous acid is a powerful oxidizing agent. In order to study the reactions of the acid without reaction (1) occurring, it is necessary to work in a non-aqueous solvent, and for this purpose anhydrous formic acid was chosen. It was thus possible to show that the first reaction is reversible. When dimethyl thiosulphite was hydrolysed by hydrochloric acid in the presence of sulphurous acid in the correct proportion, tetrathionic acid was formed quantitatively, the equation being $\text{H}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{SO}_3 = \text{H}_2\text{S}_4\text{O}_6 + 2\text{H}_2\text{O}$. With excess of sulphurous acid and at pH 8.9, trithionate and thiosulphate are formed in equal proportions: $\text{S}_2\text{O}_3^{2-} + \text{SO}_3^{2-} = \text{S}_3\text{O}_6^{2-} + \text{S}_2\text{O}_3^{2-}$. If in this reaction the sulphurous acid is replaced partly or completely by thiosulphuric acid, higher polythionic acids are formed, including hexathionic acid. Once formed, the polythionic acids do not react with the thiosulphuric acid. It will be seen that these reactions offer a satisfactory explanation of the formation of polythionic acids in Wackenroder's solution.

Photochemistry of Colour Vision

By Prof. F. Weigert and J. W. Morton*, University of Glasgow

SOME years ago¹, we prepared 'artificial retinas' by imbedding in thin gelatin films the pigments extracted from frog retinas. When such films were exposed to coloured light, they exhibited a typical phenomenon called 'colour selectivity', and it appeared probable that a similar process might account for colour vision in the living eye. As a result of colour selectivity, a preferential increase in transparency is developed for the wave-length of the exciting light, so that there is a minimum for this wave-length in a curve showing extinction plotted against wave-length. The effects are extremely small, and can be detected only by a special microphotometric device. This is based on the production of photodichroism in light-sensitive solid films which have been exposed to polarized light².

In the case of the artificial retina, the photodichroism is generally negative³. Its distribution through the spectrum can be measured very precisely by means of a good polarimeter with a monochromator. Colour selectivity occurs when the photodichroism has its minimum at the wave-length of the exposing light. It is of advantage to express colour selectivity diagrammatically as a maximum of negative photodichroism.

In previous experiments, solutions of sodium cholate were used for the extraction of the retinal pigments, but recent researches on the photochemistry of visual purple suggest that it is better to extract the pigments by solutions of digitonin⁴ or digitalin⁵. In the experiments here reported, crystalline digitalin (kindly presented by Mr. A. M. Chase) was used for preparing gelatin films from frog retinas. Since the dyestuff of the retina is imbedded in a film of large surface and small thickness its absorption is extremely small, but the change of absorption due to the exposure of the film to polarized light can easily be determined. The general technique of the preparation, exposure and inspection of the artificial retina was the same as described in previous papers^{1,2}.

*Strang Steel Scholar, University of Glasgow.

The main results of the new experiments agree with those published previously, with one exception. While the inspection of the artificial retina prepared with sodium cholate revealed unspecific after-effects which proceeded in the dark and destroyed the specific colour selectivity¹, these after-effects did not occur when digitalin was used for the extraction of the pigments. Accordingly, it is now possible to expose the same part of the film several times and to study the effects of increasing periods of exposure on the phenomenon. Its general feature can be described as an increase of photodichroism after a certain period of induction and a fading away after longer exposure. The phenomenon therefore is confined to a limited exposure interval on a time-scale.

The upper section of Fig. 1 shows the shape of the photodichroism curves which correspond to the illumination of the artificial retina with polarized light of narrow spectral range, purified by means of Christiansen filters. Because the maxima of these graphs coincide with the wave-lengths of the pure spectral colours which were used for the exposure, they may be termed 'colour graphs'. Each colour graph is qualitatively distinguished from any other colour graph. They cannot be transformed into each other by simple quantitative operations. The same holds true for the psychological sensation of colour. A colour graph therefore may be defined as an expression of the manner in which the artificial retina perceives coloured lights; for example, colour graphs with maxima at 650, 580 or 490 μ correspond to 'red', 'yellow' and 'blue' in common language.

The lower section of Fig. 1 contains colour graphs which are produced by light of mixed colours purified by ordinary colour filters which are transparent for a large continuous part of the spectrum. The wave-length noted in Fig. 1 is the dominant wave-length which matches the coloured light of the carbon arc used throughout the experiments, after passing through the filter. It is noteworthy that the colour graphs are nearly identical with those for pure monochromatic light although, for example, a yellow filter transmits the total spectrum except the blue. The graph for white light has its maximum at 530 μ .

This means that the artificial retina shares the inability of the eye to distinguish between different spectral compositions of light with the same dominant wave-length. On the other hand, the inspection of coloured light by a spectro-scope shows the spectral composition of the light, but it gives no idea of its 'colour'. The artificial retina has the colour system of a normal trichromat.

Further information about the artificial retina can be obtained from Fig. 2. Black lines

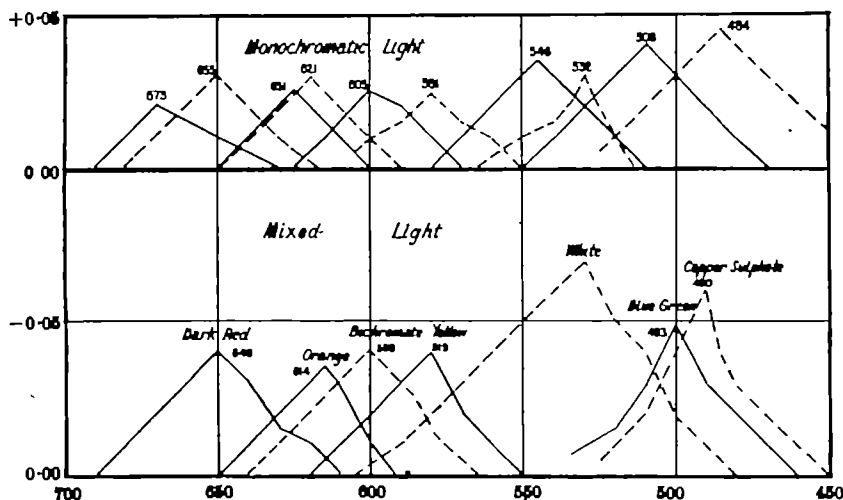


FIG. 1.

represent the limited time intervals of existence of the colour graphs for monochromatic lights (1-11) and mixed coloured lights against a logarithmic time-scale of exposure. λ (exp.) means the exposing wave-length or, in the case of mixed light, the dominant wave-length; λ (obs.) the wave-length for the maximum of the colour graph. The last column shows in hundredths of a degree the direct readings of photo-dichroism at the analyser of the polarimeter; 0.01° corresponds to a decrease of extinction by 0.00015 or to an increase of transparency by about 0.03 per cent. This means that the effect of colour selectivity is far below the limit of normal photometric precision.

Two time intervals of existence occur for the colour graphs, which are distinctly separated from each other, and are due obviously to a 'fast' and to a 'slow' photochemical process. The fast process accounts for the colour graphs from blue to orange and the slow process for orange to red, with some overlapping near 600μ . A provisional explanation is the existence of two photosensitive pigments in the retina which may account for the fast and slow processes. Both exhibit the property of colour selectivity, but up to the present, nothing can be anticipated as to whether these pigments are identical with rhodopsin and the recently discovered iodopsin*.

It can be seen from Fig. 1 that the values of the maxima of the colour graphs are invariably of the same order. This is obviously due to the fact that the pigments are highly diluted in the artificial retina and that they are completely exhausted even by weak radiation. The colour graph records, therefore, the hue typical of a coloured light. The effect of intensity and brightness is being studied. It appears probable that the existence in the retina of two light-sensitive pigments with the properties revealed by these experiments, plays a part in the 'Purkinje phenomenon' and certain colour vision anomalies.

The colour graphs corresponding to mixed lights (Fig. 2, 19-21) which the eye sees as mixed hues require some comment. Purple (19) which is always perceived as a dichromatic hue, produces a fast blue and a slow red colour graph. No. 20 corresponds to a pink which was produced from red (12) by adding some white light. The white and red components are recorded separately by the colour graphs. The mixture of red and green (21), which appears to the eye as whitish-yellow, produces at first a yellow colour graph at 585μ , a spectral range which did not occur in the exposing light. This yellow colour graph was followed by white and shortly afterwards by a red colour graph. The colour graphs for the single lights from which the yellow was composed correspond to the green (16) and the red (12), with the dominant wave-lengths 500 and 650μ . It is noteworthy that the red component in the pink light which contained some white light (20), appears as a 'fast' process, while pure red is typically in the 'slow' series. These experiments established the fact that the systems responsible for colour selectivity are not originally present in the films, but are produced by the light itself during the period of

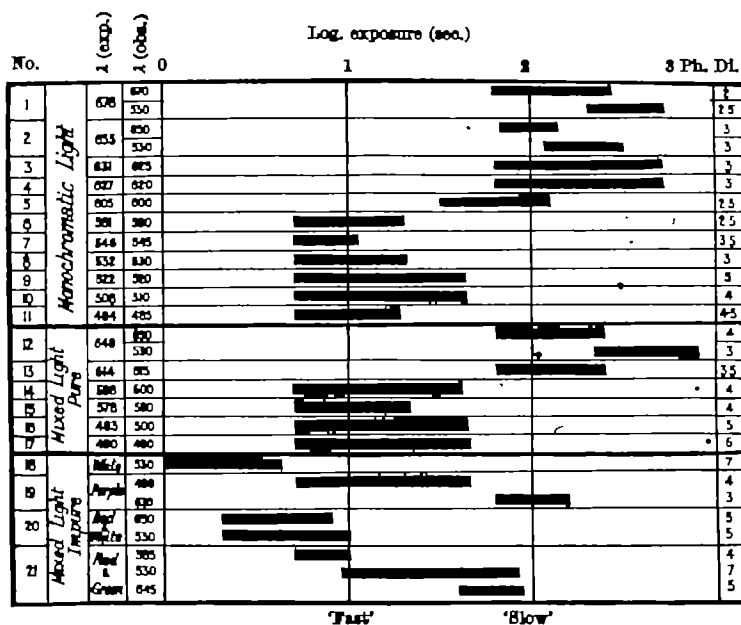


FIG. 2.

induction. Further research is in progress and will be published in due course. The examples with mixed lights demonstrate that the artificial retina distinguishes between pure and impure lights in the same way as does the eye. A hue which appears to the eye as composed of two 'valencies', for example, red and blue for purple, is recorded by two separate colour graphs.

Pure dark or mixed red light of a spectral range, or of a dominant wave-length, longer than 650μ (Nos. 1, 2, 12) is followed on continued exposure by a graph with a maximum at 580μ which does not occur in the exposing light. This slow process is distinguished from the fast process for green or white to be expected at that wave-length. No physiological phenomenon corresponds to this colour graph, but there are indications that it has its origin in an unspecific bleaching of visual purple, which cannot be observed during the state of high light adaptation required for the perception of dark red hues.

Any hypothesis with respect to the part which colour selectivity may play for colour vision must be postponed until the photochemistry of colour selectivity is clarified. But it is evident that some psycho-physical phenomena can now be studied by purely physical methods which are quite independent of the colour sense of a human observer. Even the modern graphical representation of chromaticity makes use of tri-stimulus values which are based on human colour vision*.

We are indebted to Prof. Edward Hindle for his interest in the research, and to the Society for the Protection of Science and Learning, the University of Glasgow and Lanarkshire County Council for financial help.

* Weigert, F., and Nakashima, M., *Z. phys. Chem.*, B, 7, 25 (1930).

* Weigert, F., *Ann. Phys.*, (4), 68, 669 (1930).

* Weigert, F., *Z. phys. Chem.*, B, 15, 73 (1933).

* cf. Tansley, Katherine, *J. Physiol.*, 71, 443 (1931).

* Chase, A. M., *Science*, 87, 238 (1938).

* Wald, G., *Nature*, 140, 545 (1937).

* cf. Hardy, A. C., "Handbook of Colorimetry" (Cambridge, Mass. 1936).

The Royal Observatory, Greenwich

Annual Visitation

THE annual visitation by the Board of Visitors of the Royal Observatory, Greenwich, presided over by the president of the Royal Society, took place on June 8, when the Astronomer Royal, Dr. H. Spencer Jones, presented his report for the year ending April 30, 1939. The report includes the following sections: instruments and apparatus; astronomical observations; time service; Nautical Almanac Office; magnetic observations; meteorological observations.

Transit Circle Observations. The programme for laying the foundations of a system of right ascensions with the new reversible transit circle has been continued. Since its inception in 1937, 4,333 transits have been observed; 1,501 collimations and 1,975 levels were taken in the course of these observations. Intensive observations have traced the main cause of the diurnal changes of collimation to small temperature differences between the micrometer screw and the eyepiece box, amounting sometimes to 2° F. Similarly, changes of level appear to be due largely to temperature differences between the two piers of the instrument, arising from unequal shielding in the case of any wind that is not due north or south. The adopted collimation and level errors are now derived from smoothed curves drawn through the values given by the observations; drift in the clock error has thereby been practically eliminated.

The Airy transit circle has been devoted chiefly to the observation of the sun, moon and planets. The Greenwich observations of the sun from 1750, combined with observations made at other observatories and used in conjunction with observations of the moon and Venus and of the transits of Mercury, form the data for investigating the changes in the rate of rotation of the earth. The results are being communicated to the Royal Astronomical Society.

Cooke's Zenith Telescope. 283 plates were taken for the determination of latitude variation. A definitive discussion of the observations for the years 1911-1936 is in the course of publication.

28-inch Refractor. The new comparison-image micrometer continues to prove superior to the filar micrometer, especially for the measurement of the closer double stars.

Thompson Equatorial, 26-inch Refractor. 1,238 plates for parallax determinations were secured and 38 parallaxes entirely completed.

Yapp 36-inch Reflector. With the slitless spectrograph the colour-temperature programme was completed in September. The discussion and detailed results for 250 stars will shortly be in the press.

The slit spectrograph has now taken the place on the telescope of the slitless spectrograph. In addition to experimental work, a provisional programme has been started, consisting of one-prism exposures, for the ultra-violet, on yellow and red giant spectroscopic binaries, to see whether a hot companion can be detected in this region of the spectrum even though its lines are smothered at longer wave-lengths.

Photoheliograph and Spectroheliograph. A daily series of photographs (begun in 1874) has been secured, in collaboration with the Cape Observatory and Kodaikanal Observatory, for the measurement of sunspot positions and areas. There are indications

that the peak of the maximum phase of the 11-year cycle has been passed. Eleven very large spot groups appeared during the year; in seven cases, a magnetic storm occurred within a few days of the respective times of central meridian passage. Examination of the sun's disk is made in hydrogen light ($H\alpha$) to detect the sudden occurrence of bright eruptions which show a relationship with ionospheric eruptions. Observations also include photometric measures of hydrogen disk markings and of prominences at the sun's edge.

Time Service. The official time services have been regularly maintained. The principle of employing a number of clocks as a 'mean clock' has been further extended and has proved of great assistance. The astronomical determination of clock error was made on 114 nights with a reversible transit instrument. The quartz crystal clock constructed at the National Physical Laboratory has been installed. The performance of the Westminster clock ("Big Ben") showed that, while on 16 days the error was greater than 1s., on 188 days the error did not exceed 0.5s. During the year, 4,170 chronometers and watches were received and 3,662 issued. The stock of chronometers and watches now held at the Observatory is being decentralized.

Nautical Almanac Office. During the year, the work of the Office has been mainly devoted to the routine calculation and publication of the *Nautical Almanac*, the *Abridged Nautical Almanac*, the *Air Almanac* and the *Astronomical Navigation Tables*. A working unit is being organized to deal with special investigations that frequently arise. A special supplement to the *Almanac* for 1940 will give data required in the design of instruments and their final adjustment. The paths of the ionospheric and corpuscular eclipses of October 1, 1940, have been published.

Magnetic Observations. A set of La Cour instruments for quick-run recording (3 mm. to the minute) has been added to the equipment at Abinger. The mean values of the magnetic elements for 1938 are:

Declination West, 11° 1.4'

Horizontal Intensity, 0.18522 gauss

Vertical Intensity, 0.43050 gauss

Inclination, 66° 43.2'

Magnetic activity during the year was considerable, five great storms and twenty-three small storms being recorded. The disturbance of the earth's magnetic field at Abinger by artificial fields due to electric traction is stated to have become increasingly serious as the electrification of the Southern Railway has extended. Disturbances (5 γ to 10 γ) is continuous throughout the working hours and ceases only during the interval 1h.-5h. civil time. The complexity of the total effect makes identification of the separate origins ordinarily impossible. The installation of the La Cour quick-run magnetograph has provided evidence, however, that significant effects occur coinciding with the movements of trains in the neighbourhood of Guildford as well as of Dorking. In the last few months, field investigations of the effect of electric traction have been made near

Chichester, at Itchenor and at Selsey. At the latter site, seven miles from the nearest point of the railway, disturbance was quite distinct, although seldom amounting to 1 γ in vertical intensity.

Staff. The post of chief assistant, rendered vacant by the appointment in the previous year of Mr. W. M. H. Greaves to the post of Astronomer Royal for Scotland, has been filled by Dr. H. R. Hulme, fellow of Caius College, Cambridge.

In concluding his report, the Astronomer Royal states the concern he feels regarding the steady deterioration of observing conditions at Greenwich. Long-exposure photography is no longer possible owing to the increasing brightness of the sky at night. As a result of atmospheric pollution by smoke, programmes of work which used to be successfully undertaken at Greenwich are now impracticable. The actual definition of stellar images has also suffered. In addition, there are various forms of fouling, the two most serious being the deposit of grit and the destruction of aluminized surfaces. The pivots and Y's of the new reversible transit, although carefully protected, already show appreciable scoring. There is a permanent risk of damage by grit to the

objectives of all the Greenwich telescopes. "If the Royal Observatory is to continue to make important contributions to astronomy as it has done for the past 284 years, and to provide an efficient time service of high accuracy, it is essential," the report continues, "that it should be removed to a site where astronomical conditions are favourable. The present wasteful efforts to secure observations under increasingly bad conditions, and the restrictions of programmes that are necessitated by such conditions, would thereby be avoided."

Finally, as regards the Abinger magnetic station, the general level of artificial disturbance is now such as to render all observations difficult, and when the disturbances are at their worst the observations lose much of their value. The removal of the magnetic observatory to another site has therefore become a necessity. The choice of a new site for such work in the south of England appears limited to a few regions in Devonshire.

The report concludes with the statement that proposals for the removal of the whole of the astronomical work from Greenwich and of the magnetic work from Abinger to new and more favourable sites are under consideration.

Historical Survey of Mycology*

UNLIKE the treatment of flowering plants, so far as Linnaeus was concerned, the subject of mycology had scarcely begun before his time. It is true that many fungi were mentioned by the classical writers but most of the interest in them was derived solely from their gastronomic effects. Their origin puzzled certain writers who regarded them as the result of the fermentation of the earth; truffles, on the other hand, were supposed to be due to the action of lightning. Herbals were based on classical authority: in 1593 Cesalpino wrote suggesting that fungi were not plants and were spontaneously generated.

Towards the end of the sixteenth century, Porta recognised the spores of such dark-spored forms as *Coprinus* and possibly of the mycetozoon *Phlegma septica*; but he thought they were seeds.

The arrival of the microscope was necessary before any progress in mycology could be made; but even then progress was slow. Hooke, in his "Micrographia", devoted two sections to fungi, and his description of the rose blight, *Phragmidium*, was accompanied by an illustration which is the first known diagram of a microscopic fungus. Hooke's views on fungi were thus expressed: "First, that Moulds and Mushrooms require no seminal property, but the former may be produc'd at any time from any kind of putrifying Animal, or Vegetable Substance, as flesh, etc., kept moist and warm. . . . Next, that as Mushrooms may be generated without seed, so does it not appear that they have any such thing as seed in any part of them; for having considered several kinds of them, I could never find any thing in them that I could with any probability guess to be the seed of it, so that it does not yet appear (that I know of) that Mushrooms may be generated from a seed, but they rather seem to depend merely upon a convenient constitution of

the matter out of which they are made, and a concurrence of either natural or artificial heat." In spite of accumulation of knowledge, similar ideas on the fungi extended over the following century and a half.

Malpighi, writing during 1678-79, described certain fungi in which he interpreted the sporangiophore as an inflorescence and the spores as florets. Thus, Hooke favoured the spontaneous origin of fungi, whereas Malpighi favoured the origin from seed.

Apart from Leeuwenhoek's observations on yeast in 1680, the next step was the recognition of the mycelium or spawn of mushrooms. Tournesfort, in 1707, gave the first account of mushroom-growing, and described the mycelium. Still further speculative theories of the origin of fungi appeared, until in 1729 P. A. Micheli published what may be considered as the first real step in our knowledge of the fungi. He made many morphological observations of first importance, but was actually still looking for flowers and seeds in the fungi examined. He also proved that what we now know as spores gave rise to new fungi similar to the plants from which they were taken. But in spite of Micheli's work, most botanists gave up the fungi as hopeless, and even Linnaeus in his "Philosophia Botanica" of 1751 wrote: "The order of Fungi is still Chaos, a scandal to art, no botanist knowing what is a species and what a variety."

Mixed by the observations of Baron O. F. Munckhausen, Linnaeus, in the twelfth edition of his "Systema Nature" described a genus "*Chaos*" with six species; the species "*O. Fungorum*" showed the metamorphosis of zoophytes from vegetables into animals and vice versa. "*O. Ustilago*" is the modern *Ustilago* which infects grains of cereals, grasses and certain florets. "*O. infusorium*" contained various Protozoa. The genus was rightly named, and thus did Linnaeus sadly come to grief.

John Ellis, who had a long correspondence with

* From the Presidential Address delivered to the Linnean Society of London, by Dr. J. Ramsbottom, O.B.E., on May 24.

Linnaeus on the subject, carried out a series of observations and finally convinced himself that the spores of fungi, like seeds of flowering plants, were unrelated to the animalcules which appeared when they were placed in water. But others, including Sir John Hill, persisted with Munckhausen's theory.

Necker, in 1783, published a treatise expounding the view that fungi were like plants in their method of nutrition, development and growth, but that they differed in origin. He therefore regarded them as a new kingdom between minerals and animals and proposed for it the name *Regnum mesymale*—the intermediate kingdom. Villemont also proposed a new class for them, namely, pseudo-xo-lithophytes.

Discussion on the origin of fungi which had been rife ended in 1783, and the conception of spontaneous generation was finally exploded by Pasteur, whose forerunners in this field of thought were Redi and Spallanzani.

In 1784, Hedwig published his classic work on

cryptogams, in which he proposed the use of the name 'spore' for the reproductive structures of these plants. In 1837, L veill  announced that spores are essentially different from seeds since they do not contain embryos. Hedwig's work was incorporated in the general mycological structure by Persoon, to whom was due perhaps more than to anyone else the foundation of systematic mycology. During 1815-74, the recognized authority on the classification of the fungi was Elias Fries.

The highly complex pleomorphy of the rust fungi took a long time to unravel, although heteroecism was much to the fore because of the damage caused by the rust of wheat. Heteroecism was proved conclusively in wheat by de Bary in 1865, while Oersted, in the same year, independently proved heteroecism in *Gymnosporangium* on junipers and pears.

The important part played by fungi in causing diseases of plants was obvious so soon as it was realized that mildews, etc., were fungi.

Training of Teachers

A DETERMINATION that teachers, as a body, should not be inferior to other professions in respect of their education and training led the National Union of Teachers to undertake two years ago an investigation of the whole question of the training of teachers and the grants available for the purpose. The investigating committee, composed of six members of the Union's executive and six representatives of university training departments, of training colleges and of secondary schools, completed its work last February, and the report* has been published in the form of a book of 360 pages including a summary of the principal conclusions formulated in 95 articles. These range over a wide field, including recruitment and placing as well as training. Although a number of the recommendations concern the content of training courses, the committee regarded such things as internal matters for the training institutions. In a preliminary chapter a strong case is made out for requiring some actual experience of teaching practice before admission to a training institution, this being desirable less for its intrinsic value than as a test of aptitude for the career of a teacher, for it is notorious that many recipients of grants for training have no such aptitude nor even any serious desire to take up teaching as a profession. It is proposed to make an officer of the local education authority report on the teaching potentialities, personality and general suitability for the teaching profession of every applicant for a place in a university training department or training college.

The vital importance of teaching practice as part of the college or university course is also emphasized and it is mainly to provide adequate opportunities for this that the report recommends the lengthening of the course to three years as a minimum. The report is equally emphatic as to the influence of residential conditions during the years of training, and proposes that residence in a college or hostel should be compulsory for all and that funds should be provided for ensuring that hostels are run on the

right lines as recommended by the University Grants Committee in its last quinquennial review.

Above all, the committee was concerned to press on towards the ideal of "a unified profession to serve a unified system of education", implying for the teacher trained in a training college a status equivalent to that of the university graduate. To this end it is proposed to develop the connexion between training colleges and universities so that the former may eventually become integral parts of the latter. On the crucial question of the staffing of training colleges the report observes that salaries are inadequate and prospects of promotion relatively small but leaves it at that, the additional grants it proposes for training colleges being intended to enable them to reduce the fees payable by students, not to make possible a higher standard of qualification and status for the staffs. It quotes with approval a suggestion that the staffs might be strengthened by the addition of two or three experienced practising teachers seconded for a definite period of years.

The report concludes with a paragraph on the need for immediate investigation by the Board of Education. Should such an investigation be made, it is to be hoped that the fundamental importance in this connexion of the progress of science will be recognized. The progress of science and its application has brought about changes which should affect the training of teachers both in respect of science teaching and as calling for a change in the attitude of all teachers towards science. Progress is so rapid that science teaching in schools is bound to lag hopelessly behind and be correspondingly ineffective unless it is kept constantly under review by competent observers, and modified and readjusted whenever necessary, and unless examining bodies are compelled to take cognizance of such changes. On the other hand, the social and economic transformations resulting from it are so sweeping that it is of the first importance that science should form an integral part of the curriculum of the primary as well as the post-primary school and that all teachers should grasp the relations of science teaching to the teaching of other subjects. The question is discussed in Prof. Bernal's recent book on "The Social Function of Science".

* The Training of Teachers and Grants to Intending Teachers Being a Report of a Committee of Investigation appointed by the Executive of the National Union of Teachers and adopted by the Executive on 3rd March 1939. Pp. xxxi+328. (London: National Union of Teachers, 1939.)

Science News a Century Ago

Societies and Academies

Heating and Ventilation of Public Buildings

A CENTURY ago much attention was being paid to the heating of both domestic and public buildings, and stoves of many kinds were being placed on the market. Patents for steam-heating apparatus had been taken out in the eighteenth century, and at the same time the hot-water heating system had been adopted for various purposes. At a meeting of the Institution of Civil Engineers on June 11, 1839, the subject was dealt with by Charles Hood in a paper entitled "On Warming and Ventilating Public Buildings and Apartments, with an account of the methods which have been most successfully employed in insuring a healthy state of the Atmosphere". In this paper he described the constitution of the atmosphere, the artificial changes produced in it and the effect of those changes upon annual economy. He pointed out the consequences of heating by very hot iron surfaces, or by a 'hot air cockle', and said that the systems of Mr. Bernhart and Dr. Arnolt were open to the same objections. Referring to the use of the more moderate heat of steam or hot water in pipes, he said the latter was the more economical and simple plan. The amount of heating surface depended on the building, but an approximate rule for a public building was its cubic contents divided by 200 to give the square feet necessary to maintain a temperature of 55° to 58° in the coldest weather in Great Britain. When speaking of ventilation, he said that the amount of air to be changed was 3½ cubic feet per minute per person. Natural ventilation through openings in the ceiling was the best for ordinary purposes, but in all extraordinary cases ventilation by mechanical means was the only efficacious method.

Trigonometrical Survey of India

ONE of the papers read at the Astronomical Society on June 14, 1839, was entitled "Some account of the progress of the Trigonometrical Survey now carrying on in India, extracted from the Correspondence of Colonel Everest". During the earliest operations the stations were the highest points of the mountains or hilly land; but a new district was about to be traversed where such advantages did not exist. This district, described as the Doab, was a country devoid of all natural elevations, but having mounds which appear to have been raised by the native inhabitants. For the operations in the Doab, Col. Everest contrived masts 70 ft. high, from the top of which by means of a bamboo staff an ignited blue-light was raised still 20 ft. higher. The site he chose for a base line was at Dhera Dun, near Sisse Bara on the verge of the Asan River. He had a complete set of compensation measuring rods like those used by Colonel Colby in Ireland. During his observations he had encountered some extraordinary phenomena of refraction; in many instances the distant helioscope, instead of exhibiting a round disk, appeared in the form of a tall column. His possession of the compensation bars had induced him to re-measure the base line at Seronge which he had measured in 1825 with a steel chain, and his experiences led him to the opinion that it would be necessary to revise the whole of Colonel Lambton's work before it could be joined on to the series of triangles recently completed with the new instruments.

Paris

Academy of Sciences (C.R., 208, 1257-1368, April 24, 1939).

M. MOLLIARD: New researches on the production of tubercles on potato in an aseptic medium.

H. DEVAUX: Remarkable relation between cellular constitution and 'wettability' of mosses.

C. EHRESMANN: Topology of simple closed groups.

H. HOFF: Topology of closed Lie groups and their generalizations.

P. HERRONI: Linear differential equations in a ring of certain continued matrices (hyperbolic matrices) and their applications to certain integro-differential equations.

N. OBERCHOFF: Zeros of some polynomials.

J. MARCINKIEWICZ: Interpolation of operations.

L. BERG: An integral representation of biharmonic functions in domains possessing an observable boundary surface.

P. COUDREBO: Luminous aureoles of novae.

C. SALOMANU and H. MCCORMICK: New method for the determination of the surface tension of liquids, based on the weight of falling drops.

E. BAUMGARDT: Measurement of certain adiabatic elastic constants of crystals, by the ultrasonic method.

MILN. A. DAMMANN: Analysis of musical sounds. Sounds of different instruments have been recorded by a cathode ray oscillograph; the results have analysed by a Coradi harmonic analyser.

M. PARODI: A phenomenon of the propagation of waves. Application to thermodynamics.

O. TE-TCHAO and H. LE BOITEUX: Coefficient of absorption of small ions by neutral particles suspended in air.

M. ROUAULT: Fourier analysis of the diffraction of electrons by free molecules.

C. S. PIAT: Absorption spectra of salicylic acid and of its alkaline salts in aqueous solutions.

P. ROUARD: A phase change of 2π in [optical] metallic reflection.

S. S. LU, C. HUNG-CHI and L. TA-YUAN: Influence of pressure on photographic sensibility to X-rays.

G. DUPOUY and C. FERT: Magnetic rotatory power of heavy water. Dispersion and variation with heat.

MILN. C. CHAMÉ: Grouping of atoms of radio-colloids.

T. SAN-TSIANG: Groups of protons emitted during bombardment of hydrogenous substances by α -rays.

V. KOSTOMAROFF: Influence of 'chemical tensions' and size of grain on the magnetic properties of a pure iron and of a silicon-iron.

MILN. S. VAIL: Introduction of further solutes into aqueous potassium iodide, and electrostatic effects.

E. DARMOIS and MILN. M. THEODORSSON: Raman spectrum of neutral molybdates, in the crystalline state and in aqueous solution.

M. BALLAY: Properties of some aluminium bronzes with beryllium.

MILN. P. RAMART-LUCAS: Structure and absorption of hydroxylated colouring matters derived from triphenylmethane; existence of two coloured isomeric forms of phenolsulphophthaleins and of phenol phthaleins.

Dublin

Royal Irish Academy, May 8.

D. BODROUX and R. THOMASSIN: Some derivatives of *ortho*- and *para*-cyclohexylphenols.

R. QUELLET and J. DUCASSE: Chloroalcoholation of *para*-propylanisol; application to the synthesis of some derivatives.

R. PAUL: Action of Raney nickel on alcohols; probability of combination of the catalyst with hydrogen receptors.

R. LOMBARD: Contribution to the study of pyro-abietic acids.

Z.-C. GLAUNT: Condensing reductions [in organic chemistry].

J. H. BRUNN: New observations on the south-west border of the Albano-Thessalian fold in Greece.

J. LUGNON: An integrating altimeter for aerological sounding.

A. ARNULF, R. BERNARD, D. CAVASSILAS and G. DELIARDIN: New description of the spectrum of the night sky in the ultra-violet region.

G. DEFLANDER: The 'stephanoliths', representatives of a new type of coccoliths of the Upper Jurassic.

P. DANGEARD: Some new marine algae of western Morocco.

MLLH. M. FOURCROY: Non-continuity of the internal generating zone of young roots.

R. SOULGES: Embryogeny of the Polemoniaceae; development of the embryo in *Polemonium corulorum* L.

R. GAUTHERET: Measurement of the growth of tissues of carrot cultivated *in vitro*.

G. GUITTONNEAU and MLLH. S. HAAS: A *Sporotrichum* agent of normal maturation of certain cheeses.

M. RANGIER and P. DE TRAVERSE: Urinary glycuronic acid and urochrome.

L. DAUTERBRAND: An anti-gas filtering cannister of high neutralizing capacity and responding to the exigencies of respiratory physiology.

R. CATALA: Acceleration by shock of the metamorphosis of caterpillars of *Chrysidia madagascariensis* Cram. (Uraniidae).

A. VANDEL: Researches on the genetics of *Armadillidium vulgare* (Latre.) in relation to monogeny.

A. PHYRON: Homologies between the embryonic vesicles of the human ovum and those of the parthenogenetic *embryomas*.

J. LOISELLEUR: Mechanism of the action of diastases of the tryptic group.

J. LAVOILLAY and MME. F. LABOREY: Definition of the coefficient of action of magnesium for *Aspergillus niger*; its variations with the composition of the medium.

R. DUBCHINSKY and J. JEANNERAT: Obtaining natural amino acids, starting from the racemic forms, by means of the *D*-amino-acid oxidase.

MLLH. S. VILLENEUVE-BRACHON: Division and formation of the peristome of *Licnophora* (L. Chattoni n.sp.) [Ciliates, Heterotrichs].

MLLH. G. CORDIER: Adsorption of aphthous virus by bone charcoal and tricalcium phosphate; application to immunization of the guinea pig.

M. PIÉRY, J.-F. MARTIN, J. ENSELME and O. PASCHIERA: Experimental study of the biological influence of a prolonged stay at an altitude; pulmonary modifications. Geese and rabbits were kept at the Jungfraujoch station for six months; hearts of the former show no lesions; of the latter, variable lesions. Lungs are all congested, the iron content being greatest with much congestion.

KENNETH O. BAILLY: Retardation of chemical reactions. (9) Choice of retarders in liquid phase oxidations. The results of nearly two hundred investigations of oxidations in the liquid phase have been summarized in tabular form, and the cases in which particular groups of retarders have been found to be successful or unsuccessful have been noted. No substance is known to retard all types of liquid phase oxidation. Deductions have been made as to the retarders likely to be helpful for particular groups of oxidizable compounds, and samples are given of retarders which, having been found of value in certain cases, would repay further investigation.

Rome

National Academy of the Lincei (*Atti*, 28, 283-330, 1938).

E. BOMPIANI: Projective geometry of a homogeneous linear partial differential equation. (1) Classification of the quasi-asymptotics. (2) Invariant systems associated with a system of quasi-asymptotics.

M. VILLA: Quasi-asymptotic curves (2).

T. VIOLA: Limits of an integral in the ordinary form depending on equal and uniform Lipschitz functions with first derivatives.

G. SOORZA DRAGONI: Criterion of existence for a problem of limiting values.

L. GIALANIELLA: Heterochromatic photometry and colour index of the planets Neptune and Vesta.

Tokyo

Imperial Academy (15, No. 3, 69-100, March 1939).

RYOJI SAKATA: A problem concerning transformations of polyhedra to spherical surfaces.

YUKIYOSI KAWADA: Characters of linear groups.

KÔITI KONDO: A proof of Toeplitz of the normal matrix.

AKITUNE IMAMURA: Land deformations and seismic activity in the Mutu-Dewa district.

SHIGEHICO SUGAWA, KÔITI SAKURAI and NORIO SUGIMOTO: Synthesis of some 1,2-polymethylenetetrahydro-iso-quinolines. Analyses were executed by Mias K. Serikawa.

HISAKATSU YABE and TOSHIO SUGIYAMA: Discovery of a Mesozoic hexacoral in a green schistose rock of the Kamuikotan system of Hokkaidô.

HARUO KINOSHITA: Electrolytic 'washing' of *Paramecium*. Unlike most living cells, by this method, *Paramecium* can be repeatedly washed in distilled water practically indefinitely, provided that the water is free from oligodynamic impurities.

TADAO YOKOYAMA: Circulation of blood in the silk worm. The generally accepted circulatory course of the blood is disproved.

EIJI FUKUSHIMA: Acanaphthene as a polyploidizing agency. Young archesporial cells are affected by acanaphthene and produce polyploid pollen grains. The polyploidizing value on late archesporial cells and cells in the meiotic stage is much lower.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ASSISTANT CIVIL ENGINEER ADVISER to the Director of Ordnance Factories, India—The Secretary, Military Department, India Office, London, S.W.1, marking envelope "Ordnance Department" (June 12).

ASSISTANT WORKS MANAGER at the Cordite Factory, Aruvankadu, Madras—The Secretary, Military Department, India Office, London, S.W.1, marking envelope "Ordnance Department" (June 12).

ASSISTANT LECTURER IN GEOGRAPHY in the University of Sheffield—The Registrar (June 12).

WOMAN LABORATORY ASSISTANT at the Horton Malaria Laboratory, Horton Hospital, Bpsom—The Director of Establishments, Ministry of Health, Whitehall, London, S.W.1 (June 12).

DEMONSTRATOR (man or woman) in the DEPARTMENT OF ZOOLOGY at Bedford College for Women, London, N.W.1—The Secretary (June 12).

ASSISTANTS (III) for compilation and analysis of statistical data in the Directorate of Scientific Research, Air Ministry—The Superintendent, Bawdsey Research Station, Bawdsey Manor, Woodbridge, Suffolk, quoting Ref. O.800 (June 16).

ASSISTANT LECTURER IN ZOOLOGY at Chelsea Polytechnic, London, S.W.8—The Principal (June 16).

HEAD OF THE PHYSICS DEPARTMENT in the Swansea Municipal Technical College—Director of Education, Gulliford, Swansea (June 16).

JUNIOR LECTURER IN CIVIL ENGINEERING in Queen's University, Belfast—The Secretary (June 17).

LECTURER IN THE DEPARTMENT OF PHYSICS, University College of Wales, Aberystwyth—The Registrar (June 17).

LECTURER IN MATHEMATICS in the County Mining and Technical School, Nuneaton—The Principal (June 17).

HEAD OF THE DEPARTMENT OF ENGINEERING AND BUILDING in the County Technical College, Guildford—The Principal (June 17).

LIVERPOOL OFFICER in the Ministry of Agriculture and Fisheries—The Secretary of the Ministry, 10 Whitehall Place, London, S.W.1 (June 19).

LECTURER IN METALLURGY in the Technical College, Bradford—The Director of Education, Town Hall, Bradford (June 21).

LECTURER IN ORGANIC CHEMISTRY in University College, Bangor—The Registrar (June 24).

HEAD OF THE PHARMACY DEPARTMENT of the Central Technical College, Birmingham—The Principal (June 24).

TUTOR (Geography) and a **TUTOR (Mathematics)** in the Gordon Memorial College, Khartoum—The Controller, Sudan Government, London Office, Wellington House, Buckingham Gate, London, S.W.1 marked "Tutor (Geography)" or "Tutor (Mathematics)" respectively (June 25).

TWO RESEARCH OFFICERS (Farm Management and Agricultural Caring) in the Agricultural Economics Research Institute, Oxford—The Secretary of the Committee for Rural Economy, School of Rural Economy, Parks Road, Oxford (July 1).

UNIVERSITY PROFESSOR OF METALLURGY at the Imperial College of Science and Technology—The Academic Registrar, University of London, Senate House, W.C.1 (Jan. 31, 1940).

ASSISTANT ENGINEER (M/5731) for the Malayan Public Works Service and an **ASSISTANT ENGINEER (M/5765)** for the Drainage and Irrigation Department, Malaya—Crown Agents for the Colonies, 4 Millbank, London, S.W.1.

PROFESSOR OF MINING ENGINEERING and **PROFESSOR OF ORE DRESSING** in Laval University, Quebec City, Canada—The Secretary, Faculty of Science.

The Annual Report of the Oundle School Natural History Society. Pp. 28. (Oundle: Oundle School.)

Department of Scientific and Industrial Research. The Investigation of Atmospheric Pollution. Report on Observations in the Year ended 31st March 1938: Twenty-fourth Report. Pp. v+117. 1 not. General Deposit Tables for the Year ended 31st March 1938 Supplementary to the Twenty-fourth Report. Pp. ii+124. 4s. 6 not. (London: H.M. Stationery Office.)

Proceedings of the Royal Irish Academy. Vol. 45, Section B, No. 1. Reports from the Limnological Laboratory. 4: The Phytoplankton of the River Shannon and Lough Derg. By B. Southern and A. Gardiner. Pp. 89-124+plates 17-21. 2s. Vol. 45, Section B, No. 2. River Liffey Survey, 2: The Food consumed by the Brown Trout (*Salmo trutta* Linn.) in Acid and Alkaline Waters. By Winifred J. Frost. Pp. 129-206+plate 24. 2s. Vol. 45, Section B, No. 13: Lary Stages of the Euphausiid *Tropocyclops aestivus* (Holt) and Tertiary taken off the South-west Coast of Ireland. By Winifred J. Frost. Pp. 201-219. 1s. 6d. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Morgate, Ltd.)

Other Countries

U.S. Department of the Interior: Office of Education. Vocational Division Bulletin No. 199 (Trade and Vocational Series No. 57) Vocational Training for Foremen. By Frank Cushman. Pp. v+58 (Washington, D.C.: Government Printing Office.) 10 cents.

Journées Internationales de Chronométrie et de Métrologie, Paris, Juillet 1937. Procès-verbaux et mémoires recueillis par René Baillet de Pierre-Nicolas. Pp. 740. (Paris: Éditions de la Revue d'Optique Scientifique et Instrumentale.)

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series B, No. 25: A Dial Reading Apparatus for the Determination of Fibre Strength. By S. S. Sukthanker, D. N. Ahmad and H. Nayak. Pp. 16. 1 rupee. Technological Bulletin, Series B, No. 27: The Determination of the Swollen Diameter of Cotton Fibres—Effect of Size of Sample on the Significance and Reliability of the Results. By B. R. Koshal and Dr. N. Ahmad. Pp. 12. 8 annas. (Bombay: Indian Central Cotton Committee.)

Proceedings of the U.S. National Museum. Vol. 86, No. 2064: Two New Ophiurans from the Smithsonian-Hartford Expedition, 1937. By Hubert Lyman Clark. Pp. 415-418+1 plate. Vol. 86, No. 2065: New Species of Flatworms from North, Central and South America. By Libbie H. Hyman. Pp. 419-440. Vol. 86, No. 2066: Modernism of the Smithsonian-Hartford Expedition, 1937, with other West Indian Records. By Austin H. Clark. Pp. 441-456. (Washington D.C.: Government Printing Office.)

U.S. Department of the Interior: Office of Education. Bulletin 1937, No. 13: Economic Status of Rural Teachers. By Walter H. Gammita. (Project of Research in Universities.) Pp. viii+56 (Washington, D.C.: Government Printing Office.) 10 cents.

Memoirs of the Geological Survey of India. Palaeontologia Indica New Series, Vol. 27, Memoir No. 1: The Mesozoic Brachiopoda of the Bannu District. By Dr. M. R. Sahni. Pp. iv+26+2 plates (Calcutta: Geological Survey of India.) 1.6 rupees, 2s.

Publications of the Dominion Observatory, Ottawa. Vol. 13 Bibliography of Solimology. No. 20: Items 4189-4259, October-November, December 1938. By Ernest A. Hodgson. Pp. 406-426 (Ottawa: King's Printer.) 25 cents.

Mitteilungen der Naturforschenden Gesellschaft Bern aus dem Jahre 1938. Pp. ix+178. (Bern: Paul Haupt.)

Nigeria. Annual Report on the Forest Administration of Nigeria for the Year 1937. Pp. 46. (Lagos: Government Printer; London: Crown Agents for the Colonies.) 4s.

Punjab Irrigation Research Institute. Research Publication, Vol. 4, No. 10: Dispersion and Stability of Soil Colloids in Water, Part 1. Auto-Diintegration. By Dr. Amar Nath Puri and Manohar Lal. Pp. 8+7 plates. 7 annas. 8d. Research Publication, Vol. 4, No. 11: Dispersion and Stability of Soil Colloids in Water, Part 2: Ultra-Clay and the Efficiency of Dispersion Methods. By Dr. Amar Nath Puri, B. R. Puri and Manohar Lal. Pp. 9. 4 annas. 6d. Research Publication, Vol. 4, No. 12: The Sodium Carbonate Method of Lining Canals and Water-Courses for preventing Seepage Losses. By Dr. Amar Nath Puri. Pp. 11+4 plates. 4 annas. 6d. Research Publication, Vol. 5, No. 8: The Development of the Electrical Analogy to Problems of Flow of Water in Sub-Soil, with Special Reference to the Design of Weirs and similar Structures. By Gurdas Ram and Dr. V. I. Vaidyanathan. Pp. 44+88 plates. 1.10 rupees; 2s. 6d. Research Publication, Vol. 5, No. 9: On the Transmission Constant of Water in Subsoil Sands. By Othman Singh, Hans Raj Luthra and Dr. V. I. Vaidyanathan. Pp. 7+9 plates. 7 annas; 8d. (Lahore: Punjab Irrigation Research Institute.)

Catalogues, etc.

Die Askania-Werte. Jahrgang 4, Nr. 17, Mai-Juni 1939. Pp. 49-72. (Berlin-Friedenau: Askania-Werke A.G.)

Solar Telescope at Oxford University Observatory. (Reprint) from *Engineering*, March 10 and 24, 1939. (Publication No. 1. Pp. 16+1 plate. (Newcastle-upon-Tyne: Sir Howard Grubb, Paris and Co.)

Catalogue of Books on the Subjects of Geology, Palaeontology, Conchology, Entomology, Ornithology, etc. (No. 279.) Pp. 16. (London: Dulau and Co., Ltd.)

Botanik. Zeitschriften, Bücher, Monographien. (Antiquarische Katalog Nr. 56.) Pp. 232. (Leipzig: Karl Max Poppe.)

Mobile Pumping Units for Vacuum or Pressure. (Mob. 1.) Pp. 4. (London: W. Edwards and Co.)

Deutsche Landes- und Ortsgeschichte: Genealogie und Heraldik. (Antiquarische Katalog Nr. 732.) Pp. 322. (Leipzig: Buchhandlung Gustav Fock, G.m.b.H.)

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Patents, Designs and Trade Marks. Fifty-sixth Report of the Comptroller-General of Patents, Designs and Trade Marks, with Appendices, for the Year 1938. Pp. 26. (London: H.M. Stationery Office.) 6d. net.

South Pacific Ocean Currents. Published by authority of the Meteorological Committee and prepared in the Marine Division of the Meteorological Office under the supervision of Capt. L. A. Brooke Smith. (M.O. 436.) Pp. 10. 35 in. x 24 in. (London: H.M. Stationery Office.) 7s. 6d. net.

How to Banish Hay Fever. By William Gilbert Orr. Pp. 32. (London: Orzone (London), Ltd.) 1s.

Scottish Education Department. Report on the Royal Scottish Museum, Edinburgh, for the Year 1938. Pp. 23. (Edinburgh and London: H.M. Stationery Office.) 4d. net.

British Trust for Ornithology. Fifth Report, Spring 1939. Pp. 36. (London: British Trust for Ornithology, c/o Zoological Society of London.)

King's College: Dove Marine Laboratory. Report for the Year ending July 31, 1938. (Third Series, No. 6.) Pp. 45. (Oullockrocks: Dove Marine Laboratory.) 5s.

The Scientific Journal of the Royal College of Science. Vol. 9: containing Papers read during the Session 1938-1939 before the Imperial College Chemical Society, the Royal College of Science Natural History Society, the Royal College of Science Mathematical and Physical Society. Pp. 187. (London: Edward Arnold and Co.) 7s. 6d.

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Discipline in Freedom

THE three lectures which Lord Baldwin delivered at Toronto in April last, inaugurating the lectureship founded in memory of Sir Robert Falconer, have distinct claims on the attention of scientific workers. His analysis of the ideals and dangers of democracy and of the opposing forces at the present time both clarifies the fundamental issues and sounds a call to service to which men of science will not wish to be indifferent.

The supreme task, Lord Baldwin asserted, is that of combining freedom and discipline; in these lectures he adds one more voice to the many that have summoned scientific workers and their fellows to the defence of freedom of thought and speech and to the necessity of self-discipline and spontaneous service in order to enable the survival of our ideals. Lord Baldwin also insists on the necessity for having regard to the trends of our modern industrial system, for a wide perspective and not partial or biased views, and for imaginative handling of the possibilities which physiological knowledge and medical science offer us of eliminating some of the fundamental causes of industrial unrest by minimizing the strain or stress due to speed or monotony.

Here indeed is scope for further investigation, and not even the immediate exigencies of national defence should be allowed to stand in the way of increased effort in such fields as those in which the National Institute of Industrial Psychology and the Industrial Health Research Board are working. The work of the latter Board, it should be remembered, owes its origin to endeavours to safeguard the health of munition workers and increase their efficiency. A national defence policy must have full regard to the health of those who answer

the call to national service, whether in working or in leisure hours. The careless destruction of amenities may have serious consequences to the national efficiency or morale in more ways than one. The protests against the proposal to erect a steel works in the Edale district find strong justification in the threat the proposal may well involve to the health of the industrial populations which have benefited so much from the availability of that district for recreation.

This is indeed a particular aspect of the problem of maintaining standards, which Lord Baldwin reminds us is an ever-present danger in a democracy. The coalition of paganism and machinery which makes the situation grave to-day challenges almost every one of the essential values cherished in a democracy—human personality, freedom and truth. Universities have their special responsibilities in maintaining those standards, and above all in supplying leaders who will be loyal to them and adamant in their service. The pursuit of intellectual truth is the chief object of university training, as the advancement of knowledge is one of the chief functions of a university.

The logical sequel to the pursuit of intellectual truth in the university is that the community is entitled to expect those leaving a university to have trained minds able to give dispassionate consideration to varied problems. This point was made by Sir Robert Pickard, vice-chancellor of the University of London, in addressing the new graduates at the annual degree-giving ceremony last month. He warned them that their academic distinctions were based mainly upon book learning, and gave them no claim to special consideration, except in so far as their training had taught them to develop unprejudiced minds able to weigh evidence. Such.

critical interest in world affairs is indeed the plain duty of all thoughtful men.

Sir Robert Pickard also referred to the attacks which have been made in recent years upon mental freedom. A constant desire for truth, a hunger for knowledge, a balanced judgment and earnest consideration for the views of others who might not share their views on different problems, these are the hall-marks of a truly educated man. This attitude can only be achieved in an atmosphere of academic freedom, wherein the mind can follow the pursuit of knowledge untrammelled by the dictates of State or other institutions. Without mental freedom, Sir Robert rightly said, humanity and civilization must surely perish. It is a precious gift, which all who cherish learning would wish to hand on undiminished in value to succeeding generations.

Nevertheless, the path to knowledge, as Sir David Munro pointed out in his rectorial address at St. Andrews, is a disciplined path. The freedom we still possess in Great Britain to think for ourselves, to study the particular fields of knowledge that interest us, to act fearlessly on the dictates of our opinions and ideals involves discipline of the mind as well as of the body. Lack of self-discipline, Sir David Munro asserted, is what most endangers freedom.

The discipline and freedom of our schools and universities are not always enough to develop innate qualities of leadership. Sir David Munro pointed out that sometimes neither school nor college life fosters the eagerness and zest for life without which freedom is an empty gift and there is little worth disciplining. Such failure does not always lie in missed opportunities or in the biological make-up of the individual. What is lacking is interest or desire, in default of which faculties lie dormant and the tide of life runs low. Zest, he contended, is what matters; but without discipline it is unbridled, and without freedom it is stifled.

Nor is this reminder one for youth alone. It may be that youth has its special advantages and opportunities to be experimental. One of democracy's greatest needs to-day is for creative minds, willing and able to experiment wisely and constructively. A root cause of our failure to develop the new technique of social control which Lord Baldwin desiderated is this lack of zest and lack of interest in the social consequences of scientific discovery on the part of scientific workers themselves. That indifference is passing, but until disciplined enthusiasm in such matters is char-

acteristic of the overwhelming majority of scientific workers, we can scarcely hope to progress at the rate desired.

What we have yet to take account of is the changed condition of the struggle. New social techniques are available for directing mass behaviour in obedience to one man's will; new economic techniques for the industrial regimentation of the workers; new financial techniques for the ruthless taxation of rich and poor, for the plunder of aliens and the enemy within the gates. Plans can be prepared in secret and applied overnight for the enslavement of a whole nation and for the swift incarceration of its leaders by the hundred or by the thousand as required.

Conditions such as these impose on all democracies the necessity of attaining new levels of technical efficiency for self-defence and in co-operation. Moreover, there must be a devotion to the ideals of social justice and individual freedom inspired by a passion and zest for life which more than match the idolatrous worship of the State and brute force in the totalitarian countries. Grave as may be the threat which the menace of war offers to the world at the moment, if those in whose hands the defence of truth and freedom still remains are inspired, not by academic loyalty, but by a passionate zest for life, the danger may yet be averted, and advances in the standards of life for multitudes which social and scientific progress have made possible may be realized.

This is above all a question of leadership. It is not to be achieved by the pursuit of academic freedom as a thing apart from life, but by unflinching devotion to whatever that service and quest may involve in the social and political world, no less than within the walls of a university or laboratory. It demands that scientific workers themselves be willing to seek out and deal with all that restricts the full freedom of investigation or exposition and interpretation, or retards the application of the results of their work in the service of mankind. It means in practice the close study or investigation of many problems or even whole fields as yet largely unexplored. It means the acceptance of responsibilities for leadership and service and the development of such capacities, no less than of technical or scientific qualifications. But it involves above all an enthusiasm, a zest for life, a vision and sense of values and loyalty to ideals implicit alike in real leadership and in that moral disarmament for which the call was issued with the appeal for national service.

Cylinder Seals

■Cylinder Seals

A Documentary Essay on the Art and Religion of the Ancient Near East. By Prof. H. Frankfort. Pp. xlvii+328+47 plates. (London: Macmillan & Co. Ltd., 1939.) 42s. net.

THE cylinder seal is the typical product of the civilization of those countries and periods where cuneiform writing was employed, as is the scarab in Egypt or the coin on Roman sites. Invented at some period well before 3000 B.C., at the end of what is now called the Uruk period, in the land of Sumer, by men who had already begun to write, it spread wherever writing on clay with impressed signs was adopted. During the long ages which preceded its final disappearance, when Alexander conquered the East, roughly some three thousand years, this type of seal was employed at different times in Elam and Persia, in Anatolia, Syria and Palestine, in Cyprus and the Aegean islands. In Egypt, too, the shape was common at an early date, and it has long been a subject of debate whether its use there was borrowed from Mesopotamia or independently invented; Prof. Frankfort is now able to show, in his fourth chapter, that some cylinders from Egypt actually must have been importations from Sumer in the Jamdat Nasr period, which followed the invention of the type in Sumer, and that those Egyptian seals which show no trace of foreign influence, when placed beside those that do, point to the way in which a foreign idea can be borrowed and developed independently. Later, the cylinder seal lost its popularity in Egypt, perhaps owing to the practice of writing on papyrus, and occurs only sporadically, though occasionally examples of true Babylonian cylinders, imported, occur.

The classification of such a quantity of material, for there are many thousands of these seals in European and American museums, has been the subject of large catalogues of public and private collections. Much still remains to be done in this essential ground-work. What Prof. Frankfort supplies in this book is a brilliant, comprehensive *aperçu* which serves as a most readable introduction to the subject and will also give the necessary background for the cataloguing which has still to be done.

The purpose of the essay is correctly described in the sub-title. Questions of form are mentioned, but discussed only briefly; little emphasis is placed on the materials employed and cutting is scarcely described apart from an account of the tools employed and mention of cases where drill holes

are left conspicuous. Yet these matters are peculiarly relevant when considering any individual seal, and even for whole classes. It is not unimportant to note, for example, that the statement that "the Kassites favoured chalcedony or agate" is not accurate, for these stones by no means predominate in collections of Kassite cylinders; mottled stones, chosen presumably for the magical virtues of the colours, and so to reinforce the simple designs common on this type, are in fact more usual. As to technique, it should have been clearly pointed out that impressions do not always, or necessarily, indicate the real depth of cutting, and that no judgment should be passed until the original seal has been closely examined.

The detailed studies of the designs are written from the point of view of a trained historian of art, and form a masterly analysis of the possibilities of such design and the actual achievement of the different periods. In disposing their space, the seal-cutters could adopt diverse treatments; they might arrange continuous bands, divide up the area between groups capable of repetition, secure symmetry around a central theme, such as the inscription giving the owner's name, or secure variety by dividing into two registers. Some covered all the surface, others depicted a single animal *bombinans in vacuo*. Geometrical patterns were used in many periods side by side with seals showing complicated, sometimes dramatic, representations of divine and human figures.

Prof. Frankfort is an excellent guide through this maze; he uses dated material to classify undated with admirable discretion, and applies sound general principles as the basis of his arrangement. That is not to say that the author will escape criticism, for sometimes a general principle is deduced from too limited a set of ascertained facts. It may be true, for example, that in Prof. Frankfort's own excavations seals representing mythological scenes were found only in buildings belonging to the time of the Agade dynasty. It does not necessarily follow that all seals with such scenes must belong to that period. That is an old error in the typological argument, and has, the reviewer thinks, led to the wrong dating of the famous seal in the British Museum representing the sunrise, Plate XIX *a*; style, cutting and detail point to a later date. Sometimes the author commits himself to aesthetic judgments not necessarily right. To speak of "decline" in the Jamdat Nasr period is surely arbitrary, for it was a time of most fruitful experiment which, at least in the opinion of some, produced some excellent, and some good work.

Again, in discussing the designs of Sargonic seals, the author has lost sight of an important fact, that these seals, like the early Sumerian, have to perform their function of producing a design to cover not a given, but any length; he is peremptory in deciding where a design begins and ends, but the user of the seal was not, and these well-spaced groups do in fact allow of repetition, as do the endless bands. Indeed the learned will no doubt spend much ink controverting details in this book, but the main lines will undoubtedly stand, a pleasant general introduction which will also be of great use to the student.

The other subject fully dealt with—the religious significance of the subjects—requires and receives very different treatment. The purpose of these designs was, in general, prophylactic; sometimes the seals merely served as amulets. The author very rightly stresses the connexion of many scenes with myth and ritual. His object in this matter has been to make fruitful suggestions and to advance the study of ancient religion even at the risk of error. For this effort the right-minded

will be thankful. Once again, criticism will come in no small measure. The author does not, for example, fully expound the curious duality which attached to all the composite creatures of Mesopotamian fantasy, their sometimes good, sometimes evil, character; his argument on pp. 200–201, though it refers to this duality, fails to apply it to the *shedû* and *lamassu*—typical examples, as are other creatures mentioned. Similarly, in his discussion of the scenes which depict a light-god, he finds no place for the moon-god and thinks only of the sun; when a light-god is in a boat, he must always be Shamash, though Sin had a boat too and some of the symbols clearly refer to the night sky, not the underworld. So controversy could be conducted over much of the ground covered in what is said about religion. It is more pleasant to end on a note of praise for a stimulating and in many ways pioneering contribution to learning.

The book is well printed, misprints are few, the format convenient and the plates excellent. The publishers deserve the thanks of scholars for producing such an admirable work.

1938 Recorded

Encyclopædia Britannica of the Year 1939

Being a Survey of the Principal Persons, Events and Developments in Various Spheres of Knowledge and Affairs during the Year 1938. Pp. xvi+760. (London: Encyclopædia Britannica Co., Ltd., 1939.) 45s.

THIS is the second of a series of yearbooks projected as annual supplements to the "Encyclopædia Britannica". The first of the series was reviewed in NATURE of June 25, 1938, p. 1120, when the reviewer regarded it as a step towards the realization of the World Encyclopædia of Mr. H. G. Wells. This second volume is a further step towards that ideal, for all branches of knowledge and culture and all political and social problems—national and international—are dealt with in an objective and dispassionate manner.

To the editors and contributors, the work must have been prodigious, especially in keeping to the objective policy throughout; but it is a wise policy since the value of such an important work lies in its being not only a source of information for present-day readers but also a true and well-balanced review of past events for the benefit of future readers.

Events have moved very quickly recently, not only in international relations but also in science

and other branches of culture. Consequence and fulfilment have trod so closely on the heels of cause and prophecy that the editors must have found it a difficult task to make this volume a contemporary survey of men and affairs during the year 1938. But they have persisted in this well-chosen policy, for since the volume is one of a series it is the only safe policy to adopt. We already know the consequences and sequels of many incidents of last year (especially in international politics); but here "the closing scenes [of 1938] especially are depicted, not in retrospect and with foreknowledge of what was to come, but as they appeared at the time to the audience then witnessing the performance". Reading many of the topics so far into 1939 thus makes them all the more interesting and intriguing. On the other hand—and this applies especially to certain branches of scientific activity—progress over such a short period as one year is so slow that in each volume is to be given a summary of the developments for a period of several years.

It is noticeable that nuclear studies are still claiming the attention of many leading physicists throughout the world. Nearly three-quarters of the section devoted to physics is taken up by a review of progress in research in nuclear physics and cosmic rays. The rest is devoted to studies of liquid helium, properties of thin films,

and mass spectrography. In accordance with the wise policy adopted, the work on uranium, which has excited the whole of the world of physics during the first half of the current year, is not mentioned, and the cyclotrons, some of which are now at work, are described as "being constructed" or "not yet complete". In a similar way, all branches of science are treated. In spite of very careful scrutiny, no omission of importance has been detected; but it is interesting to the present-day reader with the results of current scientific work fresh in his mind to see how events of 1938 have inevitably led up to what he knows now but could not even prophesy then. That point of view may not strike the reader of several years hence so forcibly; but he will be able to deem himself fortunate in having at hand such an authoritative survey of events from year to year.

Scientific personalities are treated in a way similar to that accorded to the subjects themselves. Although a man of science may have a comparatively full biographical sketch of himself in the "Encyclopædia", if his achievements since the publication of the last edition (1929) warrant it, he appears again here, and sometimes accompanied by an up-to-date portrait. For example, Bohr's more recent work on atomic structure is given in a biographical sketch, together with reference to his award in 1938 of the Copley Medal. For very obvious reasons, too, Sir William Bragg appears again. The same may also be said of such scientific worthies as Sir James Frazer, the British anthropologist, philosopher and student of comparative religions; Sir James Crichton-Browne, the British physician; Prof. Samuel Alexander, the British philosopher; Dr. George E. Hale, the

American astronomer (the last three of whom died last year); and several others. What portraits are inserted are strikingly good.

In the review of the publishing world, an informative table is given of all classes of literature published in Great Britain and Eire as new books, translations, pamphlets, and new editions. The totals of these are compared with those of 1937. It is interesting to note that not only science but also most other branches of knowledge and culture had decreased, with the exception of philosophy, which remained constant, and sociology, law, philology, business and literature, which showed slight increases. Science showed a decrease from 758 to 701 and other decreases of interest were: history (131), medicine (86), education (45), technology (28), agriculture and horticulture (22) and geography (30). These figures were, no doubt, a sign of the times, though probably little was lost by the decreases, at any rate where science and related subjects are concerned.

Only a few topics, of interest even to the most exclusive men of science, have been chosen for comment; but sufficient has been told to emphasize the value and interest of this newcomer to the world of yearbooks. Not a page lacks interest; in fact, this, like the "Encyclopædia" itself, makes the inquiring man of science realize suddenly (and sometimes inconveniently) how interested he can be in such diverse subjects as music and jazz, ballet and boxing, navies and armies, stock exchanges and communism. Thus does the present volume maintain the very high standard set by its predecessor and achieved by the "Encyclopædia" itself.

Distillation and the Phase Rule

The Elements of Fractional Distillation

By Prof. Clark Shove Robinson and Prof. Edwin Richard Gilliland. (International Chemical Series.) Third edition. Pp. xii + 287. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 18s.

THE expression 'fractional distillation' inevitably recalls the name of Young to the older generation, but his book was written before the days when the art was of industrial significance and viewed the subject almost entirely from the laboratory bench. Of recent years the use of modern and often very complex types of distillation apparatus is growing apace, and though there have been foreign works on the subject, due largely to the fact that the inception of such

plant was on the Continent, there was no work available in English for the use of engineers and operators until the first edition in 1920 of this book, of which the third edition is now in our hands.

As experience has progressed, many changes in method and design of distillation plant have been made; the present treatment is believed to represent the best general practice in distillation design, but it is an introduction to, and not a complete treatise on, the subject of distillation.

Fractional distillation is a very ancient art which has developed by the gradual accumulation of empirical knowledge: it has from the beginning been associated with alcoholic beverages; indeed it is well known that H.M. Excise still find it.

difficult to divorce the word 'still' from its contact with alcohol.

The art has become a science as the result of the application of the phase rule, which enables the prediction of the conditions under which all systems of equilibrium can exist. The authors begin with the phase rule in Chapter i and, proceeding from simple one-component to complex systems, clear the ground for the study of specific problems of technical import best indicated by their chapter headings, namely, ammonia, benzolized wash oil, methyl and ethyl alcohol. So far the text is relatively simple, but we come to real grips with the subject in long chapters on the rectification of binary mixtures and of complex multicomponent mixtures. A lot of mathematics

is introduced with useful phase diagrams and tables, and the treatment is advanced and essentially for the specialist.

The subsequent sections deal with the theory of topping stills and continuous distillation, and give data for the performance of columns and condensers.

The book is essentially one for the specialist, who will undoubtedly find it of great value, but it must be hard reading for the engineers and operators mentioned in the preface. This does give us the opportunity to pay tribute to the skill of the operator of a modern petroleum still; at first sight it seems quite impossible that one man working in front of a complex instrument board can exercise the control he does.

The Cytological Approach to Inheritance

An Introduction to Modern Genetics

By Dr. C. H. Waddington. Pp. 441 + 5 plates. (London: George Allen and Unwin, Ltd., 1939.) 18s. net.

IT is curious and unfortunate that an experimental embryologist should write a genetical book which represents the extreme mechanistic branch of genetical opinion. It would seem that Dr. Waddington has missed a golden opportunity of bridging the gap between genetics and botany and zoology as taught in British universities. Instead he has accentuated the importance of chromosome twists and genic acrobatics at the expense of morphological and physiological genetics. Sufficient accounts of the relationship between genetics and cytology and between genetics and mathematics are now available elsewhere, but there is little text-book writing which combines a knowledgeable appreciation of genetics with physiology, morphology and systematics. There is a large amount of information on these latter subjects in research papers which is comparatively unknown in text-books.

In the encyclopædic survey of genetics and allied subjects, the author has presented a condensed text full of precise and annotated data on many subjects which are of interest to those with cytological and mathematical tendencies. This is done by dividing the book into five sections: formal genetics, genetics and development, genetics and evolution, genetics and human affairs, the nature of the gene. Within these sections space has been found for plant and animal breeding, the ramifications of chiasma formation and the mechanics of the chromosome, the genetics of

man, the genetics of pattern, and many other problems.

It is obvious that an 'introductory' treatment of this vast body of data is not possible in 450 pages. Indeed the book has an unfortunate title, since it is neither introductory in form nor does it contain a balanced statement of modern genetics.

For those who require a book which contains an extended survey of current topics, results and theories of the subjects allied to genetics in the form of an encyclopædic reference book, this volume can be recommended. But no non-geneticist or student should be permitted to visualize genetics as exhibited by this book. The general reader will find that some chapters are rather perplexing in construction and specialists may cavil at the attitude, and phraseology used on their own subject. The reviewer, for example, dislikes the chapters on sex-determination, chromatid segregation and evolution mainly for the essential features which are omitted. This is highly regrettable, since the material which is presented has been carefully described and the author has kept a critical hold on himself when discussing rival cytological theories.

There are a useful index and a bibliography which has been well designed; but the illustrations are poorly reproduced. Further, the acknowledgments to the borrowed figures are vague and unsatisfactory. The author has spent much time and painstaking effort in compiling a heavily packed but readable text ranging in subject from chromosome hysteresis to artificial insemination in man. It is not, however, an introduction to modern genetics as understood by the reviewer.

F. W. SANSOME.

Weed Plates Series 3, Plates 61-90

By Prof. Dr. E. Korsmo. 84 cm. x 64 cm. With Text-book of 140 pp. (Leipzig: Koehler and Volkmar A. G. and Co.) 22 gold marks.

THE third set of Prof. Korsmo's weed plates completes a series of ninety plates which are unequalled by any previous publication anywhere in the world. They are bold, colourful and easily understood by the most elementary student, but only a trained botanist can appreciate the accuracy of delineation and the skill with which the salient points have been selected. The illustrations of each weed provide an epitome of the life-history from seed to seed. Germination, seedling stages, mature plants, methods of propagation and seed dispersal all find their place.

Unusual details which frequently escape observation often throw light on the ecological behaviour of various species. In *Cardamine pratensis*, for example, rooting from the base of the leaflets of the lower leaves provides for new plantlets and continuous propagation. In *Cuscuta* the process of attachment of the young seedling to the host, and the withdrawal of the dodder from the soil explains the apparent mystery of how such a total parasite spreads by means of seeds. Examples might be multiplied to show the great value of these charts for teaching purposes. Their usefulness is enhanced by the booklet of explanatory notes published in various languages, with direct reference to the drawings.

Prof. Korsmo is to be congratulated on a valuable piece of work brought to a successful conclusion with the co-operation of an able staff of draughtsmen, who achieved the difficult task of combining scientific accuracy with true pictorial representation of the living plant.

Reports of the Progress of Applied Chemistry

Issued by the Society of Chemical Industry. Vol. 23, 1938. Pp. 861. (London: Society of Chemical Industry, 1939.) 7s. 6d.; to non-members, 12s. 6d.

IT is, perhaps, scarcely necessary to remark that, although these excellent annual reports are written by chemists and chemical engineers, they find many readers beyond the confines of the profession. While much of the information which they contain is admittedly of purely chemical interest and value, one cannot easily divorce chemistry from physics, engineering, or biology, and there is much which cannot fail to interest medical men, economists, and indeed all who have a lively concern in the more important phases of scientific industry. Any one volume is much the same in form as its predecessor, but considerable variations in substance in fact arise from such changes in authorship as occur from time to time.

In the report for 1938 there are twenty-seven chapters, including a report on explosives covering the period 1937-1938, and one on plastics. Of these, comparison with the previous report shows that in seven cases there has been a complete change of author, whilst in several others the responsibility has been differently shared among joint authors. In

the present volume, plant and machinery are discussed by S. G. M. Ure and F. J. Bailey; pulp and paper by T. T. Potts; iron and steel by S. J. Kennett; soils and fertilizers by G. V. Jacks; sugar by H. C. S. de Whalley; fine chemicals, medicinal substances, and essential oils by T. M. Sharp and W. Solomon; photographic materials and processes by C. Waller; and explosives by J. Weir. A. A. E.

The Annual Register

A Review of Public Events at Home and Abroad for the Year 1938. Edited by Dr. M. Epstein. Pp. xii+498. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1939.) 30s. net.

AGAIN this volume gives a survey of the year's history. In spite of a troubled year, crowded with events of great significance, the volume maintains its usual compass and departs in no respect from the customary allocation of space. Home, Imperial and foreign history again occupy rather more than half the volume, and much skill has evidently been exercised in the narrative of European events. No fault can be found with the factual record; every event of significance is mentioned, and in the main the survey is objective, though here and there a party point of view is manifest. The second part begins with a chronicle of events and is followed by a retrospect of literature, art and science in 1938. The section on science, though short, is a most comprehensive survey of work and publications of the year. Finally, there are the usual résumés of finance, commerce and law and obituaries of eminent persons. The public documents printed in full are of unusual interest since they include the Anglo-Italian Agreement of April 1938 and the famous Munich Agreement of September last.

Observation and Protocol Statement

By Dr. Bent Schultzer. Pp. ix+161. (Copenhagen: Levin and Munksgaard; London: Williams and Norgate, Ltd., 1938.) 7s. 6d. net.

PHILOSOPHICAL discussions about our knowledge of the external world have drifted more and more towards linguistic considerations. This is mainly the case with logical positivism, which asserts the importance of the logic and language of science at the expense of metaphysics. In this line of thought, Dr. Schultzer asks himself the question, How can an observation be validly registered in language? A close analysis of the condition of observation and of the content and structure of the so-called "protocol statements" (elementary propositions about direct observations) shows him that the only possible way of answering it correctly is by stating explicitly the presuppositions of a valid linguistic formulation of observations tacitly recognized by every empirical observer. It is the discussion of these presuppositions which forms the object of this book. Even if the results obtained are not final, Dr. Schultzer's treatment of the problem, especially when he proposes alternatives to the narrow orthodoxy of the Vienna circle, is both refreshing and useful. T. G.

Fauna and Flora of the Inner and Outer Hebrides

King's College (University of Durham) Biological Expeditions

By Prof. J. W. Heslop Harrison, F.R.S.

SO long ago as 1934, the idea of exploring the Hebrides with the view of writing a comprehensive Flora of the Inner and Outer Isles was conceived by the Department of Botany, King's College, University of Durham, and with it, as a corollary, the notion of studying the evolution of local races in the same area. At the same time,



VOLCANIC VENT WITH BROOCHIL CASTLE, ISLE OF RAASAY;
CLIFFS AT SCHRAPADAL BEHIND.

too, the whole of the plans necessary for bringing our project to a successful conclusion were formulated.

In consequence, since our first visit to Raasay in 1934, a yearly average of eleven weeks, spread over various parts of the year, has been spent in working the islands. Thus, in 1935 we visited Skye, Raasay, Scalpay, Longay, Mull, Coll, Tiree, Barra, South Uist, Canna and Sanday; in 1936 Skye, Raasay, Scalpay, South Rona, Eigg, Canna and Sanday; in 1937, Skye, Soay, Raasay, Pabbay, Coll, Rhum, Eigg, Canna, Sañday, Barra, Berneray and Mingulay; and, finally, in 1938, Rhum, Eigg, Muck, Eilean nan Each, Hyekeir, Lewis, Harris, Taransay, North Uist, Baleshare, the Monach Islands, South Uist and Eriskay. From this it will be seen that our investigations, although incomplete, have covered most of the area to be explored, and that we are in a position to take

stock of our present results, and to assess the value of our work.

Almost at the very commencement of our researches, we encountered a remarkable and inspiring cliff flora growing upon the precipitous cliffs, towering a thousand feet above the sea, along the east coast of Raasay. This included not only plants of alpine predilections such as *Arabis petraea*, *Silene acaulis*, *Dryas octopetala*, *Oxyria digyna*, *Polygonum viviparum*, but, in addition, commoner plants such as *Gerum urbanum*, *Lychnis dioica*, *Geranium lucidum*, *Calamagrostis Epigeios*, so rare and local in, or formerly considered absent from, the islands. There, too, jutting out from the cliffs, the rare shrub *Sorbus rupicola* flourished. Moreover, elsewhere in Raasay, we encountered unexpected species in the form of *Juncus pygmaeus*, *J. capitatus* and *Cicendia pusilla*, the first-named hitherto only recorded in Britain from the Lizard, the second from the same district and Anglesey, and *C. pusilla* from the Channel Islands.

These discoveries naturally invited speculation as to the causes of the peculiar and discontinuous distribution of the plants concerned. At once, it was forced upon us that the problem and its solution depended upon the Pleistocene and early Holocene history and geography of the Hebrides. Similarly, the resemblance between the positions of the plants on Raasay and those so brilliantly studied by Fernald in Newfoundland and in the Gaspé Peninsula, Quebec, was too striking to be disregarded. Naturally, we concluded that the circumstances explaining the situation in one case accounted for it in the other. These, in Fernald's opinion, and in ours, lay in the view that many, if not all, of the species involved, had escaped, by virtue of their positions, or by the local failure of glaciation, the wholesale extermination due to ice action so often pictured for us by those of extreme views.

Thus we were compelled to add to the original items of our programme a study of the influence of Pleistocene glaciations upon the composition and distribution of the Hebridean flora and fauna. To aid in this, a new line of attack, involving tedious examination of the pollen contents of the various peat deposits available, was of necessity developed.

Later, as we passed from island to island, these

onvictions have been progressively strengthened. The Isles of Eigg and Canna, with the flora of their magnificent western cliffs, reproduce on a smaller scale the conditions of Raasay, whilst the Isle of Rhum, with its rugged mountain masses, yields much more weighty evidence. On the latter island, the American grass, *Festuca prolifera*, reported by Fernald from Newfoundland, Anticosti, Gaspe and New Hampshire, turned up. Further, the Alpine penny cress, *Thlaspi calaminare*, formerly supposed to be restricted in Britain to Derbyshire, was collected freely on Fionohra and on the seaward cliffs of Bloodstone Hill. In the same way, the southern mountain massif produced the Norwegian sandwort, *Arenaria norvegica*, once listed as occurring with us only in the Shetlands and in Sutherland. Other significant plants secured on the Isle of Rhum included *Carex dioica*, *Deschampsia alpina*, *Juncus capitatus*, *Filago gallica* and many others, generally possessing alpine habitats.

When we passed to the Outer Islands, the same tale was continued. There the plant novelties belonged more particularly to two groups: (1) those of western or south-western tendencies; (2) those of arctic or alpine preferences. The former are exemplified by *Carex verticillatum* and *Vicia Orobus* and the latter by *Alopecurus alpinus*, *Festuca prolifera*, *Carex Halleri*, *C. rariflora*, *C. rupestris*, etc. Here, more especially in the case of South Uist, the case for glacial survival becomes much more powerful, for the Hecla-Beinn Mhor mountain group reveals considerable areas free from evidences of glaciation. The presence of *Alopecurus alpinus* adds a fact of vital importance, for the grass does not appear on the continent of Europe at all.

On the animal side, although few groups have been ignored, our chief interests have lain in the Mollusca, Insecta and Arachnida—circumstances determined by the personnel of the various expeditions. Among the molluscs, our principal discoveries were the detection of the American species *Planorbis dilatata* on Raasay, and of *Clausilia cravenensis* on North Uist and Harris, both again suggesting that the species are glacial relicts.

In the Insecta our most striking captures have been among the aquatic Coleoptera. These included *Hydroporus foveolatus*, hitherto only known from high mountain lakes in the Alps and Pyrenees, and now taken in similar localities in the central mountains of Rhum, *Deronectes canariensis*, a Canary Island species, now recorded from Barra, and the Mediterranean *Aulonogyrus striatus* from Raasay. Again, the import of the evidence seems unmistakable.

Among the Lepidoptera, although some of

our additions to the Hebridean lists were to be expected, others stand out conspicuously; these are species like *Omphaloscelis lunosa*, *Pachnobia leucographa*, *Miana exposita*, *Selidosema ericetaria*, *Zygna achilleae* and *Z. purpuralis*. At this stage, one of our special quests, *Nyssia zonaria*, a moth possessing apterous females, needs strong emphasis. In the form of the local race *atlantica* (Healop Harrison), we took it on Canna, Sanday, Rhum, Muick, Coll, Tiree, Harris, North and South Uist, Baleshare, Taransay, Monach Islands, Eriskay, Barra and Mingulay—a very significant and informative series of islands.

The Hymenoptera, likewise, have their quota of evidence to supply. In this connexion we would



WATERFALL ON ALLT LIATH, ISLE OF SCALPAY, WITH *Osmunda regalis* (ROYAL FERN).

single out as specially instructive the two Bombs, *Bombus smithianus* and *B. jonellus* var. *hebridensis*. The former we encountered on the same islands as *Nyssia zonaria*, with Eigg, Hyskeir, Berneray, and Raasay, in addition, whilst the latter was captured on every member of the Outer Island group examined.

On the other hand, in the case of the Hemiptera, although they provided unexpectedly long lists, only one species needs comment and that is *Anihocoris pilosus* Jak., beaten from trees on Scalpay; it is new to the British Fauna.

The Arachnida simply continue the indications of the other arthropods; in particular, the southern element represented by the spiders *Drassodes pubescens*, *Zelotes latreillei*, *Z. apricorum* and *Xysticus pini* deserves mention.

It is impossible within the limits of the present article to set out the whole of the results, or the

deductions to be made from them; that remains for our final reports. Nevertheless, a few facts may be offered now, and a few deductions mentioned without providing full details of the arguments leading up to them. In the first place, referring to our original task of producing a Flora and Fauna of the Inner and Outer Hebrides, it can be reported that we collected no fewer than 639 forms of flowering plants and their closest

concluded that at least some of the plants observed have survived the Ice Age, both in the Inner and Outer Islands, in habitats in, or near, those where they now exist.

Further, taking due cognizance of the whole of the animals and plants, we have been forced to admit that present geographical divisions do not harmonize with those based in biogeographical facts. From the faunistic and floristic points of view, Skye, Raasay, Scalpay, South Rona and Soay belong undoubtedly to the mainland; no form is more emphatic in deciding this than the endemic rose, *Rosa Sherardi* var. *glabrata* (Ley) Heslop Harrison. On the other hand, in the same respects, Canna, Sanday, Rhum, Eigg, Muck, Hyskeir, Tiree and Coll, just as emphatically line up with the Outer Isles.

In turn, this points to a long-continued separation of the islands just named from the mainland, and their more or less recent connexion with the 'Long' Island. In leading to this conclusion, no evidence has been of greater value than the distribution of *Nyssia zonaria* var. *atlantica* and *Bombus smithianus*, coupled with the indications of the Hyskeir reef peats, as well as of the occurrence of the bluebell, tormentil, etc., of the common blue butterfly, *Polyommatus icarus*, and of the small dragonfly *Ischnura elegans* on the same islet. Both the Hyskeir peat, and its present flora and fauna, suggest very recent oscillations and subsidences indeed, as do the submarine peats west of Uist.

At this point also, we should make it clear that we have been driven to



EAST COAST OF RAASAY, INNER HEBRIDES.

allies from the islands lying to the north of Skye, 651 from the Rhum, Eigg, Canna group to the south thereof, and approximately 600 from the Outer Islands. Of these at least 150 are new county records. We see little scope for adding further to these lists in the case of Watsonian Vice-county 104, but we are certain that, judging from our last year's results in the Outer Hebrides, our 1939 work will add substantially to those from Vice-county 110.

Our results in the insect groups discussed above and in others, as well as in the molluscs, arachnids, birds, mammals, etc., are of the same order.

Now let us consider the remaining aspects of our work. As will have been made abundantly clear from various remarks made above, we have

conclude that such forms as *Nyssia zonaria* var. *atlantica* and *Bombus smithianus*, which display a so-called fringing distribution, do not supply, as is generally supposed, the extreme western limits of species driven in that direction by invaders from the east. On the contrary, we regard them as the present limits of species falling back eastward as the land (the "Tir-fo-thonn" of Gaelic legend) sank beneath the waves, or was fretted away by Atlantic storms. In these cases we believe that they survived the glacial period in lands far to the west of the limits of to-day. Link this up with the presence of the same insects in the western islands of Ireland, and it will be seen that the land connexion between Ireland and Scotland, and the date of its severance, become part of the same problem, and that its

solution is assisted by the presence of the moths *Zygaena purpuralis* and *Miana exposita* in the west of Ireland, and in Rhum. Moreover, the distribution of the two bees *Bombus smithianus* and *B. jonellus* var. *hebridensis* hints that the Shetland Islands cannot be neglected in the same discussion.

In our evolutionary studies, we have been struck by the unusual facies presented by many island species of animals and plants when they

are studied alongside representatives of ordinary English populations, and we have already described well-marked island races, for example, an Outer Island honeysuckle *Lonicera Periclymenum* var. *Clarki*, a new race of *Nyssia zonaria* and so on, the whole emphasizing the importance both of the local race, and of isolation, in evolution. From the very nature of this work, observation must be backed by experimental work, and this, in the case of some forms, is well in hand.

'Photochemical Reactions in the Gaseous, Liquid and Solid States'

By Dr. C. F. Goodeve, University College, London

PHOTOCHEMISTRY is concerned with processes in which light quanta are absorbed and chemical changes result. A molecular species is characterized by a certain spatial arrangement of atoms governed by forces due to electrons. The oscillating electric field of a light quantum acts on a binding electron and raises it to an energy-level where the bond is either loosened or broken. This permits the spatial rearrangements to take place which we observe as chemical change.

The photochemical process may be divided into two stages: the primary process which occurs more or less simultaneously with the absorption process, and the secondary process which occurs consequent to the first. These two processes can be studied separately and by different methods, the first by a study of the absorption spectrum and the second by the methods of reaction kinetics.

PHOTOSENSITIVITY

The dual nature of photochemistry is emphasized by a consideration of the velocity of photochemical reactions. This velocity generally follows the equation

$$-\frac{dn}{dt} = \gamma I_a \quad (1)$$

where n represents the number of molecules of absorbing species present at any moment, $-\frac{dn}{dt}$ their rate of decrease with time, and I_a the absorbed light intensity in quanta per second. γ is the quantum efficiency defined as

$$\frac{\text{No. of molecules changed}}{\text{No. of quanta absorbed}}$$

* Taken from a course of afternoon lectures given at the Royal Institution, February 16, 23, March 2. References to, and further details of, most of the work described here may be found in papers to recent Faraday Society Discussions, the third Report on Photochemistry (*J. Phys. Chem.*, June 1938), and recent papers by Bowen, by Norrish and by the author, each with collaborators.

If a beam of monochromatic light of intensity I quanta per second falls on a *thin* layer of absorbing substance the concentration of which is n/v molecules per c.c., the fraction of the light absorbed is proportional to the concentration and to the thickness, and is given by

$$\frac{I_a}{I} = \alpha \cdot \frac{n}{v} \cdot l \quad (2)$$

The constant of proportionality α is the *molecular extinction coefficient* and has a value usually between 10^{-18} and 10^{-22} cm.². It is the 'target area' that a molecule presents to the light beam, that is, the chance of it absorbing light.

We can combine equations (1) and (2) to give us the final equation for the rate of a photochemical change

$$-\frac{dn}{dt} = \alpha \gamma \frac{I}{v} = \alpha \gamma \cdot \frac{I}{A} \quad (3)$$

where I/A is the intensity per unit area. This is the simplest equation for the rate of a photochemical reaction, and it is to be noted that the rate-determining constant is the product $\alpha\gamma$. This combined quantity is obviously the *photosensitivity*.

We see therefore that the sensitivity of a substance to light is governed by two quantities: the chance of the substance absorbing a light quantum, and the efficiency of the process per quantum absorbed. For example, the well-known reaction which takes place when a mixture of chlorine and hydrogen is illuminated is a very fast one. The extinction coefficient of chlorine is comparatively low—about 10^{-21} cm.². This low extinction is, however, counterbalanced by the fact that the quantum efficiency in the reaction with hydrogen is very high, between 10^3 and 10^4 . The photosensitivity therefore has values from 10^{-18} to 10^{-16} cm.² per quantum absorbed. It follows from equation (3) that in bright daylight, the blue light

of which has a value of I/A of about 10^{14} quanta per sec. per cm.², chlorine reacts at a rate of about 10 per cent per second.

As another example, a very light-sensitive substance called visual purple can be extracted from the retinae of the eyes of animals which have been adapted to darkness before being killed. It has recently been shown that the high sensitivity of this substance arises from the fact that the extinction coefficient is high, while the quantum efficiency has a value of about unity; its photosensitivity is about 10^{-12} cm.². On the other hand, for reactions such as the photodecomposition of aliphatic nitroso compounds, the quantum efficiency is unity and the extinction coefficient very low, the value of the photosensitivity being less than 10^{-12} cm.². If a solution of a nitroso compound is exposed side by side with a solution of visual purple, it decomposes at a rate 1,000 times slower than the visual purple, although its quantum efficiency is about the same. In a further class, there exist many dyestuffs of a very high extinction but of a low photosensitivity arising from the fact that their quantum efficiencies are extremely small. The photosensitivity of a reaction varies greatly with wave-length, largely due to the variation in the extinction coefficient α .

Here, as in thermal reactions, it is more convenient to make observations on the number of molecules present after certain intervals of time rather than to measure the rate at any instant, and we therefore use an integrated form of equation (3). For a layer of any thickness we arrive at the equation,

$$\log_{10} \frac{I_t}{I - I_t} = \alpha \gamma \cdot \frac{I}{2.3 A} \cdot t + \text{constant}, \quad (4)$$

where I_t is the light transmitted by a substance at the time t . In practice, coloured products may be produced, impurities may be present, reactions independent of light may proceed, etc. Equations may be set up for all these types of photochemical change and in them the photosensitivity $\alpha\gamma$ is the major rate-determining constant, similar to the 'velocity constant' appearing in equations for first- and second-order reactions. The photosensitivity may be conveniently determined by plotting the logarithmic function against the time, when a straight line should be obtained the slope of which is equal to the photosensitivity times the light intensity, I/A . This analytical method has been called "the method of photometric curves".

THE PRIMARY PROCESS

The absorption spectra of molecules in the gaseous state are of two principal types—discontinuous (band) and continuous. The first type

can be further divided according as the bands can or cannot be resolved into lines by high dispersion instruments. The presence of bands indicates that the molecule on absorption of a quantum has vibration frequencies characteristic of the excited state, and indeed these frequencies can be determined from the intervals between the bands. The excited state must therefore be one that can vibrate—it must be a complete molecule although the valence bonds may be weakened.

Cases where the bands cannot be resolved have been interpreted as meaning that the molecule has a short life in the excited state—something of the order of 10^{-12} sec. This has been called *pre-dissociation*. Conclusions in these cases, however, are not so reliable as in the others, as lack of resolution may arise from a number of causes.

If, on the other hand, there are no bands and the spectrum is *continuous*, there can be no characteristic frequency for the excited state and at least one of the bonds is broken. The primary process in this case yields atoms or free radicals.

SECONDARY PROCESSES

Secondary processes following discontinuous absorption usually consist of one or other of the following:

(a) The molecule may fluoresce, that is, give out most of its excess energy as light and return more or less to its original state.

(b) The molecule may suffer a collision in which its excess energy is converted into thermal energy. It is thus deactivated and cannot fluoresce or undergo photochemical change. Usually a molecule of the same species is particularly effective in quenching fluorescence. This arises from the fact that it is attracted to an excited molecule.

(c) The collision may lead to a chemical change. In any system there is usually competition between these possibilities. Most molecules will fluoresce unless they are deactivated or undergo chemical change within 10^{-8} sec.

Considerable advance has recently been made in our knowledge of the mechanism of chemical changes occurring on collision. This advance has been based on a consideration of the potential energy of the system as a function of the distances between the atoms. For each chemical state, defined by the existence of chemical bonds between certain atoms, there is a 'multi-dimensional potential energy surface' which describes this functional relation. A change over from one state to the other only occurs at an intersection of these surfaces, as it is only here that the energy, position and momentum of each of the particles can best be conserved. We now know that these quantities need only be conserved within the limits

set by the 'uncertainty principle' of quantum mechanics, and that change can take place with decreasing probability a short distance on either side of the intersection. In addition, however, the spins of the electrons need to be conserved.

Secondary processes following continuous absorption can also be considered according to the methods of reaction kinetics. The atoms or free radicals, produced by the primary process, are very reactive as they have free valencies. The chance of their reacting depends on the chance of their suffering a collision with a species with which they could react, and on the chance of their having sufficient energy, E_0 , to overcome any repelling force that may be present. This latter chance is given by the simple exponential expression, $e^{-E_0/RT}$.

EXAMPLES IN GASES

Iodine and oxygen absorb discontinuously in certain parts of the spectrum; iodine has been found to fluoresce at very low pressures. The excited molecules formed by the primary (light absorption) process collide and react with normal molecules, forming $I_2 + I(^2P_{3/2})$ and $O_2 + O(^1D)$ respectively in conformity with the conservation rules of the previous section. I_2 is, however, unstable, but ozone is produced with an efficiency of nearly two molecules per quantum absorbed—the second coming from a reaction between the oxygen atom and an oxygen molecule.

The bands of formaldehyde are unresolvable below 280 mμ. It is easily shown that the potential energy surface of the excited molecule intersects that of a different state of chemical combination of the four atoms— $H_2 + CO$. A path therefore exists via which the formaldehyde molecule, on absorption of a light quantum, can change over spontaneously into hydrogen and carbon monoxide with good conservation of energy, position, momentum and electron spin, and indeed experimentally this change is found to occur with a quantum efficiency of unity.

Hydrogen iodide absorbs continually and therefore dissociates into two atoms. Energy considerations indicate that the hydrogen atom reacts on its first collision with an HI molecule to produce $H_2 + I$. On the other hand, a reaction between $I + HI$ would be *endothermic* by 35 kcal. The value of E_0 is therefore at least as great as this and of $e^{-E_0/RT}$ less than 10^{-8} . This reaction is therefore negligible and the iodine atoms accumulate until they can collide and combine together. A quantum efficiency of two molecules of HI decomposed per quantum absorbed is therefore to be expected and is found experimentally over a wide range of pressure and temperature.

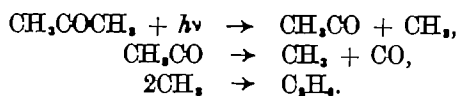
Although the chlorine-hydrogen reaction has been known for nearly a hundred years, it has only recently been understood. Most of the quanta responsible for photochemical change are absorbed in the continuous part of the spectrum and therefore the primary process is the production of chlorine atoms. Each atom suffers frequent collisions with hydrogen molecules, and from independent experiments it is found that about one collision in 10,000 is effective in producing a hydrogen chloride molecule and a hydrogen atom. The hydrogen atom reacts readily with a chlorine molecule, producing hydrogen chloride and a chlorine atom, which in turn repeats the cycle. In other words, a 'chain' is set up which can carry on indefinitely unless something happens to stop it. Most of the disagreeing results obtained by different investigators are now attributed to varying effects of chain-stoppers such as oxygen molecules or the walls of the container. With poisoned walls, and gases free from inhibitors, quantum efficiencies of 10^4 have been obtained.

REACTIONS IN LIQUIDS

In passing now to examples in the liquid state, we have first to consider how far our conclusions with regard to the primary process, as judged from absorption spectra, can apply. Molecules in the liquid are in a continual state of collision. As a consequence of this there is a general smoothing out of the absorption spectrum, and it is impossible to resolve the bands into fine lines, as in the case of discontinuous absorption in gases. However, a continuous absorption band of a molecule in the gaseous phase is characterized by the fact that it has a smooth rounded maximum and that its threshold on the long-wave side has a gentle slope. These two characteristics are retained in the liquid state, and in fact whenever we find, in liquids, absorption bands with rounded tops and gentle sloping thresholds, we find that photodecomposition takes place. For example, the absorption spectra of nitroso-compounds and diazonium salts are of this type. On the other hand, the spectra of most dyes, such as the cyanine dyes, have sharp maxima and steep thresholds. The primary process undoubtedly leaves the molecule intact and in an excited state. In the case of most dyes we find that the secondary process is one of fluorescence or deactivation, but sometimes the substances react with inorganic ions. The mechanism of the nitroso-compounds is not fully understood, but apparently free radicals are produced which react with the solvent.

A large amount of work has recently been done on the photodecomposition of aldehydes and ketones. Gaseous acetone decomposes with a

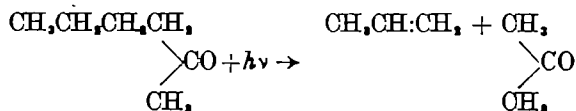
quantum efficiency of about 0.3, and the reaction apparently proceeds by the following mechanism:



Pure liquid acetone, however, is completely inactive to light. Apparently on absorption of light the electronic energy is degraded to heat very quickly. We have already noted that molecules of the same species have a very powerful effect in deactivating one another.

Even in dilute solutions, however, this reaction, particularly with higher ketones, is largely suppressed. This is apparently due to the fact that the free radicals produced in the primary process, being caged around by solvent, very readily recombine with one another, thus reducing the quantum efficiency. This is a common type of phenomenon in photochemistry, and is due simply to the fact that the movement of molecules, or their parts, is restricted by the surrounding molecules. We could not get a permanent chemical change unless the parts of the molecules could stay apart long enough to enter into some other state of combination. Given sufficient thermal energy, however, they may react at once with caging solvent molecules.

On the other hand, the higher ketones decompose partially in another way.



The process is a curious one. Light absorption takes place without a doubt by an electron associated with the carbonyl group. This excitation energy by some means or other is able to move along the molecule and break it at a position several carbon atoms away (a similar process occurs in crystals). The products are not free radicals, but normal molecules, and even if they are caged around by other molecules, they should have no tendency to recombine. We should not expect the rate of this process to be different in solution from what it is in the gaseous phase, and in fact no difference is found.

Finally, there is an interesting class of photo-reactions in solution involving changes of the charge on an ion. On the face of it, these reactions should not involve movement of nuclei. For example, to change an iodide ion into an iodine atom requires only the removal of an electron. The same is true for the conversion of ferrous into ferric ion. These changes of charge, however, are accompanied by changes in the arrangement of the solvent sheath around the ions.

REACTIONS IN SOLIDS

So far we have seen that modern theories of photochemistry give a fairly satisfactory treatment of gaseous reactions, and, to some extent, of reactions in liquids. With solids, however, the theories are only in a very early stage of development. The chief difficulty is that, whereas in gases and in liquids we can deduce something about the primary process from the absorption spectra, parallel deductions with solids can only be made in exceptional cases. We know, of course, that the movement of an electron is involved, but we cannot deduce how far an electron acts alone and how far its movement is coupled with that of the nuclei. However, we should expect to find more deactivation and greater restriction to spatial rearrangement in solids. For example, *trans*-azobenzene on absorption of a light quantum changes over quantitatively into *cis*-azobenzene, and the latter on absorption is reconverted back into the *trans* form. Both these reactions involve a large spatial rearrangement of nuclei, a rearrangement which could not take place inside a crystal lattice. In fact, in the solid state, these substances are quite stable to light, the energy of the light being degraded into heat. Similarly, the quantum efficiency of the decomposition of ethyl iodide is reduced in the solid state.

On the other hand, we have reactions of the type such as the conversion of *o*-nitrobenzaldehyde into *o*-nitrosobenzoic acid. This reaction proceeds in solution with a quantum efficiency of about unity. It involves only an internal rearrangement of the position of an oxygen atom, a movement in no way obstructed in the crystalline state. The conversion is found to proceed in the solid at exactly the same rate as in solution. There are many phototropic effects in organic chemistry which are of this type.

Apparently the only well-established case where atoms may be rearranged inside an ionic crystal is that of the dissociation of potassium hydride dissolved in potassium bromide. Here hydrogen and potassium atoms are produced by the action of light; these at low temperatures simply recombine. At room or higher temperatures, however, the hydrogen atoms have sufficient thermal energy to escape from their lattice points, the remaining potassium atoms producing a blue colour in the crystal.

While spatial rearrangements are restricted inside a crystal, they are much less so on the surface. However, the quanta absorbed by the surface layer of a crystal are generally few compared with the total number absorbed by the crystal itself, and could not account for most of the photochemical reactions occurring with solids. It is therefore believed that a quantum may be absorbed

in the interior of a crystal and its energy passed on, more or less as a complete unit, to the surface.

There are two possible mechanisms by which this transfer might take place. The first is based on the fact that there is little restriction from a *spatial* point of view to the movement of electrons through a crystal lattice. Normally, in non-conducting inorganic crystals the most loosely bound electrons are attached to the negative ions. They cannot move about very much at ordinary temperatures, because more energy than is usually available at this temperature is required to move them from their position. At higher temperatures, of course, most crystals become conducting. When a quantum of light is absorbed by a bromide ion in silver bromide, the electron may be torn from its position and sent to another part of the crystal. There it settles on a silver ion, producing a silver atom. Very little energy is now required to move it from one silver to another, and in an electric field such a movement may readily take place, giving rise to the phenomenon of photoconductivity.

When the electron is removed from the bromide ion, it leaves it as a bromine atom. An electron from a neighbouring bromide ion can readily take the place of the original one, leaving in turn a bromine atom. In other words, the *position* of the bromine atom can move about through the crystal lattice. If it by chance comes to the surface it can, in the case of the photographic plate, readily oxidize an adsorbed gelatine molecule. The silver atom is then stabilized and its *position* moves about until it meets another silver atom,

preferably at a surface, where it starts the nucleus of a crystal. This forms the latent image of the photographic plate which, on development, is increased about ten millionfold. Crystals not already having nuclei of silver do not develop in the period of time in which the plate is immersed in a reducing solution. The whole question of the action of a photographic plate is much more complicated than this, but the above mechanism provides a good working hypothesis.

The second important mechanism for the transfer of energy through a crystal does not require even the movement of an electron. According to this, the primary process of light absorption results (as usual) in an electron with a higher amount of vibrational energy, but moving more or less in its original mean position. Such a vibrating electron produces an oscillating electric field which influences neighbouring electrons, and the *energy* of the electron, the 'exciton', is passed on from one electron to another as a complete unit. In this way the exciton 'diffuses' about until it reaches a surface where it may cause a chemical change, or until it reaches a potential radiator where it may result in fluorescence.

There are many examples similar to the photographic plate in which light absorbed in the interior of a crystal leads to a reaction on the surface. Most inorganic oxides, such as zinc, titanium and antimony, which absorb in the near ultra-violet, can cause a photochemical change with certain organic compounds adsorbed on their surface. In no case as yet has it been established whether the transfer occurs by free electron diffusion or by exciton diffusion.

Obituary Notices

Prof. S. L. Loney

SIDNEY LUXTON LONEY, whose death at the age of seventy-nine years occurred on May 16, belonged to the older generation of Cambridge mathematicians, whose training was broad as well as specialized, and his position as third Wrangler in the then undivided Tripos justified the high opinion formed of his abilities at Tonbridge School by his teacher, Mr. Hilary, one of the most remarkable mathematical teachers of his generation.

On leaving Sidney Sussex College, Cambridge, Loney was faced with the choice which so often confronts the ablest young graduates—the choice between the advancement of specialized learning by research, or the advancement and diffusion of sound knowledge by direct teaching. His exceptional gifts of clear exposition and fertility of illustration led him towards teaching, and he devoted

himself wholeheartedly to his chosen profession, as professor of mathematics at Royal Holloway College, London. Before the establishment of the internal side of the University of London, many students of Holloway College took the Final Honour Schools of the University of Oxford, and the mathematical class lists of the years 1891–1907 afford evidence of the high standard of mathematics at the College at that time. After the College became one of the internal colleges of the University of London, a correspondingly high standard was maintained in the London honours lists, and this tradition has been continued under his successors, Prof. Jolliffe and Prof. Bevan Baker.

It was during his tenure of the College professorship of mathematics that Loney's text-books on applied and pure mathematics were written; and for nearly fifty years they have been established as

standard text-books, well known throughout the educational world. In addition to these books, he also actually wrote a popular "Arithmetic", although he himself considered that he "knew no Arithmetic".

Besides being a first-rate teacher, Prof. Loney was an excellent man of business, with a genius for committee work; and for many years he was one of the most influential members of the Senate of the University of London. His capacity for strenuous work, his thorough grasp of business, and his intuitive knowledge of men and women, were given full scope during the Great War, when for a considerable time he carried out many of the duties of Principal Officer of the University in addition to his other work. As chairman of Convocation since 1923, and deputy chairman of the Court since 1929, he rendered greatly appreciated services. These services were all the more valuable because of his dual position in the University. As a former professor in one of the internal colleges, he was a warm supporter of the teaching side; on the other hand, he was also an active and enthusiastic representative of the external side; and he was strongly of opinion that there was ample room for both internal and external sides in a great Imperial university, and that harmonious co-operation was the desirable ideal. Now, thanks largely to his efforts and those of other like-minded members of the Senate, this ideal has been to a large extent realized.

After retiring in 1920 from his professorship at Royal Holloway College, Prof. Loney continued to render valuable services as governor and trustee; and he had the satisfaction of seeing the College, with which he had been so long and honourably connected, established in its present position in the University and in the educational world.

E. C. HIGGINS.

Dr. J. G. Lipman

We regret to announce the death, after a brief illness, of Dr. Jacob Goodale Lipman, the well-known director of the New Jersey Experiment Station, New Brunswick, N.J. Dr. Lipman was born in Friedrichstadt, Russia (now in Latvia), on November 18, 1874, and received his early education first in Moscow and later in the *gymnasium* of Orenburg. In 1888 his family emigrated to the United States and soon settled on a farm at Woodbine, New Jersey. Here he became interested in agriculture and the scientific principles underlying it, and when in 1894 he entered Rutgers College, he came under the influence of Prof. E. V. Voorhees, one of the earlier American leaders in research on soils and fertilizers. He proceeded to Cornell University for advanced training in chemistry and bacteriology, and in 1901 was appointed to the Agricultural Experiment Station at New Jersey in charge of the Department of Soil Chemistry and Bacteriology. Shortly afterwards he was appointed, first instructor and afterwards professor, in agricultural chemistry at the neighbouring Rutgers College. His whole life was spent between the two institutions, and in 1911 he became director of the Experiment Station.

Lipman was one of the leaders in soil bacteriology and the study of fertilizers in the United States, and his writings did much to direct the attention of the public to the need for providing adequate support for studies of these subjects. Among his well-known publications were many reports of considerable technical interest, and in 1908 he published his book "Bacteria in Relation to Country Life".

Lipman was a great organizer and will long be remembered by all who took part in the First International Congress of Soil Science, held in 1927 in Washington, D.C., followed by a special scientific excursion throughout the United States and Canada. The whole Congress was a brilliant success, a model of what such functions should be.

Lipman was also editor of *Soil Science*, a journal which first appeared in January 1916 and owes much of its success to his enthusiastic and devoted labours. He was a man of unbounded kindness and geniality, wise in counsel, and a delightful host; he attracted and kept together a brilliant band of scientific workers and he made the New Jersey Experiment Station one of the leading agricultural institutions in the world. His death removes a great figure from among us.

E. J. R.

Mr. H. E. Wroot

We regret to announce the death of Mr. H. E. Wroot at the age of seventy-one years.

Herbert E. Wroot went to Yorkshire from St. Albans in 1890 to join the staff of the *Bradford Observer*, with which he was associated for thirty years. He then joined the staff of the *Yorkshire Post* and later became an assistant editor and, until illness overtook him in 1933, he was of great assistance to natural history workers by his knowledge and facile pen; the extent of this work is only known to those who were in touch with him at this time. He joined the Bradford Scientific Society, acting on the council, and as secretary and president.

Mr. Wroot was a member of the executive of the Yorkshire Naturalists' Union, president of its Geological Section and president of the Union in 1929. His address from the chair on "The Pennines in History" (*Naturalist*, 45-60, 105-115; 1930) is proof of his knowledge and interest in the county of his adoption. As a member of the council of the Thoresby Society he contributed a study of J. M. W. Turner's wanderings in Yorkshire. He did much work for the Yorkshire Dialects Society and the Brontë Society.

Mr. Wroot will be best remembered for his work in connexion with Prof. P. F. Kendall, "The Geology of Yorkshire". This work illustrates how a trained journalist, interested in the subject, can place in the reader's hands the knowledge and insight of the scientific worker with whom he collaborates. His reports of the meetings of Yorkshire naturalists and geologists were valued and always eagerly awaited. He enlisted a body of naturalists to aid him in a weekly column of Nature notes, and in these ways his pen greatly helped the local societies and increased their membership and usefulness.

Mr. Frank Corner

MR. FRANK CORNER, antiquarian and naturalist, died in London on April 22, at the age of seventy-seven years. Although he contributed little to the printed proceedings of antiquarian and natural history societies of London and of the home counties, yet his unfailing presence at their meetings and his enthusiasm helped greatly to their welfare. He succeeded to his father's extensive medical practice in the East End of London in the early nineties of last century after qualifying from the London Hospital, and his burly figure and warm heart made him hosts of friends in Poplar.

Mr. Corner had as a near neighbour at that time Sir Arthur Keith, who was teaching anatomy at the London Hospital. Although immersed in practice, Mr. Corner was then making a large rather than discriminative collection of fossils and stone implements of the Pleistocene period of south England. Among the specimens he succeeded in acquiring were the much-discussed fossil skull and skeleton of

the Galley Hill man. This he placed at the disposal of Sir Arthur Keith for examination, and afterwards gave it on loan to the British Museum (Natural History). His collection of Pleistocene animal remains was also freely accessible to the expert.

The case of acromegaly which Mr. Corner presented to the Museum of the Royal College of Surgeons in 1910 is one of the most instructive as well as one of the best worked out cases on record.

We regret to announce the following deaths:

Prof. Edwin Linton, formerly professor of biology and geology in Washington and Jefferson College, Pennsylvania, an authority on helminthology, on June 4, aged eighty-four years.

Prof. David Todd, formerly professor of astronomy and navigation and director of the observatory in Amherst College, Massachusetts, aged eighty-four years.

News and Views

King's Birthday Honours

THE following names of men of science and others associated with scientific work appear in the King's Birthday Honours List: *Baronet*: Dr. R. Hutchison, president of the Royal College of Physicians; *K.B.E.*: Prof. W. B. Benham, emeritus professor of biology, University of Otago, Dominion of New Zealand; Prof. T. A. Hunter, professor of philosophy and psychology, Victoria College, University of New Zealand; the Hon. P. H. Rogers, judge of the Supreme Court, and chancellor of the University of Sydney. *Knight Bachelor*: Dr. E. J. Butler, secretary to the Committee of the Privy Council for Agricultural Research and secretary to the Agricultural Research Council; Mr. F. Carnegie, chief superintendent of Ordnance Factories, War Office; Dr. R. E. Kelly, professor of surgery, University of Liverpool; Prof. J. Graham Kerr, M.P. for the Scottish Universities since June 1935, formerly regius professor of zoology in the University of Glasgow; Prof. O. W. Richardson, Yarrow research professor of the Royal Society, University of London; Prof. J. F. Thorpe, chairman of the Smoke Sub-Committee, Chemical Defence Committee, War Office, emeritus professor of organic chemistry in the University of London, and in the Imperial College.

O.I.E.: Mr. C. E. O. Cox, chief conservator of forests, Central Provinces and Berar; Mr. H. R. Stewart, director of agriculture, Punjab; Mr. E. A. Smythies, chief conservator of forests, United Provinces; Mr. W. J. Jenkins, officiating director of agriculture, Bombay. *O.B.E.*: Mr. A. S. Cox, assistant comptroller, Patent Office, Board of Trade; Mr. Seton Gordon, for services to literature and

natural history; Mr. C. E. Legat, for services to the Empire Forestry Association; Mr. G. M. Mathews, a prominent ornithologist, for services to the Commonwealth of Australia; Mr. J. P. Mead, director of forestry, Straits Settlements, and adviser on forestry, Malay States; Prof. E. J. Salisbury, Quain professor of Botany, University of London; Mr. R. J. L. V. Sukuna, district commissioner and chief assistant, Native Lands Commission, Fiji.

O.B.E.: Mr. E. J. Bruen, livestock expert to the Government of Bombay; Dr. G. P. Douglas, assistant superintendent (research), Royal Aircraft Establishment, Farnborough; Dr. W. E. Fisher, principal, Wolverhampton Technical College; Prof. W. G. R. Paterson, principal and professor of agriculture, West of Scotland Agricultural College, Glasgow; Mr. H. F. Mooney, forest officer, Eastern States Agency, India; Mr. J. Sinclair, for services to agriculture in the Nyasaland Protectorate; Mr. A. A. Topp, manager of the Government Explosives Factory, Maribyrnong, Commonwealth of Australia; Mr. J. Turner, forestry officer, Department of Natural Resources, Newfoundland. *M.B.E.*: Mr. B. M. Cameron, manager, Government Stock Farm and Agricultural Station, Acre, Palestine; Mr. A. P. Dodd, chief entomologist to the Prickly Pear Board, Commonwealth of Australia; Mr. W. M. Findlay, superintendent of experiments and lecturer in seed testing, North of Scotland College of Agriculture; Miss E. A. Leighton, accountant, Building Research Station, Department of Scientific and Industrial Research; Mr. A. F. MacCulloch, advisory chemist, Medical Store Depot, Madras; Mr. T. K. Mirchandani, officiating deputy

conservator of forests, Bombay; Miss U. F. M. Morton, principal, Women's Medical School, Agra, United Provinces; Mr. K. R. N. Pillai, extra assistant conservator of forests, Jubbulpore, Central Provinces and Berar; Mr. H. G. Smith, statistician, Agricultural Department, Uganda Protectorate. *I.S.O.*: Mr. J. M. Dumbur, assistant and office superintendent, Department of Agriculture, Gold Coast.

Dr. George Senter

DR. GEORGE SENTER, principal of Birkbeck College, University of London, since 1918, retires at the end of the current session. He became head of the Department of Chemistry at the College in 1914 and retained that position until 1932. His principalship has been a memorable one. In 1920 the College was recognized as a school of the University of London and in 1926 a Royal Charter was granted. The College thereby realized an ambition which existed so far back as 1863, when courses of instruction for University of London examinations were instituted. Further, Principal Senter has played a major part in the elaboration of the scheme for new buildings which are to be erected on the University site at Bloomsbury. His sound judgment and wide administrative experience have been of the greatest value in University affairs. Principal Senter first became a member of the Senate in 1912, was for many years chairman of the University Extension and Tutorial Classes Council and chairman of the University Scholarships Committee, and held the office of deputy vice-chancellor in 1933-34. To this record of distinguished service must be added the profound influence which Dr. Senter has exerted as investigator, teacher and writer in the realm of chemistry. He has contributed many important communications to scientific journals on physico-chemical and biochemical subjects and his "Outlines of Physical Chemistry" (17th Edition, 1933) and "Text Book of Inorganic Chemistry" (14th Edition, 1934) bear witness to his distinction as a writer and teacher. Recently the staff of Birkbeck College made a presentation to Principal Senter, which in the words of Prof. Dame Helen Gwynne-Vaughan, the chairman on that occasion, "will be a frequent reminder of the affectionate regard—the enduring respect—of those with whom he has worked so long".

The late Prof. E. B. Wilson, For.Mem.R.S.

REFERRING to Prof. E. W. MacBride's obituary article on Prof. E. B. Wilson in *NATURE* of April 1 "a gracious appreciation of the work of an eminent fellow biologist", Prof. G. N. Colkins and Prof. J. H. McGregor write that the statement that "His ill-health and subsequent death were due to a tragic accident which befell him when he was conducting a body of students, men and women, on a cruise up the Pacific coast of Canada" is incorrect. On the return journey the boat struck a rock and foundered. They write that they were members of the Columbia University party referred to and have been closely associated with Prof. Wilson ever since until his death. It is true that the ship struck a submerged

rock and sank, but no one suffered the slightest physical injury and no one was in the water. The sea was calm, there was no panic, the transfer of passengers and crew to the lifeboats was conducted in an orderly manner and more than two hours elapsed after striking the rock before the ship finally disappeared. This occurred on August 5, 1897. By far the greater part of Wilson's cytological research and much of his work in experimental embryology were done after the shipwreck. His last contribution to cellular biology was published in 1937, when he was eighty years of age, and his last visit to the laboratory was one week before his death.

Colonial Administration and Progress, 1938-39

IF a certain complacency noted by critics was not indeed entirely absent from Mr. Malcolm MacDonald's review of the year's activities in the debate in the House of Commons on June 7 on the estimates for Colonial and Middle Eastern Services, 1939, he no doubt derived justification from the substantial progress made. Further, the increased interest and understanding of Colonial problems on the part of the public warranted a certain optimism in forecasting increased activity on the part of the administrative authorities in applying the resources of scientific research to the solution of the varied problems which have arisen, especially in Africa, from the contact of backward peoples with the, to them, new standards of a more advanced civilization. Among the more notable features, indeed, of a statement which as a whole can in truth be described as gratifying, was Mr. MacDonald's announcement of the consideration being given, both by the local administrative authorities and the Colonial Office in London, to the recommendations of Lord Hailey's "African Survey" and of Lord Bledisloe's Rhodesia-Nyasaland Commission, and especially to the manner in which effect can be given to the main proposal of the former for the development and co-ordination of research. In dealing with the varied range of problems with which research in Africa is now concerned, Mr. MacDonald was able to speak only in most general terms; but this was of less moment as the annual report was already available ("The Colonial Empire: Statement relating to the Period 1st April, 1938 to 31st March, 1939, to accompany the Estimates for Colonial and Middle Eastern Services, 1939". H.M. Stationery Office. Pp. iv + 97. 1s. 6d. net), in which the activities of administration are set out in detail under headings such as "Research", "Social Progress", "Development of Natural Resources" and the like.

IN opening his statement, Mr. MacDonald emphasized the responsibility of British democracy in government of the Colonial Empire—a field, as he said, of every kind of variety in which "we were still to a greater or less degree the trustees, the guardians, and the tutors of the various peoples". As was said by Sir Edward Grigg on another occasion a few days later, criticism of our ability to make the best for all men of the vast territories under our control is a moral challenge which is by far the most

serious we have to repel. In Africa, which at present is our gravest responsibility, the touchstone of our policy, whatever efforts may be expended in social or economic advancement, must be the opportunities afforded the native by our administrative system to train himself towards adjustment with the changed conditions which must result inevitably from the impact on tribal institutions of a system and civilization in which personal responsibility and personal liberty of thought and action, with certain recognized and admitted limitations due to the rights of others, are the corner-stone. Under the present administration of the Colonial Office, faith is implicit in indirect rule, or local government by traditional chiefs and native councils. The report records with a note of enthusiasm that while local government is regarded as a great experiment, "the year under review affords encouragement for continuing that experiment in high hope of success". The number of local administrations has been increased in several of the African colonies; but is there a subdued note of cynicism in the remark of one of them, that under its administration, extensions "tend rather towards improving the native tribunals than towards setting up native treasures"?

Down House

It is just ten years ago since the British Association threw open to the public Down House, Charles Darwin's home, at Downe in Kent, which had been presented to it by Sir Buckston Browne as a memorial to be held in custody for the nation. The memorial rooms and the grounds are open without charge throughout the year except on Christmas Day, and the number of visitors during the past year is stated to have been 7,362. This figure is very close to the average annual attendance of 7,300 during the ten years since the opening, and since the village of Downe, four miles from a railway station and on an infrequent omnibus service, is probably less easily accessible than almost any other place within the radius of twenty miles from London, it cannot be felt that the number of those who make the pilgrimage to Darwin's house is unworthy of his memory. It has, in fact, always exceeded the expectations of those who are responsible for the maintenance of the house. The collection of Darwinian relics, remarkably complete from the first, is still receiving additions from time to time. The British Association, by means of an appeal to its members and others, is now acquiring the nucleus of a collection of books, magazine articles, and other studies and critiques of Darwin's views, such as appeared in large numbers especially after the publication of the "Origin of Species" in 1859. The Association will gratefully acknowledge any appropriate gifts to the collection.

An Oxford Expedition to Peru

THREE members of the Geology Department of the University of Oxford, Dr. J. V. Harrison (Christ Church), Mr. J. D. Weir (University College), and Mr. C. H. Kearny (Queen's College) and Mr. M. H. Donald are leaving on June 17 for Peru to study

and map the geology of a part of the Central Andes of Peru, a triangular area the apices of which are Tarma, Cerro de Pasco, and Canta, the centre being about eighty miles north-east of Lima. Besides doing the work of mapping and survey, the expedition will collect fossils and specimens of rocks from this region for the British Museum. Dr. Harrison has a wide knowledge of Peru. Mr. Weir, a Rhodes scholar from the University of Saskatoon, has served two summers with the Canadian Geological Survey and Mr. Kearny, a Rhodes scholar from Princeton, has collected archaeological material in north-western Mexico. Mr. Donald of Cumberland has previously collected for the British Museum. How much this expedition will do depends largely upon the weather it experiences. In the high altitudes where it will be, the weather in August and September is capricious and may be very stormy. The plans have been approved by the Royal Geographical Society. The expedition hopes to return to Oxford in October.

Accessions to the British Museum (Bloomsbury)

A serious gap in the archaeological material available for study in museum collections in Great Britain has been filled by accessions to the British Museum (Bloomsbury) reported at the meeting of the Trustees held on June 10. Representative specimens have been received of the antiquities found at Mohenjodaro in the Indus Valley during the years 1925-28 in the archaeological excavations carried out under Sir John Marshall, formerly Director of Archaeology in India. The collection consists of 247 pieces, which have been acquired by exchange from the Director General of Archaeology in India. It is of especial value to archaeologists not only on account of the fact that the Indus Valley civilization, one of the major archaeological discoveries of the decade following the Great War, was almost completely unrepresented previously in English museum collections, but also because of the extent to which it throws light on the relations between this civilization and that of Mesopotamia in the course of the third millennium B.C. The list of accessions to the Museum also included a remarkable archaic Sumerian figure of a seated mountain goat in gold, about 1½ inches long, which has been given by Mr. J. A. Spranger. It is dated approximately at about 2500 B.C. Roughly it is contemporary with, though larger than, similar objects found at Ur by Sir Leonard Woolley. From Mr. M. E. L. Mallowan's excavations in northern Syria of last year come a group of Chalcolithic pottery from the Balikh Valley and antiquities from Brak, among which are the remarkable series of amulets, seals and necklaces of beads and coloured stones, as well as the frieze from the pedestal of the statue found in a sanctuary, consisting of rows of different coloured stones or artificial material, fired at top and bottom with gold bands and gold nails. It is dated approximately at 3000 B.C. A gold figure of a weather god of Hittite origin from Anatolia, dating from the fourteenth or thirteenth century B.C., was acquired by purchase.

Early Man in the Somme Valley, France

A SCOTCHMAN similar to that to which Mr. J. Reid Moir referred in his recent Huxley Memorial Lecture in reviewing the evidence for the existence of man in Pliocene times, has appeared among French archaeologists, in attacks on the authenticity of the evidence which would associate the Abbevillian industry, formerly known as pre-Chellean, with an early type of mammalian fauna with Pliocene affinities in the Somme valley. The evidence is derived from the observations of Ault du Mesnil on a quaternary site at Porte du Bois, Abbeville, between 1875 and 1896. He recorded the association there in the lower horizons of implements with a fauna, which included relics of *Elephas meridionalis*. This site was further investigated by Commont from 1906 onward; but although he confirmed the existence of a fauna such as Ault du Mesnil had described, with the addition of two early types of rhinoceros, no implements were found in association. In view of this, doubt has been cast on Ault du Mesnil's testimony. It is said that he was misled as to an association, of which, in default of a categorical statement, it is assumed that he had no direct and personal ocular evidence. It is well known that early investigators, including Boucher de Perthes, suffered much from fraud on the part of workmen. The whole matter is thoroughly discussed by the Abbé Breuil in the current issue of *L'Anthropologie* (49, 1-2; 1939), where he shows that not only was Ault du Mesnil too careful an observer to make a statement for which he had not good ground, but also that the records of the finds occur in unpublished memoranda still extant, though many of his notes have been destroyed. Further, a closely reasoned archaeological argument by Breuil supports the authenticity of the evidence, as well as shows the impossibility that such implements as these could have been introduced from another source to be foisted on Ault du Mesnil by fraud. Further argument is rendered unnecessary by the discovery, after this paper was written, by Breuil, accompanied by the chief critic, of implements in the strata in which their existence is in dispute.

Climatic Conditions and Living Things in 1938

THE spring of 1938 was remarkable in Britain for a long dry period with varied temperature. January and the first ten days of February were warm, following a December with a temperature about 2.5° F. below normal; but a colder spell in late February was succeeded by a March which broke all records in a warm spell, accompanied by drought, which extended into April. The dry spell continued into April and May, but then it was associated by coolness during the day and frosts at night (Phenological Report, 1938, in *Quart. J. Roy. Meteor. Soc.*, 65, 1939). These conditions had a marked effect upon vegetation. At most of the recording stations plant life was brought forward with a rush, so that by the end of March early stations were recording a precedence of 20 days, while at the highest station, Braemar in Aberdeenshire (1100 feet), rather more than 20 days advance was noted. This precocity, restrained to some extent

by the drought, was eventually checked by the weather of April and May, which caused widespread damage to blossom and foliage. Insects made an early response, as plants did, and suffered the same check, the recorders sharing an impression that, over all, butterflies and moths were scarce throughout the season.

MIGRATING birds can scarcely be expected to regulate their coming by conditions at the end of their journey, but although they arrived in season or even earlier than usual in the southern areas, this earliness was reduced, disappeared or was changed to lateness by the time they had reached their northern quarters in April-May. The report makes reference to the profound effect over an extensive area of the invasion of the Norfolk Broads by the sea, which destroyed the freshwater fishes and many other creatures, but the total results of which have not yet been assessed. The Phenological Report is not an easy document to read or understand, owing largely to the mass of statistics which it summarises and the system of symbols used in the discussion, but it is of great interest, and its band of recorders now numbers 446. Additional observers would add to the trustworthiness of the conclusions, especially in certain areas where records are sparse; for example, no insect observation is listed from Scotland. Any qualified reader of NATURE may obtain the forms necessary for contributing to this team work by applying to the Secretary of the Royal Meteorological Society, 49 Cromwell Road, London, S.W.7.

The Science Museum

THE report of the advisory council of the Science Museum to the President of the Board of Education for the year 1938 opens on rather an ominous note, for it appears that the suggestion has been made that to provide the badly needed further accommodation a building should be erected with "four or more floors". Miniature skyscrapers may be quite suitable for offices and flats, but there will be very general agreement with the opinion that it is unwise to erect a museum with several storeys. "The Council," says the report, "deem it right to mention that the site area they request for the Science Museum in the future falls short of the areas now occupied by our other major national museums." As the Science Museum represents the very activities on which our national prosperity depends most, it surely is against the country's interest to fetter it by unnecessarily limiting its possibility of serving wide educational purposes, and we trust the views of the Advisory Council will prevail. The various sections of the Museum hitherto known as 'Divisions' are now named 'Departments'. Of these there are now five, namely, the Department of Physics and Geophysics, the Department of Astronomy, Mathematics, Optics and Chemistry, the Department of Civil and Mechanical Engineering and Land Transport, the Department of Industrial Engineering, and the Department of Air and Water Transport. These various titles at once suggest the names of great

pioneers, all of whose work is represented in the Museum. Recent acquisitions, special exhibitions, lectures, attendances, staff are all referred to in the report, which contains information also of the Library, testimony being paid to the initiative and resource of Dr. S. O. Bradford, who last year retired after being in charge of the Library for thirteen years. The record of the Museum is one of steady progress.

*Vocational Education in India

AMONG the many baffling problems confronting the authorities responsible for education in India are the prevalence of unemployment among ex-students of high schools, intermediate colleges and universities, and the scarcity of young people trained for practical work in industry. Mr. A. Abbott was invited as an expert in vocational education to bring his special knowledge to bear on these problems, and delivered a lecture on the subject at the Royal Society of Arts (*Journal*, March 10). His lecture is largely based on observations in the Punjab, the United Provinces, Delhi, and the States of Hyderabad and Baroda. It outlines a scheme providing for vocational schools of three grades: the vocational high school, the technical college and the postgraduate stage. The first and, for the time being, most important would be open to students who had completed eight years of 'general' education. As an exception, prospective artisans of the small-scale industries would be admitted to industrial schools if qualified in arithmetic, reading and writing by six years of general schooling. These would devote a third of their time in the industrial school to general subjects, including drawing, and spend the remainder in workshop exercises. But the keynote of the lecture is 'planning'. The first step must be the establishment of machinery for effective consultation between industry and educational organizations. This would take the form of advisory councils, provincial and local. The former would in the first instance survey the needs of industry and plan a provincial scheme. On the local council would devolve the critical function of estimating the number of recruits needed annually for each calling, a consideration too often ignored in the provision of opportunities for advanced literary education. Entry to the technical colleges would be restricted to students who had not only gained the leaving certificate of a higher secondary school with credits in mathematics and science, involving ordinarily eleven years of schooling, but also had already a prospect, more or less assured, of finding employment.

Indian Statistical Conference

ALTHOUGH the desirability of holding an Indian Statistical Conference was realized by the Indian Government in 1934, it was not possible to hold the first meeting until January 1938. The Proceedings of the Conference were published in December (Calcutta: Statistical Publishing Society; London: P. S. King and Son, Ltd., 1938), and contain, besides the official speeches, some twenty research papers in

full and abstracts of many others; it will probably surprise many English statisticians to learn how vigorously the subject is being developed in India. The Conference was divided into four sections dealing respectively with theoretical statistics, agricultural statistics, medical and public health statistics, and economic statistics. There was a symposium on agricultural field experiments, and a special discussion on standardization in industry. The Conference was presided over by Prof. R. A. Fisher. Among the supplements is a biographical sketch of Prof. Fisher, pointing out how deeply he has influenced statistical work in India. Other supplements give the sixth annual report of the Indian Statistical Institute, and an account of the work of the Calcutta Statistical Laboratory, with a list of 128 original papers produced there.

The Art of Pyrometry

THE growth of the science of matter at high temperatures in the last century has been largely determined by the perfection of methods of measuring high temperatures. Prior to that time manufactures at high temperatures were of necessity empirical and dependent on the unaided skill and judgment of craftsmen. It was impossible to measure furnace temperatures much more exactly than in the time of Shadrach, Meshach, and Abednego. The progress can be realized by comparing the symposium on "Gas Temperature Measurement" (*J. Inst. Fuel*, March 1939) with the modest and pioneering classic of Le Chatelier "Les Mesures des Températures Elevees" published only so recently as 1900. This report, with its discussions, covers more than 100 quarto pages and forms an excellent summary of the art of pyrometry as it exists to-day—an art which makes use of almost every branch of physics. In the symposium all pyrometric matters were considered, but considerable attention was directed to the suction pyrometer for measuring temperatures of gases flowing through flues. Dr. G. Naesser described a recent introduction to pyrometric technique—a colour brightness pyrometer—which makes use of colour instead of the intensity of radiation. Advantages are claimed in connexion with the measurement of the temperature of melted metal.

The Ross Institute Industrial Advisory Committee

AT a meeting of the Ross Institute Industrial Advisory Committee held on April 21 with Mr. G. H. Masefield in the chair, reports were presented upon malaria control in Ceylon, and upon housing and air-conditioning in the tropics. Sir Malcolm Watson spoke on anti-malarial oil for treating water in order to destroy mosquito larvae. An almost perfect anti-malarial mixture has been compounded, but it is very necessary to employ the right kind of oils, which are not always available. The conveyance of disease by aircraft was another subject discussed, particularly by transmission of infected mosquitoes, and it was mentioned that an apparatus had been recently devised for disinfection during flight.

Directory of British Health Resorts

THE British Health Resorts Association, Tavistock Square, W.C.1, has just published its official Handbook entitled "British Health Resorts: Spa, Seaside, Inland" (2s. 6d. net). The volume, which is edited by Drs. Fortescue Fox and Wyndham Lloyd, is a guide to the spas and health resorts, seaside and inland, of the British Isles and British Dominions and Colonies, giving particulars of their climate and rainfall, the characteristics of their baths and waters, if any, and indications of the conditions for which they are suitable. The Minister of Health contributes a foreword, and chapters are included on the science of waters and baths and on climates, with maps, charts and many illustrations.

Recent Earthquakes

THE recently enhanced seismic activity has continued. Several strong earthquakes and tremors have been experienced in many widely separated places. On May 6, violent tremors were felt in Chile, especially in the neighbourhood of the epicentre of the destructive shock of January 24. Many buildings damaged previously in Chillan, San Carlos and Parral collapsed, but there was no loss of life. Port of Spain, Trinidad, experienced a severe tremor on the evening of May 7, but no damage was reported and there were no casualties. On the morning of May 8, a severe tremor occurred in the neighbourhood of Athens but again no damage is reported. The strongest shock, however, was on the morning of May 8. Provisional readings of the initial pulses (*P* waves) of seismograms and calculated epicentral distances are as follows: Kew, 1h. 51m. 48s. (compressional), Δ , nearly 23° ; Paris, 1h. 51m. 55s., Δ , $2,540$ km.; Uccle, 1h. 52m. 11s. (compressional), Δ , $2,700$ km.; Hamburg, 1h. 52m. 50s., Δ , $3,100$ km.; De Bilt, 1h. 52m. 21s., Δ , about 24.5° . The shock was also recorded at West Bromwich, and at Selfridges in London the maximum double amplitude was nearly $6''$. These readings point to an epicentre in the Azores at approximately latitude 37° N., longitude 24° W., with normal depth of focus, and initial time approximately 1h. 46m. 50s. G.O.T. Reports from Ponta Delgada state that at about this time a severe earth tremor lasting about twenty-five seconds was experienced on Sao Miguel Island in the Azores but no damage was caused. The shock was preceded by unusual heat and terrifying underground rumblings. It is known that a definite band of epicentres lies near the Dolphin or North Atlantic Divide on which the Azores are situated, although earthquakes are not so numerous on this band as in the Mediterranean or circum-Pacific regions of instability.

Physical Society's Rutherford Memorial Lecture

It is right and fitting that we should, in due season, praise the work of famous men, and no man has left the impress of his work and personality more deeply graven on the structure of modern physical science than has Ernest Rutherford. It has been said with truth that he was on the crest of the wave

of scientific advance; it has been said, with deeper truth, that he made the wave. A memorial lecture is a useful and appropriate form of homage, which has been adopted by the Physical Society, it was announced at the summer meeting of the Society held at University College, Southampton, on June 9. The Society's Rutherford Memorial Lecture is to be given annually between October and March, and to be devoted to an address on some topic concerning recent advances in atomic and nuclear physics. The first lecture will be given in the session 1939-40.

International Congress of Biology

THE first International Congress of Biology will be held at Brussels on July 9-12 under the presidency of Prof. E. Sphel. Discussions have been arranged on the role of diet in the output of muscular work, introduced by M. Bigwood; physiology of muscular contraction (M. Bouckaert); muscular work and circulation of the blood (M. Heymans); physiological mechanisms during training (M. Brouha). Further information can be obtained from the secretariat, 96 Avenue Paul Janson, Anderlecht, Brussels.

Physics of Metals

THE University of Pittsburgh, Pennsylvania, is organising a summer course during July 6-August 11 on the "Physics of Metals", which will deal with the fundamental structure of metals and other solids. An attempt will be made to understand the nature of the forces which make pure metals and alloys hard or soft, ductile or brittle, good or bad conductors of electricity, etc. The lecturers include: Dr. John C. Slater, head of the Department of Physics, Massachusetts Institute of Technology; Dr. M. F. Manning, University of Pittsburgh; Dr. W. Shockley, Bell Telephone Laboratories; Dr. Frederick Seitz, University of Pennsylvania; and Dr. E. U. Condon, associate director, Westinghouse Research Laboratory. Further particulars can be obtained from Prof. E. Hutchison, University of Pittsburgh.

French Association for the Advancement of Science

A PROVISIONAL programme and a list of sectional presidents (twenty-two in number) have now been issued for the Liège meeting on July 17-22 of the French Association for the Advancement of Science. Arising out of the formation at Cambridge of the new Division for the Social and International Relations of Science of the British Association, an exchange of views between the British and French Associations was arranged, as a result of which it was decided to elect to honorary membership of the Association the president, vice-president, secretary, deputy-secretary, treasurer and secretary of council of the French Association. The latter has now elected to honorary membership the president (Sir Albert Seward), general treasurer (Prof. P. G. H. Boswell), general secretaries (Profs. F. T. Brooks and A. Ferguson) and secretary (Dr. O. J. R. Howarth) of the British Association. The offices of the French Association are at rue Sapperte 28, Paris VI^e.

International Congress for Experimental Cytology

THE sixth International Congress for Experimental Cytology will be held at Stockholm during July 25–August 1, 1940. A preliminary programme has been arranged by the Swedish organization committee (President, Prof. John Runnström; Secretary, Dr. Sven Hörstadius; address: Wenner-Grens Institut, Norrtullagatan 16, Stockholm). It has been developed from the point of view of cellular physiology. The conventional distinctions between physical chemistry, biochemistry and cellular physiology have at present no sharp borders. Therefore place has been reserved for physico-chemical discussions of the behaviour of the components of protoplasm. Opportunities will, however, be provided for the arrangement of informal afternoon sessions wherein smaller groups may enjoy unrestricted discussion. Membership fee for the Congress is 25 Swedish crowns.

Lady Tata Memorial Trust

THE Trustees of the Lady Tata Memorial Fund announce that, on the recommendation of the Scientific Advisory Committee, they have made the following awards for research in blood diseases with special reference to leukaemia, in the academic year beginning on October 1, 1939. Grants for research expenses: Dr. Jørgen Bichel (Aarhus, Denmark); Dr. Julius Engelbreth-Holm (Copenhagen); Dr. Maurice P. J. Guérin (Paris); Prof. Karl Jármai (Budapest); Prof. James McIntosh (London); Prof. Eugene L. Opie and Dr. Jacob Furth (New York); and Dr. Joachim Wienbeck (Breslau). A part-time personal grant and grant for research expenses has been made to Dr. Werner Jacobson (Cambridge), and a whole-time scholarship awarded to Dr. Edoardo Storti (Pavia).

The Colonial Service: Recent Appointments

THE following appointments and promotions in the Colonial Service have been made: F. E. Reid, chemist, Institute of Medical Research, Federated Malay States; Dr. W. Rintoul, assistant analyst, Straits Settlements; A. Huddleston, geologist, Gold Coast; L. H. Lester, veterinary officer, Uganda; B. E. Webb, utilisation officer, Forestry Department, Tanganyika Territory; G. K. G. Campbell (agricultural officer), botanist, Nigeria; E. F. Martin (agricultural officer), senior agricultural officer, Uganda; R. O. Williams (chief horticultural officer, Palestine), deputy director of agriculture, Trinidad; W. D. MacGregor (conservator of forests, Nigeria), conservator of forests, Sierra Leone; J. N. Oliphant (director of the Imperial Forestry Institute, Oxford, and formerly department director of forestry, Malaya), chief conservator of forests, Nigeria; Captain R. L. Creery (veterinary officer), senior veterinary officer, Kenya; W. G. Emerson (veterinary officer), senior veterinary officer, Kenya; W. Fotheringham (veterinary officer), senior veterinary research officer, Kenya; F. H. Geake (assistant analyst, Straits Settlements), chemist, Customs and Excise Department, Federated Malay States.

Announcements

Viscount Nuffield and Mr. John Davison Rockefeller have been elected fellows of the Royal Society in accordance with the terms of Statute 12, which provides for the election of persons who, in the opinion of the Council, "either have rendered conspicuous service to the cause of science, or are such that their election would be of signal service to the Society".

DR. W. BOWIE, formerly chief of the Section of Geodesy of the U.S. Coast and Geodetic Survey, has been given the first Bowie Medal of the American Geophysical Union. The medal was established to commemorate his work for geophysical research, and will be awarded annually for outstanding achievement in related work.

A PORTRAIT of James Watt was unveiled by Sir Nigel Gresley at the Institution of Mechanical Engineers during the course of a reception held on June 9. The portrait represents Watt at fifty-seven years of age; it was painted in 1792 by Charles Frederick von Breda, and was acquired by the Institution from the family of John Rennie in 1936. During the reception, a formal announcement was made of the award of the James Watt International Medal to Mr. Henry Ford, and an address was delivered by the American Ambassador.

THE new laboratories at Mill Hill, London, N.W.7, of the Imperial Cancer Research Fund will be opened officially on June 27 by Lord Halifax, president of the Fund. Sir Frederick Gowland Hopkins will deliver an address on "Scientific Aspects of Cancer Research".

THE ninth General Conference of Weights and Measures will meet in Paris and Sèvres early in October.

AN International Exhibition against Air Attack will be held at Brussels on July 8–29 at the same time as the second International Salon of Aeronautics. Further information can be obtained from La Ligue de Protection Aérienne, 182 rue de la Loi, Brussels.

THE sixth Pacific Science Congress will be held at Berkeley, Stanford and San Francisco during July 24–August 12, under the auspices of the U.S. National Research Council. Programmes and further information can be obtained from Dr. Roy. E. Clausen, Room 205, Hilgard Hall, University of California, Berkeley, California.

WE are informed by Prof. C. Daryll Forde that his work on the tribal customs in the Obubra Division of Southern Nigeria, referred to in NATURE of May 13, p. 816, was carried out while he held a Leverhulme Research Fellowship for field work in Nigeria, and not, as stated in AFRICA, a Rockefeller research fellowship of the International Institute of African Languages and Cultures.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1027.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Photo-oxides of Carcinogenic Hydrocarbons

SUGGESTIONS have sometimes been made that the biological action of carcinogenic hydrocarbons is preceded by conversion, probably by oxidation, into water-soluble derivatives which may more readily be conceived as able to exert a direct action on the cells which eventually become malignant than the water-insoluble parent hydrocarbons. The photo-sensitivity of solutions of some of the more potent carcinogenic hydrocarbons (namely, 3:4-benzpyrene and 20-methylholanthrene) is apparent to those accustomed to work with them; moreover, Boyland¹ found that alkaline extracts of photo-oxidized carcinogenic hydrocarbons arrest the activity of certain enzymes, and Maisin and de Jonghe² observed that light accelerates the production of skin tumours in mice by 3:4-benzpyrene. Most of the known carcinogenic hydrocarbons are anthracene derivatives and are therefore related to the group of compounds which have been shown by Dufraisse and his collaborators³ to undergo facile photo-oxidation to oxides which are peroxidic in character.

With the view of determining whether oxides of this type are involved in the biological action of carcinogenic hydrocarbons, we have attempted to isolate the photo-oxides of some of these hydrocarbons. Such photo-oxides would naturally be insoluble in water and hence would represent merely one stage in the oxidation process envisaged as a prelude to biological action. During the earlier stages of our work, Vallux⁴ reported that no absorption of oxygen occurred when solutions of 1:2:5:6-dibenzanthracene and 20-methylholanthrene were exposed to sunlight. We have ourselves been unable to obtain photo-oxides from 1:2:5:6-dibenzanthracene and 3:4-benzpyrene; in the latter case, dark-coloured unidentified products were obtained. With 1:2-benzanthracene we found indications of the formation of a photo-oxide; but contamination with dark-coloured by-products hindered its isolation.

The most rapidly acting carcinogenic hydrocarbon now known is 9:10-dimethyl-1:2-benzanthracene⁵, and the superior *meso* additive reactivity of this hydrocarbon towards maleic anhydride⁶ suggested that a photo-oxide might be more readily formed than in the case of the hydrocarbons previously mentioned. This has proved to be so. Oxygen was passed through 500 c.c. of a 0.05 per cent solution of 9:10-dimethyl-1:2-benzanthracene in carbon disulphide, exposed to the light of a 200-watt gas-filled lamp. The solution was kept cool by immersion in a bath of running water. After some four hours, the blue fluorescence had disappeared, and the solvent was removed under reduced pressure, in the dark. The resulting photo-oxide crystallized from carbon

disulphide in colourless needles, m.p. 193–194°. Photo-oxides having the melting points given in parenthesis were also obtained with approximately equal facility from the following related hydrocarbons: 5:9:10-trimethyl-1:2-benzanthracene (212–213°); 6:9:10-trimethyl-1:2-benzanthracene (205–206°), 5:6:9:10-tetramethyl-1:2-benzanthracene (228–229°), and 9:10-dimethyl-1:2:5:6-dibenzanthracene (222–223°). Two of the hydrocarbons have not been described (6:9:10-trimethyl-1:2-benzanthracene, m.p. 157–158°, and 5:6:9:10-tetramethyl-1:2-benzanthracene, m.p. 132–133°) and their synthesis, and also full descriptions of the photo-oxides, will be published elsewhere.

The compounds thus made available should suffice to show whether oxides of this nature are intermediate products in carcinogenesis by the hydrocarbons, although the lack of correspondence between the carcinogenic activity of a compound and its ability to form a photo-oxide does not support this view.

The ultra-violet absorption spectrum of the photo-oxide of 9:10-dimethyl-1:2-benzanthracene has been examined. It is intermediate between a benzene and a naphthalene type of absorption as shown by their complex derivatives. That is, the bands are similar in position to those of a *meso*-dihydro derivative of 1:2:5:6-dibenzanthracene, but have only about half the intensities. On irradiation with the mercury arc, a hexane solution of the photo-oxide is decomposed and the spectrum of the parent hydrocarbon with its long wave-length band system (3200–4000 Å.) reappears. Prolonged irradiation results in further change in the spectrum leading to a continuous absorption rising towards the region of shorter wave-length, and the same change is observed when the parent hydrocarbon, 9:10-dimethyl-1:2-benzanthracene, is similarly treated. The spectrum of 9:10-dihydroxy-9:10-dimethyl-9:10-dihydro-1:2-benzanthracene, examined for comparison with that of the photo-oxide, shows bands of the same order of intensity as the photo-oxide, but shifted about 180 Å. towards the far ultra-violet.

J. W. COOK.

R. MARTIN.

E. M. F. ROW

Research Institute,
Royal Cancer Hospital (Free),
London, S.W.3.

May 17.

¹ Boyland, B., NATURE, 130, 274 (1932); Biochem. J., 27, 791 (1933).

² Maisin, J., and de Jonghe, A., C.R. Soc. Biol., 117, 111 (1934).

³ See, for example, Dufraisse, G., Bull. Soc. Chim., (v) 15, 422 (1930).

⁴ Vallux, L., C.R., 203, 1514 (1933).

⁵ Bachmann, W. R., Kennaway, E. L., and Kennaway, N. M., Yale J. Biol. and Med., 11, 97 (1938).

⁶ Bachmann, W. R., and Chemers, J. M., J. Amer. Chem. Soc., 60, 1023 (1938).

Variations in the Inhibitory Power of Carcinogenic Hydrocarbons according to the Solvent

PRACOCK¹ has noted a difference in the carcinogenic power of certain hydrocarbons injected subcutaneously, according to the solvent used. This potency reaches its maximum in the case of lard or olive oil, and its minimum with fats obtained from the same species.

We judged it useful to find whether by varying the solvent any difference would be produced in the inhibitory action, possessed by carcinogenic compounds², on the growth of transplantable tumours. In the first tests, made on rat tumours, we used as solvent a fat obtained from this species by successive extractions with acetone, hot and cold alcohol and ether. In the final ether solution, small quantities of undissolved substances were filtered off. The action of the hydrocarbon dissolved in this lipoidal mixture was compared with that of the same substance dissolved in lard, or in colloidal suspension. In a first series of tests, rats in which Walker carcinoma had been grafted 4 days earlier were subdivided as follows: (a) 14 control rats injected twice with 1 c.c. of untreated lard with an interval of one week; (b) 14 rats injected twice with 3 mgm. of 3:4-benzopyrene dissolved in 1 c.c. of rat fat, with an interval of one week; (c) 14 rats injected twice with the same quantity of hydrocarbon dissolved in 1 c.c. of lard, with an interval of one week.

In a second series of tests, rats bearing Walker carcinoma were treated as follows: (a) 12 control rats injected twice with 2 c.c. of untreated lard, with an interval of one week; (b) 12 rats injected twice with 3 mgm. of 1:2:5:6-dibenzanthracene dissolved in 2 c.c. of rat fat, with an interval of one week; (c) 12 rats injected twice with the same quantity of hydrocarbon dissolved in 2 c.c. of lard, with an interval of one week.

Lastly, in a third series, we have compared the inhibitory power of 3:4-benzopyrene dissolved in lard and injected subcutaneously with that of the same substance administered in colloidal suspension by intravenous injection (30 rats for each test).

The results proved that the highest inhibitory power was obtained by subcutaneous injection of the hydrocarbons in lard. The colloidal solution given intravenously showed a less constant activity. *In mixtures of homologous lipoids and fats (that is, fats obtained by extraction from rats and injected into animals of the same species) there is a total suppression of the inhibitory power for 3:4-benzopyrene and a distinct diminution for 1:2:5:6-dibenzanthracene.*

This last fact cannot be easily ascribed to a more rapid elimination of the compound due to easier absorption of the solvent. In fact, when the animals died on account of the tumour, autopsy showed that most of the fat remained at the site of injection, where it determines a more rapid and more intense inflammatory reaction than is the case with lard. A formation of ulcers earlier than in the case of lard was also observed (10-15 days).

Tests are being carried out to explain this anomalous behaviour of homologous fat as a solvent of the carcinogenic hydrocarbons.

Istituto Giuliana Ronconi,
Milano. May 14.

E. MORELLI.
A. DANZI.

¹ Pracock, *Proc. Levenschoek-Versamling* 1935. See also Beck, *Brit. J. Exp. Path.*, 19, 81 (1938).

² Haddow, *NATURE*, 133, 808 (1935). Morelli, *Boll. Ige. It. per le lott. contro il Cancro*, 1936. Morelli and Danzi, *Seconda Internat. Cancer Congress*, Brussels, 2 (1936). Haddow, *ibid.*

Permeability of Corpuscles and Muscle Cells to Potassium Ions

AN almost ideal method to study the permeability of corpuscles is to introduce into the plasma cations, for example, ions of potassium labelled by the addition of a radioactive potassium isotope, to separate after the lapse of a certain time the corpuscles, and to determine if and to what extent the latter contain radioactive potassium ions.

⁴¹K, which has a half-life time of 12 hours, was administered in the form of potassium chloride to a rabbit by subcutaneous injection. The active potassium was kindly prepared by Dr. J. C. Jacobsen and Mr. N. Lassen by means of the cyclotron in Prof. Bohr's institute. Blood samples were taken at intervals, the corpuscles were separated from the plasma by centrifuging, washed twice with inactive plasma and the activity of both the corpuscles and the plasma determined. After the lapse of twenty-four hours the animal was killed, and the activity of the different organs was also determined.

As seen in the accompanying table, a part of the labelled potassium resorbed into the plasma is present in the corpuscles; but, even after the lapse of twenty-four hours, the activity of 1 gm. corpuscles amounts only to 66 per cent of that of 1 gm. plasma. As 1 gm. corpuscles contains about twenty times more potassium than 1 gm. plasma, the above figure has to be divided by 20 to arrive at the figure representing the extent of equipartition of the individual potassium ions present in the plasma at the start of the experiment between the plasma and the corpuscles.

Thus, 3 per cent of all individual potassium ions present in the aggregate of the corpuscles at the end of the experiment were incorporated in the course of the last 24 hours. A part of this 3 per cent is due to the formation of new corpuscles, since corpuscles formed in an organism containing labelled potassium must certainly contain labelled potassium; furthermore, some of the ⁴¹K ions found in the corpuscle fractions may have been adsorbed on the surface, some may be penetrated into the corpuscles. From the above figures it follows that the permeability of corpuscles to potassium ions is certainly very minute, or more correctly, the bulk of the potassium ions present in the corpuscles is not replaced within the life-time of the latter. Incidentally, we can conclude that the formation of new corpuscles within twenty-four hours is restricted to 3 per cent of the total corpuscle content of the rabbit.

DISTRIBUTION OF ⁴¹K.

Time	Organ	Percentage of ⁴¹ K administered present in 1 gm. fresh substance*
16 min.	Plasma	2.0×10^{-3}
35 "	"	2.4×10^{-3}
61 "	"	2.7×10^{-3}
93 "	"	3.3×10^{-3}
93 hours	"	3.0×10^{-3}
7 "	"	3.0×10^{-3}
15.5 "	"	3.0×10^{-3}
19.5 "	"	3.1×10^{-3}
24.5 "	"	2.9×10^{-3}
24.5 hours	Corpuscles	1.9×10^{-3}
24.5 "	Muscles	4.2×10^{-3}
24.5 "	Liver	4.1×10^{-3}
24.5 "	Kidneys	4.7×10^{-3}
24.5 "	Brain	2.8×10^{-3}
24.5 "	Tibia epiphysis	3.1×10^{-3}
24.5 "	Tibia diaphysis	1.9×10^{-3}
24.5 "	Marrow	2.3×10^{-3}
24.5 "	Spleen	3.3×10^{-3}

* When evaluating the above figures due regard was taken of the activity of the tissue potassium due to ⁴¹K.

We also carried out experiments *in vitro*. Blood was shaken with labelled potassium chloride at 37° in an O₂-CO₂ atmosphere for a few hours; corpuscles and plasma were then separated. The corpuscles of rabbit blood were found to contain 35 per cent of the activity of the same volume of plasma. Taking into account, as above, the much larger potassium content of the corpuscles, we obtain 2 per cent as the extent of equipartition of the individual potassium ions between plasma and corpuscles.

We found the membrane of muscle cells to be somewhat permeable to potassium ions, as shown in the table. The ⁴²K content of 1 gm. muscle tissue was found to be 150 per cent of that of 1 gm. plasma. If we assume, as is generally given, the extracellular volume to be 16 per cent of the muscle volume, the ⁴²K content of the muscle cells after the lapse of twenty-four hours amounts to 1.8 as much as the ⁴²K content of the equal weight of plasma. Taking into account that the muscle cells contain about twenty times as much potassium as plasma of the same weight, we can conclude that in the course of twenty-four hours 8 per cent of the K⁺ of the muscle cells exchanged with those present in the plasma.

In an experiment in which labelled potassium chloride was injected into the lymph sac of a frog kept at 22°, no ⁴²K of any significance was found in the corpuscles after the lapse of sixteen hours, while 1 gm. of muscle tissue was found to be 2.4 times as active as 1 gm. plasma.

L. HAHN.
G. HEVESY.
O. REBER.

Institute of Theoretical Physics,
University, Copenhagen.
May 9.

Colour Reactions of Lignin and Tannins

SEVERAL recent observations have led us to the view that the Mitchell colour reaction of gallotannins¹ and the chlorine-sodium sulphite reaction of hardwood lignin, which latter has been studied in this Laboratory^{2,3}, are essentially similar. The observation that ferric salts are among the oxidising agents which give a magenta coloration with gallic acid in the presence of such weak alkalis as sodium bicarbonate, sodium sulphite⁴ and Rochelle salt suggests that, in the Mitchell reaction, there is first oxidation of ferrous sulphate to the ferric state and then oxidation of tannin by the ferric salt. It would appear that all the observations of ourselves and others can now be explained by assuming that these reactions take place in stages as shown in the accompanying table.

Trimethylgallic acid and hardwood lignin	Gallic acid and tannins
(1) An excess of chlorine is required in order to break down other links and form a phenol.	Contain no other links.
(2) The necessary oxidation is carried out simultaneously by the chlorine.	A variety of oxidising agents may be used.
(3) The excess of chlorine must be removed whilst the system is acid since the coloured substance is specially sensitive to oxidation in alkaline solutions.	No excess of oxidising agent need be used.
(4) The system must be rendered weakly alkaline before the characteristic magenta colour develops.	The system must be weakly alkaline for the development of the magenta colour.

In the case of lignin, the importance of the third and fourth of the above steps is brought out as follows. Urea may be added to destroy excess of chlorine, and the coloration is given when the system is rendered alkaline. When sodium bicarbonate is added direct to freshly chlorinated wood, no colour is produced, even if urea is added afterwards. Sodium sulphite both removes excess chlorine and renders the system alkaline; but even in the presence of this reagent the colour is only transient, since it changes to brown on exposure to air. That atmospheric oxygen has little effect on the substance immediately responsible for the coloration when the medium is acid is shown by the observation that chlorinated beechwood, from which excess chlorine had been removed by sulphurous acid, still gave the magenta coloration, when alkali was added, after an interval of six days.

Lastly, we have observed that the colour develops when gaseous chlorine is passed into a dilute aqueous solution of gallic acid containing an excess of basic lead acetate in suspension. The colour disappears in the presence of excess chlorine and does not reappear on adding sodium sulphite. On the other hand, if either beechwood or trimethylgallic acid is treated in the same way, no colour is developed; but if, after using an excess of chlorine, sodium sulphite is added, the colour appears as usual. In the first case, a small amount of chlorine causes sufficient oxidation for the production of the colour in the presence of the weakly alkaline basic lead acetate. Then, while the liquid is still alkaline, the coloured compound is destroyed by further chlorine. In the second case, phenol formation is not complete until sufficient chlorine has been passed to make the medium acid so that the colour is developed by sodium sulphite in the usual way.

W. G. CAMPBELL.
J. O. MCGOWAN.

Section of Chemistry,
Forest Products Research Laboratory,
Princes Risborough,
Aylesbury, Bucks.
May 10.

¹ Mitchell, O. A., *Analyst*, 48, 2 (1923).

² Campbell, W. G., Bryant, S. A., and Swann, G., *Biochem. J.*, 31, 1235 (1937).

³ Campbell, W. G., McGowan, J. O., and Bryant, S. A., *Biochem. J.*, 33, 2138 (1938).

⁴ See Ghamston, S., *Analyst*, 50, 49 (1925) in this connexion.

Ultra-Violet Chemi-Luminescence

A RECENT report by R. Audubert¹ on ultra-violet chemi-luminescence has provoked a good deal of discussion on the possible mechanism of the phenomenon. The phenomenon seems to be identical with the mitogenetic radiation², a fact which was emphasized in the discussion following Audubert's paper (S. I. Wawilow, P. Fringsheim). In this connexion it may be of some interest to report briefly on our recent results, which have a bearing on some points raised in the discussion (Polanyi), and which suggest an interpretation of the radiation occurring in chemical reactions as a kind of sensitized fluorescence. A detailed report is in preparation.

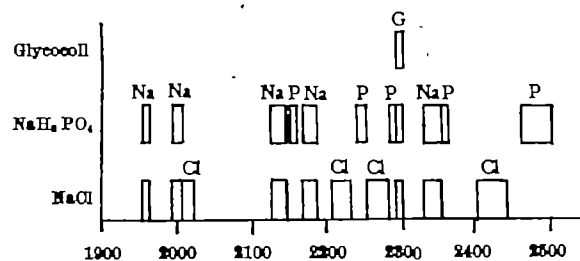
The starting-point of our investigation was Frankenburg's hypothesis on the origin of mitogenetic radiation, from which we quote the following extract³: "According to that interpretation [that of Haber and Willstätter] there may occur as

by-products of these reactions [fermentations] interactions between atoms and radicals, in other words, highly exothermic processes which may serve as sources of an ultra-violet radiation of very short wavelength. The ultra-violet luminescence could here either be caused directly by recombination of atoms with radicals, or indirectly by transferring the energy balance to 'molecules capable of radiating'. Evidence in favour of the latter alternative is supplied by the emission spectra of specific metabolic processes (glycolysis, proteolysis, oxidation, &c.) as found by Gurwitsch¹ (our italics).

The passage in italics suggests a possibility of experimental verification, which leads to unambiguously positive results. If one adds to a source (*S*) of chemi-luminescence of which the emission spectrum is known, a substance (*K*) which does not radiate spontaneously, and does not take any part in the reaction *S*, the emission spectrum of the mixture contains new bands, which must therefore be due to the mere presence, and not to any chemical action, of the substance *K*.

If radiation from the substance *K* can be excited by other means (for example, by fermentation) the spectrum in the first case (*K* + *S*) and in the second (*K* + ferment) are found to be identical.

The following case may serve as an example: The source *S* is a 0.5 solution of glycine, which has been irradiated mitogenetically (source $K_2Cr_2O_7$ + $FeSO_4$) and continues to emit for several hours. As we have shown elsewhere² the process is the excitation of a fermentative reaction (desamination of glycine). The emission spectrum was examined in repeated experiments, and contains only one band at 2290–2300 Å. After adding 0.1 per cent of glucose, the emission spectrum contains the bands 1900–1905, 1915–1920, etc., which are typical of glycolysis, in addition to the original glycine band³.



EMISSION SPECTRA OF THE THREE COMPOUNDS, USING YEAST CULTURES AS INDICATORS (OF. REF. 5).

The spectra of glycine and of the PO_4 radiation (denoted by 'P') were measured with greater precision (monochromator band width of 10 Å.), the rest of the spectra less accurately (monochromator slit of 2 mm., corresponding to 10 Å. for short waves and 45–50 Å. for longer waves). The PO_4 spectrum as found here is identical with that of the fermentation of nucleic acid; the latter is also a case in which the phosphate radical is set free (cf. ref. 5, p. 23).

We investigated a number of substances, which may be divided in two groups, 'fluorescent' substances and 'non-fluorescent' ones. The second group contains all the high-molecular compounds we have so far investigated (glycogen, pure albumin, nucleic acid). The first group contains several monosaccharides (glucose, levulose, mannose), sucrose, peptides, tryptophane phosphate radical, the ions of sodium and chlorine. For the last two, the fluorescent

spectrum was obtained by comparing the emission spectra of the systems glycine plus sodium chloride and glycine plus sodium dihydrogen phosphate. The accompanying diagram shows that some bands are common to both spectra, whereas others occur only in one of them. The former belong to the sodium ion, whereas the latter must be due to the chlorine ion, or to the phosphate ion, respectively. The extension of the spectra is, of course, limited by the properties of the biological detectors, which, according to measurements made by us recently, respond only up to waves of about 2800 Å.

A. GURWITSCH.

L. GURWITSCH.

Institute of Experimental Medicine,
Leningrad.

¹Trans. Faraday Soc., January 1939.

²Levy et Audubert, *Protoplasma*, 26, 23 (1936). Gurwitsch, A., *ibid.*, 26, No. 3.

³Frankenburger, *Strahlenheerapie*, 47, 259 (1933).

⁴Gurwitsch, A. and L., *Enzymologia*, 5, 17 (1938).

⁵Gurwitsch, A. and L., "Analyse mitogénétique spectrale" (*Actualités scientifiques*, No. 150. Hermann and Co. Paris, 1934).

Structure of Benzil

C. C. Caldwell and R. J. W. le Fèvre¹, by a comparison of the dipole moments of benzil and of phenanthraquinone in various solvents, are able to suggest that the former molecule has a maximum stability when the two $Ph - \dot{C} = O$ units lie in planes which are mutually perpendicular.

We have been engaged for some time in an analysis of the structure of crystalline benzil, based on complete X-ray measurements and on a new determination of the magnetic anisotropy. Benzil crystallizes in the D_2^h and D_2^d (enantiomorphous) space-groups, the unit cell containing three molecules. Each molecule has a dyad axis, normal to the central carbon-carbon bond². Starting with the plane *trans*-configuration, possible molecular arrangements may involve either a rotation of the two $Ph - \dot{C} = O$ groups about the central single bond, or a symmetrical rotation of the phenyl groups about their single bonds, or both of these. Seven main molecular types are being investigated:

(1) The plane *trans*-form: all the atoms must then lie in the {1120} planes. An exhaustive comparison of calculated and observed X-ray intensities of reflection over a complete range of parameters has eliminated this form.

(2) The plane *cis*-form: this is ruled out both by steric considerations and by the X-ray intensities.

(3) The form suggested by K. Banerjee and K. L. Sinja³, in which the two phenyl groups are normal to the plane central $O = \dot{C} - \dot{C} = O$ group, which is of the *trans*-type. This is contradicted by a careful comparison with experimental intensities, all parameters being systematically varied.

(4) A molecular arrangement intermediate between (1) and (3), the phenyl groups being symmetrically rotated out of the plane *trans*-configuration about their appropriate single bonds. No structure based on such a molecule could be found to give agreement.

(5) A molecule obtained by rotating the phenyl groups symmetrically out of the plane *cis*-configuration about their appropriate single bonds. This also has been eliminated.

(6) A skew molecule in which there has been rotation of the $\text{Ph}-\text{C}=\text{O}$ groups out of the plane configuration about the central single bond only, each phenyl group being co-planar with the adjacent $-\text{C}=\text{O}$ atoms.

(7) A skew molecule in which, in addition to the rotation about the central single bond, there has also been symmetrical rotation of the phenyl groups about their single bonds.

The investigation of possible crystalline structures based on skew molecules of types (6) and (7) is, unfortunately, both long and tedious, and is not yet complete. The elimination of the simpler molecular structures shows, however, that the molecule must be of such a skew type, in which case it can of course exist in a right-handed or a left-handed form. The crystals will contain spirals of oxygen atoms somewhat similar to those found in quartz. The optical rotatory power of crystalline benzil is even larger than that of quartz.

I. ELLIS KNAGGS.

KATHLEEN LONSDALE.

Royal Institution,
Albemarle Street,
London, W.1.

May 19.

¹ *NATURE*, 143, 803 (1939).

² Allen, N. O. B., *Phil. Mag.*, 3, 1037 (1927).

³ *Indian J. Phys.*, 11, 409 (1937).

Preparation of Grease-free Polished Surfaces

POLISHED surfaces of metals and minerals, completely free from grease, are frequently required for scientific purposes. Adam¹ has discussed the difficulties encountered in their preparation, and the complications that ensue, for example, in electron diffraction work, if there is a surface film of grease. Del Giudice^{2,3} and Wark and Cox^{4,5} have discussed the matter from another point of view. The four main sources of contamination in polishing mineral or metal specimens are: (1) the polishing materials, that is, the abrasives and the laps of soft metal or cloth; (2) grease from the fingers used to hold the specimen during polishing or in otherwise handling it; (3) the water under which the mineral is polished and stored before use; and (4) air-borne grease.

The abrasives can be cleaned by ignition, but the polishing cloths present greater difficulties, because of a film of grease acquired during weaving. In this Laboratory, the cloth is refluxed with benzene for some hours, next boiled for three hours with 4 per cent caustic soda solution, and finally boiled in several changes of distilled water until the alkali is removed. Thereafter the cloth is kept under water.

To prevent contamination from the fingers, the operator should wear surgical rubber gloves or finger stalls, cleaned thoroughly in a fresh chromic acid-sulphuric acid mixture. Though contamination from the sides of a specimen is rare, because of the lack of mobility of most adsorbed films, it is a wise precaution to grind, under water, all faces of the specimen. After polishing, the specimen should be handled, face downwards, by cleaned glass forceps: it should never be allowed to dry.

Contamination by air-borne grease is prevented by conducting the polishing operations on wet polishing cloths, using a liberal supply of abrasive. The abrasives and finely divided metal or mineral that

tend to cling to the specimen (del Giudice² and Wark³) may be removed by wiping the surface with a pad of cleaned linen tied over the flattened end of a glass rod. In this Laboratory, aluminium oxide abrasive has been used for the final step in polishing: its known adsorptive power (upon which depends its use in vitamin extraction processes) tends to take care of any surface-active contaminants that find their way into the system. Freshly ignited magnesium oxide is a more rapid polishing agent, but because of its alkalinity it is unsuitable for some purposes.

A sensitive test for contamination is⁶ available. With the polished specimen still under water, a small bubble of air is brought into juxtaposition with the surface and pressed against it for a few minutes. In the absence of a grease film, the bubble will not spread, and comes away cleanly when it is raised. A still more stringent test is obtained by using a drop of grease-free benzene or 'Nujol' in place of the bubble of air. A convenient apparatus for these tests has been described by Taggart, Taylor and Ince⁷ and by Wark and Cox⁴; but if isolated tests only are required a simpler form could be used.

The readiness of contamination by water or the atmosphere is obviously dependent upon location. Taggart⁶ states that the New York water supply contains sufficient iron, and Talmud and Lubman⁸ state that the Moscow supply contains sufficient calcium, to alter the surface reactions of quartz. Distilled water, while free from dissolved salts, is usually found to be less free from grease.

The readiness of contamination from the atmosphere and/or the water supply is well illustrated by difficulties encountered in this Laboratory following severe bush-fires in the catchment area for the Melbourne water supply, distant about fifty miles from the city. Clean specimens could not be obtained for several days. Within a week, the difficulty disappeared for pyrite and calcite, but it was almost a month before clean specimens of chalcopyrite were consistently obtained. It is possible that the inability of some Continental investigators to obtain clean surfaces—judged by the bubble test—is due to their having to work with atmosphere or water always contaminated by some local industry.

IAN W. WARK.

Flotation Research Laboratory,
Department of Chemistry,
University of Melbourne.

¹ Adam, N. K., "The Physics and Chemistry of Surfaces" (second edit., Oxford, 1938), 174.

² del Giudice, G. B. M., *Eng. and Min.*, 137, 291 (1936).

³ del Giudice, G. B. M., *Trans. Amer. Inst. Min. and Met. Eng.*, 118, 424 (1934).

⁴ Wark, I. W., and Cox, A. B., *Eng. and Min. J.*, 137, 641 (1936).

⁵ Wark, I. W., "Principles of Flotation", (Melbourne, 1938), 74.

⁶ Taggart, A. F., private communication.

⁷ Talmud, D., and Lubman, N. M., *Koll. Z.*, 50, 159 (1930).

⁸ del Giudice, G. B. M., *Trans. Amer. Inst. Min. and Met. Eng.*, 118, 588 (1934).

⁹ Ref. 5, p. 299.

¹⁰ Taggart, A. F., Taylor, T. C., and Ince, C. B., *Trans. Amer. Inst. Min. and Met. Eng.*, 87, 217 (1920).

Lamellar Structure of Potash-Soda Felspars

In an extremely interesting paper, Ito¹ has recently described the results of an X-ray examination of a Korean moonstone which he assumes to be similar to a specimen (described by E. Spencer²)

containing approximately equal amounts of potash feldspar and soda feldspar, showing a blue schiller, and resembling sanidine in its glass-clear appearance and in having an abnormally low¹ optic axial angle. It concludes that this crystal is an intimate intergrowth of a (monoclinic) potash feldspar having the sanidine structure, and a corresponding high-temperature monoclinic form of soda feldspar.

We have carried out by X-ray methods a preliminary general survey of potash-soda orthoclase feldspars with micropertthitic structures, and (with D. L. Smae) have described the results of our investigation in a paper read before the Mineralogical Society in January last, and to appear in the *Mineralogical Magazine* of June 1939.

More recently, we have examined in greater detail specimens representing each of the two types of structure the existence of which was suggested by our previous survey. One of these structures occurs when the proportion of soda feldspar does not exceed 30 per cent approximately, the other when a greater amount of soda feldspar is present, and it appears that our data are most easily explained on the following hypothesis. The low-soda micropertthitic structure contains (i) a monoclinic potash feldspar component, and (ii) triclinic soda feldspar lamellae which are either actually twinned on the *pericline law* or arranged in the same mutual orientation. The high-soda structure contains (i) monoclinic potash feldspar, and (ii) triclinic soda feldspar lamellae twinned on the *albite law* (or arranged in the same mutual orientation). It is not yet certain whether the triclinic lamellae which occur in the low-soda structures are structurally identical with those which occur in the high-soda structures, nor is it certain that lamellae of either type are identical with ordinary albite, though all three structures are very similar if not actually identical. The experimental evidence on which this hypothesis is based, and its implications for the theory of micropertthitic structures, will be discussed elsewhere; but in the meantime we may note that there now appears for the first time a fairly definite prospect of obtaining by X-ray methods a structural classification of the micropertthitic feldspars.

We have also examined Spencer's specimen of Korean blue moonstone (from the same locality as Ito's material), and find to our surprise that it is structurally exactly similar to the low-soda micropertthites already described, that is, it contains monoclinic potash feldspar and triclinic soda feldspar twinned on the *pericline law* (or correspondingly oriented). The difference between our conclusions and Ito's with regard to the structure of the soda feldspar component may be due either to a real difference between Ito's material and ours, or to the fact that our suggested structural scheme is adequate to explain at least a part, perhaps the whole, of Ito's published data. (Some of our X-ray photographs are in fact identical with some published by Ito.) These points are also discussed in detail in a paper to be published elsewhere.

S. H. CHAO.
W. H. TAYLOR.

Physics Department,
College of Technology,
Manchester.
May 15.

¹ Ito, T., *Z. Krist.*, 100, 207 (1938).

² Spencer, H., *Min. Mag.*, 22, 201 (1930); 24, 453 (1937); 26, 87 (1938).

A New Method for the Conservation of Milk

THE conservation of milk without drastic heat treatment is perhaps the most important problem in the dairy industry. Numerous attempts have been made to solve this problem, mostly with only partial success and necessitating elaborate and expensive apparatus. It has been found possible to conserve milk for about a fortnight by the simple process of adjusting the pH to 5.2 and holding at a temperature of 36–38° F. During the first week the bacterial count actually decreases but rises abruptly in two to three weeks coincident with 'going off'. The following is a typical experiment:

Milk adjusted to pH 5.15	
Age in days	Colony count per ml.
0	2,500
2	460
7	210
21	∞

Milk requires about 4 ml. normal hydrochloric acid per 100 ml. to reduce the pH to 5.2. In practice it is sufficiently accurate to titrate a portion of the milk with *N* hydrochloric acid until casein precipitation is observed and then to add 95 per cent of this quantity *pro rata* to the bulk. The acid must be added with vigorous stirring and the milk later neutralized with an equivalent amount of normal caustic soda before use. The only effect on the milk is a slight dilution and the production of a very slight salty taste, not detectable by casual tasting. The micro-organisms ultimately responsible for the deterioration of the milk are coloured cocci and yeasts. Milk can be conserved for longer periods by holding under 'anaerobic' conditions at lower temperatures and adjusting to lower pH values. Although casein precipitates at pH values below 5.2, the milk sol can be reformed on neutralization by prolonged stirring.

The method would appear to offer possibilities for industrial purposes. The chief advantages are that no expensive plant is required and that the milk retains in full the original fresh milk flavour. Although enzymic changes are undoubtedly proceeding under these conditions, the rate is so small that they cannot be detected by taste.

J. G. DAVIS.

National Institute for Research in Dairying,
University of Reading.
May 12.

Bacterial Antigens

THE results of recent work on the nature of certain of the bacterial antigens of gram-negative micro-organisms suggest that these substances are essentially polysaccharide-phospholipin complexes¹. A further component, however, which contains 10 per cent nitrogen, has also been found². Utilizing preparations of antigenic material which had been obtained by the trichloroacetic acid method of Boivin¹ or by the diethyleneglycol extraction method³, we have succeeded in removing the phospholipin component⁴ (N:P, 1:1) from the antigenic complex of *B. dysenteriae* (Shiga) without employing acid, alkaline or enzymic hydrolysis. The phospholipin component cannot be removed by extracting the complex with acetone, ether or ether-alcohol mixture, but is readily eliminated on treatment with a strongly polar solvent such as formamide (dielectric constant 34 at 20°). The antigen dissolves readily in this solvent to give,

clear, colourless solutions which can be used for the measurement of optical rotation.

The phospholipin-free material was found to be fully antigenic in rabbits and induced the formation of specific agglutinins and precipitins and 'Shiga' heterophile immune-body. It would appear, therefore, that the phospholipin component of the complex is not essential for the manifestation of antigenic properties or for the capacity of the complex to induce the formation of haemolytic heterophile immune-body*.

This work is being continued with antigenic material that has been isolated from selected strains of *B. typhosum* which are known to contain the characteristic 'O', 'Vi', 'O + Vi' or 'Rough' antigens respectively.

Biochemical Department,
Lister Institute of
Preventive Medicine,
London, S.W.1.

W. T. J. MORGAN.
S. M. PARTRIDGE.

May 20.

* Bolvin and Macrobenn, *C.R. Soc. Biol.*, 112, 76 (1933); Macrobenn and Calah, *C.R. Soc. Biol.*, 120, 456 (1936); Rastrik and Topley, *Brit. J. Exp. Path.*, 15, 113 (1934).

* Morgan, *Chem. and Industry*, 57, 976 (1938).

* Morgan, *Biochem. J.*, 31, 2003 (1937).

* Henderson, *Brit. J. Exp. Path.*, 20, 11 (1939).

Binocular Stereoscopic Vision

WITH reference to a letter of mine in *NATURE* of December 10, 1938, Father William O'Leary, of Riverview College Observatory, Riverview, N.S.W., wrote to me shortly before his death, and, after mentioning that he also for many years past had been able to view stereoscopic pictures without a stereoscope, says: "The stereoscopic effect is also quite easily obtained by reversing the position of the pictures, putting the right to left and the left to right. If now, instead of focusing the eyes for parallel distant vision, we cross the eyes, the left eye then sees the right-hand picture and the right the left-hand picture. For some people this is rather painful, but I find no difficulty. The effect is a combination image, seemingly just half-way distant between the eyes and the two pictures, in fact, a miniature picture, but beautifully sharp in detail."

It took some practice before I was able to observe the phenomenon thus described by Father O'Leary, but I did succeed, and it has now become fairly easy. I hold the reversed stereo pictures in my left hand at about 18 inches distance and gaze at the tip of my right thumb placed in line with or a little below the lower edge of the pictures and about 6 inches from the eyes. This causes a squint so that the right eye sees mainly the left picture, and the left eye the right picture, as described by Father O'Leary. By some practice two of the four rather vague images coalesce, and the thumb can then be removed. The stereoscopic image is fairly easily held, and will survive short periods of closure of the eyes as in winking, but not much longer ones.

The most remarkable feature of the phenomenon seems to me to be the size of the image. It appears, as Father O'Leary says, about half the normal size, and, it is thus quite easy, holding the pictures at about the distance of ordinary vision, to see a normal size stereoscopic image by the commoner method, or an apparently half-size one by the cross-eye method. In the latter case, when the stereoscopic equilibrium is upset, the pictures appear to revert to their normal size.

Another curious point deserves notice. While observing this stereoscopic effect, I closed one eye, expecting to see the resulting two images resume their apparent normal size. There was, however, little or no noticeable change; it seemed only to come about on reopening the closed eye. This appears to involve the rather remarkable conclusion that an object appears to be smaller when seen by one eye than when seen by both. Perhaps the binocular image is really a little bigger than the monocular image, but this does not seem sufficient to account for the marked difference in apparent size between the two kinds of stereoscopic image. Since the phenomenon is entirely subjective it can scarcely be appreciated by those who have not observed it. In only one point does my observation differ from Father O'Leary's description. To me, by the cross-eye method (as by the other), the stereoscopic image is of the same size as the two adjacent images, and is in the same plane with them, not in a plane half way between them and the eyes; but here I may be misinterpreting Father O'Leary's meaning.

It follows from what has been said, that stereoscopic pictures can be observed by the cross-eye method when considerably separated, if viewed from a sufficient distance. At eight feet distance the pictures may be separated by two feet or rather more, and in this case the other two images fall each on the blind-spot of its receiving eye, so that the only image observed is the stereoscopic one. Father O'Leary suggests that stereoscopic pictures, suitably placed, and projected on a screen, could be observed by the cross-eye method, and this seems to be quite a practicable proposition, its only drawback being, perhaps, the reduced size of the image. I hope that someone will be able to explain this difference in apparent size.

T. S. PATTERSON.

Organic Chemistry Department,
University of Glasgow.

May 9.

Spectroscopic Power of a Human Eye due to Injury

WITH reference to Prof. Kerr Grant's recent communication on this subject¹, I wish to refer to communications on this subject by myself and others^{2,3} under the title "Conjunctival Halos".

In cases of this sort, it is important to note whether the centre of the ring-system is light or dark. Thus in that described by Mr. Barton⁴ it was light and "A very approximate measurement of the first red ring gave its angular diameter as 7°, in fair agreement with the value [radius 4° 49'] quoted in Mr. Melmore's letter". No agreement is possible, for in my case the centre of the system was dark. But taking the 'grating interval' equal to 0.0125 mm. and λ equal to 0.0007 mm., and applying the equation appropriate to a bright centred system the angular diameter works out at 6° 24'. This is in good agreement with the result of Mr. Barton's own measurement.

The value given by Prof. Grant for the angular radius of the first order red ring accords well with the value found by me for a dark-centred system.

SIDNEY MELMORE.

Accomb, York.

May 1.

¹ Grant, K., *NATURE*, 140, 725 (1939).

² Melmore, S., *NATURE*, 137, 15 (1931).

³ Barton, A. W.; Parsons, J. H., *NATURE*, 137, 308 (1931).

Fission of Heavy Nuclei

PROF. O. HAHN has written to me pointing out that the translation of a passage from a paper of Curie and Savitch (*J. Phys.*, Sept. 1938) in my recent article on "Fission of Heavy Nuclei" (*NATURE*, May 27) might possibly be misleading.

Curie and Savitch wrote: "Dans l'ensemble, les propriétés de R3.5h. sont celles du lanthane, dont il semble jusqu'ici qu'on ne puisse le séparer que par fractionnement." I omitted the final qualification in my translation: "On the whole, the properties of R3.5h. are those of lanthanum, from which it appears that until now it has not been separated." It seemed to me that the qualification in question ("except by fractionnement") was unimportant from the point of view of the proof that R3.5h. was neither an isotope of actinium nor a trans-uranic element of the chemical type envisaged by Hahn, Meitner, and Strassmann. I did not wish to use the quotation for any other purpose than the establishing of these two conclusions.

N. FEATHER.

Cavendish Laboratory,
Cambridge.

Darwin's Geological Collection from Tasmania

A VISITOR to Darwin's home, Down House, recently put a question as to the whereabouts of his geological collection from Tasmania, made during the voyage of the *Beagle*. (The specific reference was to brachiopods.) We were unable to answer, either from records in our possession or after inquiries elsewhere.

It is well known that the *Beagle* collections, geological, botanical, and zoological, were widely distributed, and it is felt by the Down House Committee of the British Association that as full a record as possible ought to be made of the present location of all the material which survives, and that the Association, as the custodian of Darwin's house, should make it. I shall be very grateful to the authorities of museums, laboratories, or other institutions, for information as to any Darwinian collection in their keeping.

O. J. R. HOWARTH.

(Secretary, British Association).

Down House,
Downe, Kent.

Points from Foregoing Letters

It has been suggested that some of the insoluble organic compounds which produce cancer do so after they are oxidized to water-soluble derivatives. J. W. Cook, R. Martin and E. M. F. Roe have prepared photo-oxides of 9:10-dimethyl-1:2-benzanthracene and of related compounds as a step towards testing this view.

E. Morelli and A. Danzi have found that the inhibitory power of carcinogenic hydrocarbons on transplantable tumours diminishes or disappears if they have been inoculated dissolved in fat of animals of the same species.

By using radioactive potassium as an indicator L. Hahn, G. Hevesy and O. Rebbe find that the bulk of the potassium ions present in the corpuscles is not replaced within the life-time of the corpuscles; about 8 per cent of the potassium ions present in the muscle cells were replaced within 24 hours by ions previously present in the plasma.

W. G. Campbell and J. C. McGowan point out the similarity between the Mitchell colour reaction of gallotannins on one hand and the chlorine-sodium sulphite colour reaction of hardwood lignin on the other.

A. Gurwitsch and L. Gurwitsch report new experiments on the spectral distribution of ultra-violet radiation emitted during certain chemical reactions. It is found that the presence of other substances (taking no part in the reaction itself) introduces new lines into the spectrum; these are presumably due to molecules being excited by the energy liberated in the reaction.

I. E. Knaggs and K. Lonsdale, from an analysis of crystalline benzil based on X-ray and magnetic measurements, have deduced that the molecule must be of a skew type. This agrees with the recent suggestion of C. C. Caldwell and R. J. W. le Fèvre, who have measured the dipole moment in various solvents.

Ian W. Wark describes a method of obtaining grease-free polished surfaces of metals and minerals. He also discusses a sensitive test for cleanliness, based

upon the fact that the angle of contact between an air bubble and a clean solid surface immersed in water is zero.

S. H. Chao and W. H. Taylor report that the experimental data obtained in an X-ray examination of selected orthoclase-microporthites are most easily explained if it is assumed that in both the observed structure types the potash feldspar is present as a monoclinic component; while in the low-soda type the soda feldspar lamellae are triclinic and twinned on the pericline law, in the high-soda type the soda feldspar lamellae are triclinic and twinned on the albite law.

J. G. Davis states that it is possible to conserve fresh milk for about a fortnight by the simple process of adjusting the pH to 5.2 and holding at a temperature of 36-38° F. The original fresh-milk flavour is retained in full.

W. T. J. Morgan and S. M. Partridge have succeeded in eliminating the phospholipin component of the antigenic complex of *B. dysenteriae* (Shiga) by utilizing the dissociating properties of the strongly polar solvent, formamide. The phospholipin-free material is fully antigenic in rabbits, thus indicating that the phospholipin component is not essential for the manifestation of antigenic properties.

T. S. Patterson points out that stereoscopic effect can be obtained by reversing the position (left for right) of ordinary stereoscopic pictures, and viewing the left picture by the right eye and vice versa. The stereoscopic image thus observed appears, however, to be only about half the normal size.

The centre of the ring-system of interference spectra seen in cases of conjunctivitis may be bright or dark. S. Melmore directs attention to the importance of distinguishing between them and notes that Prof. Kerr Grant's determination of the angular radius of the first order red ring is in agreement with his own for a dark-centred system.

The Secretary of the British Association asks for information as to the whereabouts of collections made by Darwin during the voyage of the *Beagle*.

Research Items

Early Man in San Dieguito Valley, California

SOME unexpected archaeological features were revealed in an investigation carried out by Malcolm J. Rogers, chief curator of the San Diego Museum, in a field expedition and excavation in the San Dieguito River Valley, of which a brief report is given in the Year Book of the Carnegie Institution of Washington for the year 1937-38. A site was chosen for examination which seemed to offer the deepest accumulation of alluvium available. The choice proved to be exceptionally fortunate, as on excavation a complete record of post-pluvial river history was uncovered. After trenching in recent flood river silts to a depth of two to three feet, a Yuman camp level with a maximum depth of two and a half feet was uncovered. This had been built on three feet of lateral outwash soil of terrestrial origin. Beneath this were a two feet deep band of boulders and sand, deposited in a period of flash flooding, and a stratum two feet in thickness of stream origin, consisting of coarse sands and yellow clayish sand, while the lowest stratum was composed of boulders and sand strata, attaining a thickness of seven feet at the entrance of the trench. This last formation rested on a Tertiary sandstone, into which a Pleistocene channel had been cut. The lowest stratum was also implementiferous, the material consisting of factory debris or transported items. In the upper third was a camp level which produced many whole implements. Stream-transported implements occurred down to the very base, and in contact with the Tertiary surface, probably Phase I or Phase II, San Dieguito tools derived from camps up-stream. The camp level belongs to Phase III. The main trench section showed "splendid examples" of solifluxion, probably the first to be found in the New World. As a result, San Dieguito implements were even found on top of the horizon containing the Yuman implements, a result of the lateral outwash.

Fertility Rates of Scottish Married Women

IN a study of the fertility of Scottish married women, R. S. Barclay and W. O. Kermack make a further application of their 'diagonal law', according to which the birth-rates for each age group (excluding 15-20 years) decline regularly at a rate from year to year which is expressed by a diagonal line. It is found that in Finland the same general effect is apparent, and in England and Wales predictions based on this law are in general agreement with fertility rates calculated from census data. This law is now applied (*Proc. Roy. Soc. Edinburgh*, 59, 62; 1939) to Norway and is further developed for Scotland. In almost every county, fertility is found to be greater in landward districts than in the small burghs. Ross and Cromarty has the highest value, which progressively declines towards the north, south and east. There is no striking deficiency in the fertility of large towns compared with rural areas, and the large burghs are intermediate. The new Population (Statistics) Act will shortly provide information on various points at present uncertain.

Vitamin C and Poliomyelitis

A. B. SABIN (*J. Exp. Med.*, 69, 507; 1939) carried out experiments on 46 monkeys which showed that both natural and synthetic preparations of vitamin C had no effect on the course of experimental poliomyelitis induced by nasal instillation of the virus. Administration of vitamin C was begun immediately after the instillation of the virus, and if it were capable of exerting any effect on the virus or the tissues it could have done so before multiplication of the virus had begun. Monkeys whose store of vitamin C was depleted reacted in the same way as those receiving an adequate diet; 13 out of 25 monkeys on a scorbutic diet died of spontaneous acute infections, chiefly pneumonia and enterocolitis, while the monkeys receiving an adequate diet remained well. The surviving 12 monkeys on the scorbutic diet developed the osseous and other changes of human scurvy, and vitamin C was shown to produce healing and calcification in the bones as well as to check oedema and the hemorrhagic diathesis.

Primary Lung Tumours in Mice

J. ARGYLL CAMPBELL (*Brit. J. Exp. Path.*, 20, 122; 1939) has tested tarry matters from the following for carcinogenic potency, using the simple skin painting technique for mice; dust from tarred roads, cigarette smoke, chimney soot, soot from exhausts of internal combustion engines burning heavy oil, and a binding material in cardboard. The results were as follows: (1) The tarry matter from roads and chimney soot contain potent carcinogenic agents, but in ordinary circumstances the effect on the skin of the latter is somewhat mitigated by the presence of the carbon of the soot, while the effect of the former is aided by the presence of organic constituents. (2) Cigarette smoke under ordinary conditions gives rise to tarry matter which may occasionally produce hyperplasia and cancer of the skin after prolonged application. (3) Tarry matter from the motor exhaust soot and from the cardboard do not produce cancer. (4) Exhaust soot suspended in the atmosphere slightly increases the incidence of lung tumours in mice, while chimney soot does not produce any perceptible increase. The dust from tarry roads appears to be the most dangerous source of carcinogenic agents. Here, again, the inorganic constituents of the dust such as silica or iron enhance or aid the effect of the tar, whereas the carbon of soot tends to mitigate any effect of the tar in producing tumours of the lung. (5) Although some primary lung tumours in mice are simple adenomata, other tumours show typical malignancy with definite production of metastases.

Amine and Blood

IN an examination of the action of amine on the blood, F. Jung (*Naturwissenschaften*, 27, 318; 1939) has determined the solubility of the gas in water at various temperatures, in the absence of other gases. The solubility in electrolytes is less than that in water, but solutions of proteins dissolve considerably more of the gas. Fresh blood takes up 0.5-0.8

volumes of arsine at 20° in the absence of oxygen. In the presence of oxygen, arsenic, methæmoglobin, and hydrogen peroxide are formed. There is also an increase in the readily removable iron in the blood, supporting the view of Barkan (*Hoppe-Seyler's Z. physiol. Chem.*, 254, 241; 1938) that in addition to methæmoglobin another derivative of hæmoglobin ('pseudohæmoglobin') is formed in this reaction.

Relics of the Cave Hyæna of the Ice Age

In a preliminary announcement in the *Anzeiger der Akademie der Wissenschaften in Wien*, H. Zepfe describes some work he has carried out on the study of the fossil bone fragments of animals devoured by the cave hyæna of the Ice Age. In order to be able to form a satisfactory judgment of such fragments, an extensive study was made of the feeding habits of the spotted hyæna in the Vienna Zoo. The animals were fed with the bones of oxen, horses and deer. There was found to be a remarkable regularity in the manner in which each kind of bone was seized, and in the shape of the portions finally rejected. Thus, in the case of the humerus, it is the greater tuberculum that is first attacked. The head of the joint, after being isolated in this manner, is bitten off and the large marrow-filled diaphysis can then easily be opened. This is eaten up to near the distal end of the bone; the remaining fragments have a characteristic form. On the calcaneus, tooth marks are always found on the tuberosity. In the case of the pelvis, the portions round the acetabulum, with parts of the ilium and ischium, are rejected. On the basis of this information, the fossil bones discovered in the Teufelskucken at Eggenburg were studied and bones of *Tichorhinus antiquitatis* showing all stages in the hyænas' meals were found. Thus, in the case of the humeri, there was a continuous succession from those showing the initial bites on the proximal end to characteristic small fragments of the distal ends. It appears from this work that a number of remains of rhinoceros which have hitherto been regarded as the relics of palæolithic man are really relics of hyænas. It seems probable that further work on this subject will enable the presence of hyænas and other bone-eating animals to be deduced from remains of Tertiary mammals in a larger number of cases than has hitherto been possible.

Study of Xylem in Whole Plant Organs

WORKING on whole plants of *Phylloglossum Drummondii* and on flowers, seedlings and fern fronds, Miss E. M. Debenham has devised a modified technique for the microscopic examination of the xylem of whole plants or plant organs (*Ann. Bot.*, 3, New Series, No. 10, 369; April 1939). By this method, permanent preparations of whole cleared plants or organs could be obtained with the course and structure of the xylem clearly elucidated by staining. Material with abundant food storage or a deep pigmentation caused difficulty since the period of clearing exceeded a month, and then the lignin was so affected as to take the stain either feebly or not at all. Many successful results were obtained, however, and these are illustrated by photomicrographs. The method involves clearing in 70-75 per cent lactic acid at 58-60° C., bleaching in eau de Javelle at 40° C., staining the xylem with ammoniacal fuchsin, and mounting in euparal or Canada balsam.

Effect of Seed X-radiation on Cotton Leaves

B. N. Singh, R. S. Choudhri and S. L. Kapoor have recently studied the structural abnormalities in cotton leaves following exposure of the seed to X-radiation (*Ann. Bot.*, 3, New Series, No. 10, 307; April 1939). Irradiation of seeds for five minutes induced a certain amount of leaf-modification which increased with increasing exposure. The effect on soaked seeds was greater and that on germinated seeds still greater. Petioles of normal leaves are cylindrical, those from dry, irradiated seeds were thicker and those from irradiated soaked and germinated seeds were grooved. Heavy irradiation induced dorsiventrality in the petioles, of which the bundles instead of being arranged in a ring in cross-section formed a single crescent-shaped mass associated with a greater development of wood. The lamina from a dry irradiated seed showed no modifications, but those from soaked and germinated seeds were asymmetrical and variegated and showed puckering and tumour-like structures. The vascular system was markedly affected and injurious effects were more pronounced in the palisade tissue.

'Take-all' Disease of Wheat

THE fourth of a series of papers by S. D. Garrett on parasitism of the 'take-all' fungus, *Ophiobolus graminis*, has recently appeared (*Ann. App. Biol.*, 26, No. 1, 47-55, February 1939). Ascospores of this fungus are liberated into the air, but all attempts to infect wheat seedlings with such spores on natural soils have failed. Inoculation of ascospores in sterile soils, however, is invariably successful. It is considered that inhibition of infection in unsterilized soils is due to competition of other micro-organisms, rather than their antagonism, for infection can be accomplished in unsterilized sand, where nutrients for the micro-flora are practically absent and their numbers are low. The general micro-flora of most soils apparently uses all the available nutrient material, and it is only under sterile conditions that any such material is available for the ascospores of *Ophiobolus*. It seems unlikely that the ascospores of this fungus play any part in its natural distribution under field conditions.

Intracellular Bodies of Plant Viruses

CERTAIN types of intracellular inclusions have been found in the cells of many virus-infected plants. The inclusions appear to be specific to the disease rather than to the host, and they are usually considered to be aggregates of virus particles. Much recent work upon the physico-chemical nature of these particles has shown that they are proteins of high molecular weight, and their relation to inclusion bodies is discussed in a paper by F. C. Bawden and F. M. L. Sheffield (*Ann. App. Biol.*, 26, No. 1, 102-115, February 1939). Insoluble complexes which are similar to inclusion bodies have been formed when viruses are combined with protamines, histones and proteins *in vitro*. Properties of the virus are compared with those of the corresponding inclusions, and possible explanations for the formation and disappearance of the inclusions within infected plants are suggested. Some viruses produce only amorphous inclusions in their host cells, but others form crystalline and amorphous bodies.

Elastic and Viscous Properties of a Certain Kind of Rock

KUMIZI IIDA has made a thorough study of this problem, using for experimental purposes a pumice from the island of Niisima cut into cylinders about 48 cm. in height and 5 cm. in diameter (*Bull. Earthquake Res. Inst.*, Tokyo Imp. Univ., 17, Part 1, 59-78; March 1938). The work was carried out by both static and dynamic methods, and separate sets of results obtained. The relationship between the properties of the rock and its water content were especially sought. It was found that the velocities of waves propagated in the rock and also the solid viscosity coefficients diminished with increase in water content. Young's modulus and the modulus of rigidity obtained by static measurements diminished somewhat rapidly with increase in water content, whilst Young's modulus obtained dynamically increased with increase in water content, the modulus of rigidity remaining almost unchanged. These results are considered by the author to show that in sponge-like materials such as pumice, the skeleton alone reacts to torsional vibration, the included water being scarcely affected, whilst in the case of longitudinal vibration the effects of the water content are very marked. The coefficients of normal solid viscosity were found to be greater than those of tangential solid viscosity. The ratio of the viscous coefficients λ'/μ' increased with increase in water content, and λ'/μ' is greater than 0. The quantity η , determined by the above in connexion with the ratio of the

Lamé elastic constants by the relationship $\frac{\lambda'}{\mu'} = \frac{\lambda}{\mu}$, diminished with increase in water content. The simple relationships such as

$$\frac{\lambda'}{\lambda} = \frac{\mu}{\mu'}; \lambda' + \frac{2\mu}{3} = 0, \frac{Y_I}{Y_t} = \frac{2.3K}{\mu}$$

were found not to hold in the experiments. The elastic constant of the rock was found to be of the order of 10^9 c.g.s. units, and the viscosity coefficient of the order of 10^{14} poises. The values of Young's modulus, modulus of rigidity, and Poisson's ratio obtained dynamically all exceeded those obtained statically.

Water Supplies and River Pollution

THE annual report of the Water Pollution Research Board for the year ended June 30, 1938, has been issued by the Department of Scientific and Industrial Research (H.M. Stationary Office, 1s. net). It has been found that acids, bases and salts can be removed from solution in water by means of certain synthetic resins, and the process has been applied for the removal of dissolved salts in water, and for the removal of metals and of objectionable substances, such as fluorides, present in water in low concentrations. Investigations, in collaboration with the milk industry, have been carried out on the treatment and disposal of waste waters from dairies and milk products factories, which have in the past caused serious pollution of streams into which they have been discharged. It has been found that these liquids, which are difficult to treat by ordinary methods of sewage disposal, can be satisfactorily purified when passed at a controlled rate through two percolating filters in series. The investigation on the River Mersey, begun in 1933, has been completed. Its object was to determine the effect of the discharge of crude sewage into the Estuary on the amount and hardness of the estuarine deposits. This work is summarized in the present report, and it is

concluded that the crude sewage discharged into the estuary of the River Mersey has no appreciable effect on the amount and hardness of the deposits in the Estuary.

Fluorescence of Natural Silicates

A BLUE fluorescence is obtained when certain natural silicates, including some specimens of potash felspar, potash soda felspar and datolith ($\text{HCaBSi}_2\text{O}_6$), are illuminated with ultra-violet light. The spectral similarity of this fluorescence with that given by specimens of fluorite known to contain small amounts of europium has led Haberlandt and Kohler (*Naturwiss.*, 27, 275; 1939) to carry out experiments with the object of determining whether the fluorescence of the silicates is also due to europium. Synthetic silicates with the composition of the above minerals were prepared with the addition of small quantities of europium. When these were exposed to ultra-violet light the blue fluorescence was excited. The addition of 2.5×10^{-4} gm. of europium per gram of synthetic felspar was sufficient to produce a fluorescence considerably brighter than that of the mineral itself. The europium was added in the form of the trivalent oxalate, which itself gives a fluorescence spectrum consisting of sharp, narrow bands in the red. As the fluorescence spectrum of the synthetic mineral containing europium consisted of a broad band spectrum in the blue, it is considered that the trivalent europium was reduced to the divalent form during the fusion. It was found possible to give a rough estimate of the amount of europium present in a mineral by visual comparison of the brightness of the filtered fluorescence emission, and by an improved photometric method it is possible to determine traces of europium in a mineral so small as 10^{-6} gm. per gm. of substance.

Oscillation Clocks

At a meeting of the British Astronomical Association held on March 29, G. A. Tomlinson, of the National Physical Laboratory, gave an interesting lecture on the above subject. The oscillating clock, like the synchronous clock driven from the mains, depends on the fact that a small synchronous motor, driven by an oscillating current, cannot get more than 0.1 cycle out of phase without stopping. The usual frequency for oscillating clocks is 1,000 cycles upwards—about twenty times that of the mains clocks, and hence the possible lag of the motor of about 0.1 cycle is a very small amount. A short description was given of the three different oscillators in use, the tuning fork, the quartz crystal and the longitudinally vibrating metal bar. Excellent results have been attained when all possible precautions are taken, such as keeping the oscillator in a vacuum, avoiding temperature and pressure effects on the frequency, and even safeguarding against errors from secular effects. A test in Germany from three similar clocks running for more than a year showed maximum variations of only a few milliseconds per day. Similar results were obtained by tests in the National Physical Laboratory, a gain of one clock on another being about 1 minute in 2,000 years. It seems that clocks of this type may run with a precision greater than that of the earth, and indeed the Germans claim to have detected abrupt variations in the earth's rotation by means of these clocks. The possibility of thus solving the problem of lack of uniformity in the rotation of the earth must not be overlooked.

Metabolism and Salt Absorption by Plants

By Prof. D. R. Hoagland, Division of Plant Nutrition, University of California, U.S.A., and
Dr. F. C. Steward, Department of Botany, Birkbeck College, University of London

A SATISFACTORY physical theory of salt absorption by plants has been long awaited. The general reader might infer from the communication by Lundegårdh¹ that such is now available, but this conclusion should not be drawn without a full consideration of all the evidence. It is our view that Lundegårdh's explanation of the mechanism of salt absorption represents an over-simplification of a very complicated problem the ramifications of which are only just becoming evident. That this is so is shown by extensive investigations to which we shall refer.

Lundegårdh writes as though whole root systems, with their complex anatomy and inter-relations with the tissues of the shoot, could be reduced to very simple terms—anion-induced respiration and surfaces which in contact with an external solution absorb cations and exhibit potential differences. His speculative references to these ill-defined "surfaces", to bio-electric potentials the origin of which is uncertain and respiratory components (for example, anion respiration) the reality of which is still controversial, create an illusion of precision which is dispelled when the complexity of the system involved is adequately appreciated and the results of investigations made on a wide range of living cells, tissues and organs are contemplated.

Even when the problem is restricted to single cells, or groups of cells identical in their behaviour, it is difficult, if not impossible, to segregate those vital activities which are causally involved in salt absorption from concomitant metabolic processes. So apparently simple and uniform a system as that provided by thin disks cut from the interior of potato tubers—the surface cells of which constitute a very uniform tissue the behaviour of which can be accurately controlled—presents a far more intricate piece of metabolic machinery than Lundegårdh envisages¹. Without exaggeration, one may say that under the conditions conducive to salt absorption, such cells carry out all the vital functions and metabolic processes (other than photosyntheses!) of which parenchyma tissues are capable and that each and all of these thus far investigated are affected by the variables (temperature, oxygen concentration, nature and concentration of salt present, disk thickness, etc.) which determine salt absorption. Similarly an adequate description of the system concerned in salt absorption of barley roots² demanded the consideration of a wider range of variables and processes than Lundegårdh considers necessary. In green cells, whether of submerged aquatics or of the leaves of flowering plants, light is involved in salt uptake—not only because photosynthesis is the source of sugar, but also because light regulates their capacity to grow (especially for leaves of the broad-leaved angiosperms). Hence, although respiration is clearly the most outstanding vital process associated with salt uptake, it should not be considered to the exclusion of others

with which it is also linked. In potato disks aerobic respiration, protein synthesis and salt accumulation are all linked together in a manner yet to be elucidated. In barley roots aerobic respiration, organic acid metabolism and salt uptake are clearly inter-related.

Salt accumulation is pre-eminently a property of cells still able to grow, although this relation of growth and salt accumulation may be modified in the case of the root by the removal of absorbed salts to the shoot. From the evidence on disks of potato tuber, there is increasing reason to believe that protein synthesis is the essential property of growing cells which is involved, and it remains to be seen what part, if any, protein synthesis plays in the salt accumulation which may occur in roots, previously depleted of salt during subsequent brief periods of rapid absorption. Be that as it may, a single isolated monocotyledon root represents a composite system—grading from cells at the apex active in metabolism and absorption to those much less active farther back³—and the entire attached, or unattached, root system presents still further complexity.

Lundegårdh envisages a special component of respiration which is associated only with anion absorption and by which energy is made available for anion accumulation; that is, the movement of anions against activity gradients. The experiments of Hoagland and Broyer² on barley roots and of Steward⁴ and others on disks of storage tissue, have not led to a fundamental distinction between cation and anion accumulation. These distinct investigations are in agreement and indicate that aerobic metabolism is essential to the accumulation of both cations and anions and that a high temperature coefficient is characteristic of the accumulation of either type of ion.

It might appear from an earlier publication of Lundegårdh⁵ that the accumulation of cations depends indirectly on energy provided by the postulated anion respiration. However, on this basis, it would be difficult to explain the rapid accumulation of potassium from solutions of potassium bicarbonate which has been observed in the barley root experiments; since bicarbonate ions do not stimulate, they even suppress, the anion respiration of Lundegårdh.

In experiments on the effects of different salt solutions on the respiration of barley roots, the largest salt effects observed were not related specifically to anion absorption. The cation ammonium and the anion nitrate usually produced the most marked acceleration of respiration over that occurring in distilled water. These results of the barley experiments are not inconsistent with the conclusion derived from the storage tissue work that the salt effects on respiration are related to, and caused by, concomitant effects on nitrogen metabolism (protein synthesis from amino acids). Work on the

metabolism of storage tissues has shown that in its response to salts the effective ions are the cations, although their effect is modified by the anions present. The inter-relations between organic acid metabolism and salt uptake of barley roots, already referred to, are not explained by the theory of anion respiration. Further, Lundegårdh's conclusion that a "very effective aeration is a drawback for intensive anion uptake" is not supported by our experimental evidence.

It is desirable to stress the importance, in absorption experiments on roots, of the metabolic status of the roots studied and their initial salt content. In so far as comparisons may be made of the results of Hoegland and Broyer³ on young barley roots and of Lundegårdh on wheat roots of similar age, the indication is that the former material was so prepared that it had a much greater capacity for rapid salt accumulation than the latter, and thus some of the factors associated with salt absorption may have been more sharply defined. Items of technique assume considerable importance when general theories are proposed. Both in the barley root and potato disk experiments attempts were made to control the essential variables, biological and otherwise, and so to standardize the conditions and the absorbing system that clear-cut results emerged. This procedure, though laborious, is justified by results. Confidence in the principal conclusions is increased

because they have not only been repeatedly verified over a period of years but also because they apply equally to the quite diverse systems which have been investigated. The implications of this, we believe impressive evidence, have not been adequately considered by Lundegårdh. It is, therefore, legitimate to suspend judgment concerning the reality of the anion respiration coefficients—which purport to be characteristic of the anion species—until their reality is evident, not merely from the none too concordant sets of data from which this conception was originally derived, but also from investigations on other tissues by other investigators. It is our view that Lundegårdh's concept is not critically established.

Lundegårdh further cites in support of his theory certain measurements of electro-potentials which are thought to arise between the culture solution and the absorbing surface. The secure interpretation of these potentials would, however, require further understanding of the thermodynamic system involved. It has not been proved that the potentials do in fact have the origin suggested.

¹ Lundegårdh, H., *NATURE*, 143, 203 (1939).

² Published papers summarized in *Trans. Far. Soc.*, 33, 1006 (1937). Papers on the biochemistry of salt absorption to appear in *Plant Physiology* in collaboration with O. Preston and P. S. Stout.

³ Hoegland, D. B., and Broyer, T. O., *Plant Physiol.*, 11, 471 (1936).

⁴ Prevot, P., and Steward, F. O., *Plant Physiol.*, 11, 509 (1936).

⁵ Lundegårdh, H., *Biochem. Z.*, 290, 104 (1937).

Modern Views on Magnetism

Conference at Strasbourg

A CONFERENCE on magnetism was held at Strasbourg during May 21-25 under the auspices of the International Institute of Intellectual Co-operation and of the Service Central de Recherche Scientifique de France. The discussions were directed by Prof. Pierre Weiss, to whom and to whose colleagues so much of the progress in the subject is due. As well as the members of the Strasbourg laboratories, there were some thirty specialists from other institutions.

The conference brought home the contrast between the positions of the theories of paramagnetic salts on one hand, and ferromagnetism and paramagnetism in metals on the other. Paramagnetism stands in rather the same relation to quantum theory as astronomy does to Newtonian mechanics, in being the field in which results in the most detailed agreement with experiment can be obtained. This happy state of affairs is due mainly to the theoretical work of Kramers and Van Vleck, and to the experimental work carried out at Strasbourg, Leyden, Madrid and elsewhere. Reports on the present state of the subject by Foex, Cabrera and by Van Vleck revealed, it is true, a number of unexplained facts, but the general atmosphere was one of agreement between theory and experiment. The same may be said of the results on magneto-optics presented by Becquerel, Bizette, Rabinovitch and Cotton, and Ollivier.

The discovery of the magnetic cooling method, discussed in a report by Simon, has given an added importance to paramagnetism of salts and suggested new problems for investigation, for

example, that of paramagnetic relaxation. A report on paramagnetic relaxation was presented by Gorter and Kronig. The question at issue is the time taken for the atomic magnets in a paramagnetic crystal to get into equilibrium when the field is switched on. For nuclear spins this time may possibly be so long as to prevent their use for reaching low temperatures. For atomic magnets, the authors quoted suggest two mechanisms by which the energy of magnetization can be dissipated. The actual magnetic interaction between the elementary magnets, small though it is, is capable of taking up some energy, and under certain conditions will absorb the energy of magnetization before this energy can be communicated to the lattice vibrations. The effect of applying a field will thus be to lower the temperature of the assembly of magnets below that of the lattice. If, however, the crystal is already in a field of more than about 2,000 gauss, this cannot happen; an elementary magnet can only come into equilibrium by giving up its energy directly to the lattice vibrations.

In metals, and especially in ferromagnetic metals, we are much further from being able to solve the equations of quantum mechanics than for paramagnetic salts. This is because we have here to do with exchange interaction between the atoms; since the electrons are continually changing places, one has to treat the whole assembly of electrons in the metal as one dynamical system, whereas a paramagnetic ion in a crystal can to a very good approximation be treated as moving in an electrostatic field. One starts from one or other of two models; the collective electron or Bloch model, in which the electrons are

treated as running through the lattice as a whole independently of each other, and the London-Heitler-Heisenberg model, in which the electrons are supposed to be bound to individual atoms and to move only by changing places. The relation between these models was discussed by Néel, Stoner, Mott and others, but remains by no means clear. It may, however, be of interest to give the description of a ferromagnetic metal or alloy which emerged from the discussions.

A metal such as nickel must be thought of as a mixture of ions in different states, $(3d)^{10}$, $(3d)^9$ and perhaps higher states of ionization. The conduction electrons move freely among the ions, and number about 0.6 to 0.7 per atom. The elementary magnets are the 'holes' or vacant places in the nearly completed shells of the ions. The holes in the ions are continually moving about from ion to ion; to this motion is ascribed the large electronic specific heats observed in iron, nickel, palladium and platinum at helium temperatures. If ions with the configurations $(3d)^9$ are present, then pairs of coupled spins with a moment of two Bohr magnetons will move through the crystal. The possible energy states for these holes, or pairs of holes, form bands with an energy spread of about 3 electron volts, as shown by experiments on soft X-rays (Farineau, Skinner). However, there may well be strong correlation forces which prevent more than one elementary magnet from ever being in one atom. If this is the case the correct model for a ferromagnetic material would seem to be of the Heisenberg type, modified to take account of the fact that the number of lattice points is greater than the number of magnets, a fact which allows the

free motion of the magnets (holes) already referred to. An interesting first step in this direction has been taken by Stoner, who has worked out the effect of introducing a Weiss intramolecular field into the collective electron treatment.

For nickel and nickel-rich alloys the total number of positive holes in the d shells is equal to the saturation moment in Bohr magnetons; the report of Néel showed very clearly that this cannot be the case for iron. Here the ions must be present in a large number of different states of ionization, and only some of them give a positive exchange integral and thus a contribution to the ferro-magnetism.

There were interesting discussions on what happens to the orbital moment in ferromagnetic materials, evidence being drawn from the gyromagnetic effect (Sucksmith, Barnett) and from the saturation moments of alloys (Forrer). From the theoretical point of view this problem remains quite obscure.

Becker, Sucksmith and Gerlach gave results bearing on the magnetization curves of ferromagnetic materials. A large number of facts seem to indicate that a small piece of material has a high coercive force. According to Becker, a magnetized material contains nuclei at which demagnetization can start, and such nuclei would not be present in a small specimen; but no explanation could be given of the nature of these nuclei.

The diamagnetism of aromatic crystals was discussed by Krishnan, in particular their magnetic anisotropy. As pointed out by F. London, the 'orbit' responsible for the diamagnetism in naphthalene, anthracene and so on must extend over the whole molecule.

Work of the Discovery Committee

Fifth Commission of the R.R.S. *Discovery II*

THE Discovery Committee's vessel R.R.S. *Discovery II*, built in 1929 for oceanographical research in the Southern Ocean, returned to London from her fifth voyage on May 9. Leaving England in October 1937, she spent the southern summer circumnavigating the antarctic continent, making observations along the northern edge of the pack-ice south of the Indian, Pacific and Atlantic Oceans, and running lines of stations across the antarctic, subantarctic and subtropical regions as she came northwards to Australia, New Zealand and the Falkland Islands for fuel.

In the subtropical and subantarctic regions a full station was worked every day: temperatures were measured and water samples taken at a series of depths between the surface and the bottom, and nets were fished to depths of at least 1,000 metres. In the antarctic zone extra nets were fished to obtain a more complete picture of the distribution of the small prawn-like krill (*Euphausia superba*) on which the whales feed, and a constant look-out was kept for whales. Near the ice-edge, and in regions where the krill are known to breed, the work was still more intensive.

A qualitative picture of the water circulation in the Southern Ocean and the distribution of factors that influence plant and animal growth had been obtained on previous voyages, and although this latest voyage extended the work whenever possible, its main object

was the collection of data for comparison with previous observations, particularly in regard to the contrast between summer and winter conditions. The circumpolar voyage was completed early in May 1938, and the remainder of the commission was devoted to the systematic survey, month by month, of a limited section of the Southern Ocean. Such repeated observations are of great assistance in the elucidation of oceanographical problems, and it is noteworthy that the International Council for the Exploration of the Sea is planning a similar though more concentrated survey of the Faroe-Shetland region.

The area chosen was the antarctic sector between the Greenwich meridian and 20° E.: this afforded a good opportunity for the examination of typical antarctic, subantarctic and subtropical conditions, and at the same time it allowed a continuous examination of the terminal region of the Weddell Sea current, a matter of great importance, since the Weddell Sea has been found to be by far the greatest centre of production of krill.

After refitting in Simonstown, the *Discovery II* steamed southwards along the Greenwich meridian as far as the ice-edge, and after a short cruise away from the ice to a point some 300 miles to the northward in 10° E., she returned northwards along 20° E. Between July 1, 1938, and March 19, 1939, this voyage, south and north, was made seven times, and

altogether within the last two and a half years the 0° line has been examined eleven times.

The preliminary examination of the repeated observations shows that there are important changes from month to month, particularly at the surface; but—and the discovery is a matter for great satisfaction—the changes in the deep water are not large enough to invalidate a qualitative picture of the water circulation drawn from observations made on only one or two occasions. It is hoped that a closer examination of the repeated observations will give reliable quantitative information, and that many problems—chiefly those connected with the speeds of the water and plankton movements—will be brought nearer solution.

The data and collections obtained, a valuable supplement to those of earlier voyages, have been brought to England, and the scientific staff are settling down to what it is hoped will be a very productive period.

The pressure of the scientific work on the fifth commission left little time for survey work, but charts have been prepared of the Balleny Islands, and of the antarctic coastline between the Greenwich meridian and 4½° E. Along this part of the coast there is a very narrow shelf, and in one place the ice-barrier was found to protrude beyond the 1,000-fathom line. One bay, however, that was entered was found to end in a low ice-shelf 10 feet high with a sounding of 60 fathoms within a distance of three cables; behind the bay snow-covered slopes rose gradually to 2,000 ft. The only exposed rock seen along the whole coastline was one snow-free boulder, and a small exposure at the foot of a shoulder.

The ship was commanded by Captain Hill, and Mr. Herdman was the senior scientific investigator on board. In addition to the Committee's own staff, Australian, New Zealand and South African scientific workers were carried for some parts of the commission.

Glass Technology at Sheffield

New Buildings

THE Department of Glass Technology in the University of Sheffield came into being as a result of a scientific advisory committee set up by the University of Sheffield in 1914. The Department was founded in June 1915 and existed by courtesy in various rooms in the University buildings. A small building to deal with experimental work was erected and occupied without any formality early in 1917, but growth and the need for returning borrowed accommodation to its rightful owners on the conclusion of the Great War compelled a move to other premises some distance from the University buildings in 1921. It was always felt that such a move could only be temporary, but not until 1935 was a suitable site found to house the Department in a worthy manner. This was acquired in 1936, the twenty-first anniversary year of the Department, and the appeal for funds called forth a most gratifying response. In addition to the subscriptions of more than £37,000 to the Glass Delegacy's fund, the Society of Glass Technology has contributed £2,600 towards the cost of the lecture theatre and adjacent rooms, and old students and staff have furnished the professor's room. The Frank Wood Library also was the subject of a special fund of some £1,150.

On Monday, June 12, the new buildings were formally opened by the Right Hon. Lord Riverdale of Sheffield, chairman of the Advisory Council for Scientific and Industrial Research, after dedication by the Right Rev. the Lord Bishop of Sheffield.

In his remarks, Lord Riverdale emphasized that one of the prime needs of the world to-day is confidence. Such confidence in the Glass Department has been felt by the industry that these new buildings are the result. What began as a local movement is now not only national but also international, for the Society of Glass Technology draws its members from all over the world and works in harmony with other similar bodies abroad.

The actual opening ceremony consisted of the drawing apart of curtains woven from glass silk

hung before the main doorway. Mr. Geoffrey Pilkington then unveiled a tablet in the porch commemorating the opening, after which a degree congregation was held in the Museum for the purpose of conferring the degree of LL.D. on Mr. S. B. Bagely, the chairman of the Glass Delegacy, and of Ph.D. on Mr. B. P. Dudding, who as president of the Society of Glass Technology that year launched the Society's Elmfield Fund. The vice-chancellor, Dr. Irvine Maason, said that the building is a monument to the good relations between the University and the glass industry. Its products would be two—new knowledge and scientifically trained men.

The president of the Society of Glass Technology, Dr. C. J. Peddle, next unveiled in the lecture theatre a tablet bearing the names of the donors to the Society's fund, and the ceremonies were pleasantly concluded by the presentation to Lord and Lady Riverdale of a glass rose bowl by Mrs. W. E. S. Turner, and a speech of thanks by Prof. Turner, to whom many tributes were paid during the day's proceedings.

Afterwards the Department was inspected by the guests. It is situated in two and three quarter acres of attractive grounds overlooking on either side small reservoirs and is about six minutes' walk from the main University buildings. The original stone-built house has been retained to form an administrative section. It contains on the ground floor an entrance hall with a pair of stained glass windows by Mr. S. M. Scott depicting glass makers at work and will house later a large tablet with illustrations of great achievements by English glass makers during three centuries and bearing the names of donors to the Glass Delegacy's Fund. In the porch is a glass-fronted niche containing a glass casket which holds historic records. Opening off the entrance hall are the conference room, the professor's room and the visitor's room. On the first floor is the Frank Wood Library, containing a stained glass window in memory of Mr. Frank Wood, a librarian's room,

records room and ladies' rest rooms, whilst the second floor contains a small classroom and various store rooms.

The new building runs on from the house to give a total frontage of 151 ft. 6 in., with a mean depth of 50 ft. It consists of Section A, separated by a second entrance hall from Section B. In addition, Section C runs off to form the limb of a letter L and contains the heavier practical equipment. Section A contains on the ground floor a central corridor opening into rooms on either side. These comprise the following: general office, refectory and kitchen, in which good use is made of glass for tiling and table tops, mechanics' shop, drawing office, and laboratories for the study of optical radiation and X-ray, mechanical and thermal properties, with a small dark room. On the same floor, Section B contains students' cloakrooms, a general physical and a high-temperature laboratory, and store rooms for apparatus and materials. On the first floor, the whole of Section A is taken up by a museum 60 ft. long and 31 ft. wide on one side, whilst the remaining space comprises a small lecture room, museum keeper's store, and a decorative processes laboratory. Outside the museum in Section B is the landing, with office, leading to the lecture theatre and preparation room. The theatre seats approximately one hundred and has a projection gallery, dimming device, and the usual services. On the second floor are the two laboratories, students and research, for work of a chemical nature, and two smaller rooms which are

equipped for special branches of research. There are also an office and store rooms and the projection room on this floor. A lift connects all floors with the basement, where the following are located: meter room and pipe duct, boiler room, battery room, dynamo room, and various store rooms.

Section C, only half of which is at present erected, is to have a length of 75 ft. It now consists of three rooms, one of which is built over an archway and is devoted to raw materials and mixing, whilst of the other two, 50 ft. by 36 ft., that on the ground floor is used for the storage, preparation and testing of refractories, two small laboratories being partitioned off for the latter purpose. The remaining room on the first floor is given over to glass melting and is equipped with a variety of furnaces, gas and electrically heated. Provision has been made for the building of large furnaces, and an adjustable stage has been built below an opening in the floor to accommodate regenerator or recuperator structures without taking up too much of the space in the refractories section below.

Throughout the building glass has been used as much as possible and Vitrolite, glass bricks, Thermolux and armour-plate glass, together with glass silk insulation have been effectively employed. Special mention may be made of the large glass dome over the stairway, the glass panels in the latter, the various stained glass windows, and the window to be erected in the museum depicting "Glassmaking through the Centuries".

The Royal Society and the Kaiser Wilhelm Gesellschaft Exchange of Visits

IN the autumn of 1938, following a suggestion of the president of the Kaiser Wilhelm Gesellschaft, arrangements were made by the president of the Royal Society of London, Sir William Bragg, and representatives of the Kaiser Wilhelm Gesellschaft, for an exchange of visits between these two bodies. The Kaiser Wilhelm Gesellschaft, founded in 1911 at the suggestion of the Kaiser Wilhelm II, has as its aim the encouragement of the natural and human sciences, primarily by establishing and maintaining research institutes for natural science in Germany.

This exchange of visits was welcomed by the Royal Society, which, since its foundation in 1662, has always sought to maintain, irrespective of race or politics, the liveliest interest in the work of men of science throughout the world. Consequently, arrangements were made for two fellows of the Society, Prof. F. G. Donnan, emeritus professor of chemistry in the University of London, and Prof. A. J. Clark, professor of materia medica in the University of Edinburgh, to visit Germany in March; at the express wish of the Kaiser Wilhelm Gesellschaft for a lecture on a non-scientific subject, Prof. Dover Wilson, the eminent Shakespearean scholar, was invited by the Royal Society to visit Berlin to lecture. The visits, which took place in March and April, were highly successful. The visitors were most hospitably entertained by their German colleagues and were afforded facilities for visiting laboratories and research institutes.

The Royal Society is entertaining during this month four German men of science. They are Freiherr von Verschuier, of the University of Frankfurt-on-Main, Prof. R. Kuhn, of the Kaiser Wilhelm Institut für Medizinische Forschung, Heidelberg, Prof. F. Wever, of the Kaiser Wilhelm Institut für Eisenforschung Forschung, Düsseldorf, and Prof. Otto Hahn, of the Kaiser Wilhelm Institut für Chemie, Berlin-Dahlem. Freiherr von Verschuier and Prof. Kuhn delivered lectures before the Royal Society on June 8 and 9 respectively; Prof. Wever will speak at the Royal Society on June 22 at 4.30 on metallurgical research, and Prof. Hahn at the Royal Institution on June 23 at 2.30 on the fission of uranium nuclei by neutrons.

RESEARCH IN TWINS

The first exchange lecture between the Kaiser Wilhelm Gesellschaft and the Royal Society was given on June 8 by Freiherr von Verschuier, professor of human genetics and eugenics at the University of Frankfurt-on-Main. This institution has devoted itself especially to the study of twins and the subject of the lecture was twin research.

Prof. Verschuier pointed out that Galton in 1875 was the first to recognize the importance of the study of inheritance in twins, distinguishing between monozygotic or identical, and dizygotic or fraternal, twins. The twin method dissociates the parts played

by heredity and environment in the development of the individual. A resemblance diagnosis has been established for determining the identity of similar sexed twins, and every case of identical twins is confirmed by identity of the blood groups. Examination of the after-birth of many twin births shows that identical pairs may have one chorion or two. Hair colour and eye colour are useful characters in diagnosing twins among Europeans, but not among Mongolian or African peoples, where these features do not vary appreciably. Identical twins are genetically identical persons, so that even skin transplantation can take place between them. All differences between such twins are therefore non-hereditary.

In a considerable study of tuberculous twins, extending over ten years, striking evidence has been obtained of the existence of an inherited disposition to tuberculosis. In several cases identical twins living for many years under very different conditions nevertheless sickened and died of the same form of the disease at almost the same time. In identical twins the number of concordant reactions to tuberculosis is very high compared with that of ordinary twins.

Inheritance in relation to numerous other diseases is being studied by recording all the twins in a given district and period, or by examining the twins among all the patients at certain clinics who are suffering from a particular disease.

CHEMICAL BASES OF THE BIOLOGICAL ACTIONS OF LIGHT

The second exchange lecture was delivered on June 9 by Prof. R. Kuhn, of the Kaiser Wilhelm Institut für Medizinische Forschung, Heidelberg, and president of the German Chemical Society. Prof. Kuhn said that the elucidation of the mechanism of the many living processes in which light is concerned involves the application of well-established photochemical principles and experimental technique. As only light which is absorbed can cause a photochemical change (Grotthuss-Draper law) one first looks for a photosensitive substance which absorbs light of the active wave-length. The correlation can often be confirmed by comparing quantitatively the 'action' (photosensitivity) curve with the extinction coefficient curve of the absorbing substance. In many cases the photosensitive substance is present in such minute amounts that careful extraction in the dark from a very large bulk of material is necessary in order to find it.

It is possible to make generalizations as to the types of organic structure which will lead to absorption in a certain part of the spectrum such as the

visible. There are, of course, many examples of these types found in plants and animals. Furthermore, associated with these organic structures, there are certain types of photochemical change, such as *cis-trans* transformations, shifts of the double-bond position, ring breaking, and production of free radicals.

It is a familiar fact that the higher green plants grow towards the light. The 'action' curve has recently been found to correspond to the absorption curve of carotene. The latter apparently photosensitizes the conversion of auxine-a, a growth-promoting substance, into an inactive lactone compound. On the sunny side of a plant the cell growth is therefore inhibited, while on the shady side it is not, hence the turning towards the light.

Gametes of *Chlamydomonas eugametos* in the light liberate a substance which sensitizes their copulation. This substance is found in high concentration in the stigma of *Orococcus sativus* and is called crocin. The gametes are extremely sensitive to this substance, 0.4 mgm. in 10¹¹ cm.² being sufficient to activate them when their concentration is 2 × 10⁶ per cm.². As the molecular weight of crocin is 978, this corresponds to one molecule per gamete. A concentration a hundred times stronger is necessary before fusion between males and females takes place, but such a concentration is still far below the limits of detecting this highly absorbing substance by means of the eye. The specificity for the male and female species has been correlated with the *cis* and *trans* forms.

In fishes, the liberation in the dark of a light-sensitive substance, 1,2,3,4,5,6,8 heptahydroxy, 7-ethyl-naphthalene, by the ripe eggs chemotactically attracts the spermatozoa.

The photo-activity of human skin was studied by projecting the spectrum of a carbon arc on a test area for four minutes. The usual erythema maximum at 300 mμ was found to develop after four hours, but a marked browning with maxima at 360, 380 and 408 mμ developed in a much shorter time. The erythema at 300 mμ disappeared in a few weeks, while that at longer wave-lengths persisted for some months. In a similar manner the 'action' curve of the ripening of a green banana skin was studied, and it was found to follow closely the absorption spectrum of chlorophyll.

Photosensitive substances, particularly visual purple, play a fundamental part in vision. The 'action' curve, that is, the luminosity curve, of scotopic vision follows closely the absorption spectrum of visual purple. A new colouring substance, astaxanthin, coupled to a protein, has been isolated from hana' eyes, and certain coincidences between its behaviour and phenomena occurring with colour vision may mean that it is associated with this visual process.

The S.S. *British Queen*

A CENTURY ago, no journal displayed more interest in the progress of trans-Atlantic steam navigation than the *Athenaeum*; and in its issue of June 22, 1839, it referred at length to the *British Queen*, which was built at the same time as the *Great Western*, but the completion of which had been seriously delayed. In June 1839, the *British Queen* was still in the Clyde, having her machinery

fitted by Robert Napier, and the *Athenaeum* said: "The completion of this vessel is looked forward to with much anxiety by all who take an interest in the improvement and extension of steam navigation and all who desire the peaceful and reciprocally beneficial intercourse of civilised nations. She will be most certainly a great experiment, in the theory of steam navigation, on many interesting points."

The journal promised to give an account of the voyage of the ship from the Clyde to the Thames, and added to its article some notes from a "Scientific Correspondent" who had visited the ship. "Every-one admits," he wrote, "that she is a very handsome vessel; and perhaps the greatest proof of her symmetry is that as she reposes her leviathan bulk on the level shore, she does not appear so enormous as she really is. . . . It was only when I gained the deck of the *British Queen* that I became thoroughly impressed with the truth of her enormous size. The deck is a long promenade, and the distance from stern to stem is a good rifle shot; her breadth on deck being some sixty feet. Descending to the engine room . . . looking up you perceive the men who guide the whole machinery and regulate and direct the combined strength and simultaneous energy of 500 horses, with greater success than the tyrant Philopater and his galley of 3,000 slave power, and feel that you are in the presence of one of the noblest of human creations. . . ."

The *British Queen* was built on the Thames at Limehouse by Curling and Young for the British and American Steam Navigation Company. This company had been founded through the efforts of the American lawyer and business man Junius Smith (1780-1853), who had been greatly assisted by Macgregor Laird (1808-61), the African explorer. She was 275 ft. long from figure-head to taffrail, 40 ft. 6 in. wide between the paddle boxes, and of 1,863 tons, being the largest steamship afloat. She had a two-cylinder side-lever engine, with cylinders 77½ in. in diameter and 7 ft. stroke, driving paddle wheels 31 ft. in diameter.

tenable at St. Mary's Hospital Medical School. Since 1930 he has worked at University College Hospital, being appointed as assistant in the Department of Clinical Research and, in 1936, as lecturer in cardiovascular pathology. In 1931 he was appointed a member of the permanent scientific staff of the Medical Research Council.

OXFORD.—The appointment of the first twelve fellows of Nuffield College, following on the appointment last year of its warden, Dr. H. B. Butler, marks the beginning of its corporate existence. The six faculty fellows, all of whom are fellows of existing Oxford colleges, are Mr. R. C. K. Ensor, Mr. J. Fulton and Miss Margery Perham, representing the political side, and Mr. G. D. H. Cole, Mr. R. L. Hall and Mr. R. F. Harrod, representing the economic. The six visiting fellows, whose task is "to assist those engaged in the University in research by giving them the fruits of their experience in practical affairs", are Lord Hailey, Lord Cadman, Sir Walter Citrine, Sir George Etherton, Mr. Claude Vickers and Mr. A. P. Young. In two years' time it is hoped that the buildings will be up and its gates open to the kind of persons for whom the College was intended. Apart from the fellows and the distinguished visitors for whom accommodation in the College will be provided, there will be forty students, all of whom will be reading for the degrees of D.Phil., B.Litt., or B.Sc., or engaged in some approved piece of research. These, if men, will be accommodated also in the College. It is expected that after 1941, Nuffield College will become the centre in Oxford for all those who are concerned with the practical or theoretical treatment of social, economic and political problems.

University Events

BELFAST.—The Senate of Queen's University has decided to confer the following honorary degrees, among others: D.Sc. on Dr. J. H. Smith, until recently head of the Department of Engineering in the Belfast College of Technology; Doctor of Laws on Prof. F. H. Hummel, until recently professor of Civil Engineering in the University; F. W. Ogilvie, formerly vice-chancellor of the University and now director general of the British Broadcasting Corporation.

CAMBRIDGE.—W. Campbell Smith, keeper of minerals in the British Museum (Natural History), has been approved for the degree of Sc.D.

GLASGOW.—The King has been pleased, on the recommendation of the Secretary of State for Scotland, to approve the appointment of Prof. J. W. Cook, professor of chemistry in the University of London (Royal Cancer Hospital), to be regius professor of chemistry in succession to the late Prof. George Barger.

HULL.—The following appointments and promotions, to date from October 1, have recently been made: P. G. Espinasse, to be lecturer (grade A) in the Department of Zoology; Dr. W. B. Orr, to be lecturer (grade A) in the Department of Chemistry; Dr. J. Bronowski, to be lecturer (grade B) in the Department of Mathematics; Dr. G. Tatham, to be lecturer (grade B) in the Department of Geography.

LONDON.—G. W. Pickering has been appointed, as from October 1, to the University chair of medicine

Societies and Academies

London

Royal Society (*Proc.*, A, 171, No. 945, 137-280, May 19, 1939).

SIR C. V. RAMAN and K. S. VENKATA RAMAN: Determination of the adiabatic piezo-optic coefficient of liquids.

R. G. W. NORRISH and E. F. BROOKMAN: The mechanism of polymerization reactions. (1) The polymerization of styrene and methyl methacrylate.

E. V. APPLETON and K. WEEKES: On lunar tides in the upper atmosphere.

K. G. BUDDEN, J. A. RATOLIFF and M. V. WILKES: Further investigations of very long waves reflected from the ionosphere.

P. S. H. HENRY: Diffusion in absorbing media.

J. F. ALLEN and E. GANZ: Influence of pressure on the thermal conductivity of liquid He II.

G. P. KANE: Influence of nitrogen peroxide on the two-stage ignition of hydrocarbons.

H. FRÖHLICH, W. HEITLER and B. KAHN: Deviation from the Coulomb law for the proton.

Edinburgh

Royal Society of Edinburgh, May 1.

P. M. S. BLACKETT (Bruce-Preller address): The mesotron: the new unstable cosmic ray particle. Recent work both theoretical and experimental has

shown that the penetrating cosmic rays consist of a new type of particle with a mass of about 160 times that of an electron. It has further been shown that this new particle (mesotron) is unstable and decays when at rest with a mean life of about 2×10^{-14} sec. This instability of the mesotron provides an explanation of many hitherto unexplained facts, such as the failure of the mass absorption law, and the temperature effect of cosmic rays. The mesotron must be produced in the atmosphere by some incident stable particles, but the mechanism of this is still uncertain.

I. M. H. ETHERINGTON: Non-associative combinations. This paper envisages an extension of the elementary theory of permutations and combinations by taking account of the way in which the elements of a combination are associated together.

T. M. MACROBERT: Expressions for generalized hypergeometric functions in multiple series. Various known formulae for the ordinary hypergeometric function are extended to generalized hypergeometric functions. This is made possible by the use of multiple series. Among the formulae discussed are the alternative forms of the hypergeometric function, Saalschütz's theorem, and Gauss's formula for well-poised series.

IAN SANDEMAN: The molecular spectra of the hydrogen isotopes (2). The assumption of a common potential function for the isotopic states. An analysis of one of the states of the isotopic molecules, hydrogen, deuterium hydride, and deuterium (the last two from the measurements of Dieke and Blue), has been carried out by the method of Dunham in order to test whether it is possible to represent the spectroscopic data for the three isotopes by an application of the ordinary mass-effect theory for molecular isotopes. The conclusions are (1) that the internuclear distance in the three isotopic molecules cannot differ very much and (2) that the potential functions of the three isotopes are different. The second implies that the electric field of the deuteron differs appreciably from that of the proton.

N. W. RADFORTH: Further contributions to our knowledge of the fossil Schizaeaceae (*Senftenbergia*). Using the transfer and oxidation methods in an analysis of the fructifications in two Carboniferous fern-like compressions of the plants *Senftenbergia pennsylvanica*, and *Dactylothea Sturi*, the dehiscence mechanism is revealed in detail, and the spores, preserved in different developmental stages are extracted. *Dactylothea Sturi*, having annulate sporangia, becomes a member of *Senftenbergia* although remaining specifically distinct. The comparison of the sporangia of both plants with those of *Senftenbergia plumosa*, and of the living Schizaeaceous type *Aneimia*, indicates a series in which progressive structural changes have occurred in connexion with the annulus, and in which spore output has diminished.

F. YATES: Tests for significance in the difference between regression coefficients derived from two sets of correlated variates. The test of significance for the difference between regression coefficients calculated from a sample involving one set of variates is known. The author considers the more general case, which also occurs in practice, of two sets of variates, and derives the appropriate testing formulae. The necessary computations are reduced to a systematic and easily calculable shape, which is illustrated by a worked example.

Paris

Academy of Sciences (C.R., 208, 1369-1444, May 1, 1939).

E. BOREL: An interpretation of virtual probabilities.

J. DRACH: Application of the method of Darboux to the equations $s = f(x, y, z, p, q)$: rational invariants.

J. CHAZY: Action of a circular ring on the perihelion and the node of a planet.

G. HEILBRONN: Construction of equations $s + f(x, y, z, p, q, r) = 0$ which have an invariant of the second order.

M. EGME: A characteristic property of some harmonic and biharmonic functions.

S. WACHS: Pseudo-conformal transformations admitting an invariant boundary point.

B. KWAL: Equations independent of the theory of the photon.

R. RUELLOS: The linear equation of the second order and the differential systems.

L. HERMAN and Mme. R. HERMAN: Existence of oxygen phosphorescence in the spectrum of the night sky.

F. PERRIN: Calculation relative to the eventual conditions of chain transformation of uranium.

H. VON HALBAN, JUN., L. KOWARSKI and P. SAVITCH: Simple capture of thermal neutrons and of resonance neutrons by uranium.

L. GIRAUT-ERLME: Theory of differential potentiometric titration (weak acids and bases).

J. LECOMTE and R. FREYMANN: Study of the infra-red absorption spectra by the powder method (acetates, formates, oxalates, acetylacetonates, sulphates).

H. JOLIVET and A. PORTVIN: Formation of granular structures in the upper transformation domain of steels.

R. VIELLEFOSSÉ: Partial hydrolysis of sulphoacetic dichloride.

R. CORNUBERT and G. MORILLON: Probable existence of three α - α' -dibenzoylcyclohexanones.

M. MOUSSEBON, R. GRANGER and M. RONAYROUX: Constitution of the essential and other oils of *Juniperus oxycedrus* L.

R. CALAS: A new example of passage of the C_2 cycle to the C_3 by pinacolic dehydration.

F. PRANTL: Silurian Bryozoans of the Black Mountains.

S. MAZLOUM: Propagation of some hydrometric components in the basin of the Orontes.

R. BURBAU, M. DOUGUET and Ph. WHEELÉ: Radio soundings in Australian seas. Data were obtained in February and March (Australian summer season) on the altitude and temperature of the stratosphere.

G. DUBOIS and Mme. C. DUBOIS: Micropalaeobotanical characteristics of a peat in Togoland.

M. CHADEFAUD: Active and inactive mitochondrial elements in diatoms of the genus *Fragilaria*.

J. and Mme. FELDLMANN: Alternation of generations in the Bonnemaisoniaceae (Algae).

M. SIMONET and M. GUINCHERT: Production by α -monochloronaphthalene and α -monobromonaphthalene of effects produced by colchicine on plant mitoses [namely, polyploidy].

H. PRAT: Study of the possibilities of submarine respiration.

A. POLACK: Interpretation of the Le Grand-Geblewicz phenomenon. A large brilliant flickering source of light, coloured or monochromatic, observed by indirect vision, appears continuous and colourless when

the flicker frequency is 40-50 a second. This can be explained on the basis of consecutive images.

MLLE. G. COUSIN: A graphical method for the analysis of hybridization applied to researches on different species of crickets.

MLLE. P. BERTHIER: Variation of the coefficient of specific magnetization of oxyhaemoglobin in the presence of soda and of hydrochloric acid.

P. MEYER: Relation between the concentration and colloid-osmotic pressure of blood serum.

M. DOLADILHA: Contribution to the problem of the extraction of haemolysin.

M. PIÉRY, J. ENSELME, C. PESCHIERA and P. DONJON: Experimental study of the biological influence of a prolonged stay at a great altitude [Jungfrauoch]: hepatic and muscular modifications. In geese, after six months exposure, there is a distinct lowering of muscle iron and slight lowering of hepatic iron. In rabbits, muscular iron is unaffected and hepatic iron increased.

Cape Town

Royal Society of South Africa, March 15.

J. L. B. SMITH: A surviving fish of the order Actinistia. The sub-class of fishes Crossopterygii is generally sub-divided into three orders, of which two, the Rhipidistia and the Actinistia, are generally stated to have no surviving members. Of the order Actinistia, fishes of the family Coelacanthidae originated in the mid-Palaeozoic and became very abundant over a wide range, but all were supposed to have become extinct by the close of the Mesozoic, some 50 million years ago. At East London there has recently been discovered a large living Coelacanthid fish, which is closely related to some of the Mesozoic forms. A general account, in not too great detail, of the specimen, and a figure, are given (see also NATURE of May 6, p. 748).

J. L. B. SMITH: Marine fishes of two families and two genera new to South Africa.

D. D. NIDDER: A hitherto undescribed industry from Mfongosi, Zululand.

F. G. CRAWFORD: (1) Some observations on the alleged succession of teeth in snakes. (2) Some observations on the arrangement of teeth in fishes.

R. GUHLKE: A method of correcting an objective noise meter for use on composite tones.

H. B. S. COOKE and J. DESMOND CLARK: New fossil elephant remains from the Victoria Falls, Northern Rhodesia, and a preliminary note on the geology and archaeology of the deposit.

Dublin

Royal Irish Academy, May 22, 1939.

T. THOMSON FLYNN: The egg of the rare marsupial *Sarcophilus*. *Sarcophilus*, the "Tasmanian devil", a polyprotodont marsupial, now exceedingly rare, agrees with *Dasyurus vicerrinus*, *Didelphys* and some other marsupials in producing more embryos than can be accommodated in the pouch. Twenty-two ova were found in the uteri, whereas the pouch has accommodation only for four. The egg is very similar in its structure, particularly in the distribution of deutoplasm, to that of *Phascogaster*, and in this way helps to confirm Caldwell's description of the egg of the latter marsupial, a description which has been the subject of criticism.

Vienna

Academy of Sciences, February 23

L. SCHMID and R. LANG: Colouring matter in the yellow spots on diseased potato tubers. The constituents are identified by their chemical properties and absorption spectra.

L. SCHMID and ANNEMARIE POLACZEK-WITTEK: Diffusion of glycogen in liquid ammonia. Glycogen dissolved in liquid ammonia does not pass through a cellulose membrane, and must therefore exist as a colloidal polysaccharide in this medium.

K. GRATZ: Grey cloud in the region β , α , 103 Tauri. Visual observation of this region reveals a grey cloud, while on photographic plates the same cloud appears black. This is probably due to the photographic technique commonly employed: the usual hard gradation photographs of the Milky Way certainly do not reveal all the objects present.

L. LÄMMERMAYER: Studies of underwood.

H. ZAPPE: Fossil relics of bone-eating animals, particularly the hyena.

G. GÖTZINGER: Drumlins in the Traun glacier region.

Moscow

Academy of Sciences (C.R., 21, No. 7; 1938).

P. A. CHERENKOV: Spatial distribution of visible radiation produced by fast electrons.

I. A. KHVOSTIKOV: Polarization of the green line of the luminescence of night sky.

J. LARIONOV, O. V. NOVIKOVA-MINASH and A. SEIDEL: Fluorescence and absorption of praseodymium salt solutions.

T. BOBOVICK-ROMANOVA: Effect of sodium, potassium and lithium salts introduced into the flame upon the intensity of the rubidium line.

A. IMSHENETSKY: Sugar fermentation of cellulose by thermophilic bacteria.

V. N. NIKITIN: Lower limit of the bottom fauna and its distribution in the Black Sea.

M. L. KARP: Influence of intrachromosomal and interchromosomal relations upon results of inbreeding and crossing.

E. N. MAKUSHINA: A new species of wheat, *Triticum armeniacum* (Jacq.) sp.n.

K. V. and L. V. ARNOLDI: Some relict elements and the coleopteran fauna of the Middle Donetz region.

A. A. WOIWKIEWITSCH: The question whether or not the structure and form variation of plumage following thyroidectomy may be regarded an index to masculinization.

L. W. POLEZAJEW: (1) Explantation experiments of extremity rudiments. (2) Induction factors of the early stages of extremity formation in Amphibia.

Tokyo

Imperial Academy (Proc., 15, No. 4, 101-109, April 1939).

MATSUBURO FUJIWARA: A problem of diophantine approximations in the old Japanese mathematics.

JURO HORIUTI and TAKAO KWAN: Mechanism of the contact hydrogenation of carbonyl groups in the presence of metallic catalysts.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

HEAD OF THE DEPARTMENT OF ENGINEERING AND BUILDING in the County Technical College, Guildford—The Principal (June 17).

LECTURER IN MATHEMATICS in the County Mining and Technical School, Nuneaton—The Principal (June 17).

LECTURER IN MECHANICAL ENGINEERING in the Swindon Technical College—The Director of Education, Civic Offices, Swindon (June 21).

LECTURER IN MATHEMATICS in the University of Durham (Durham Division)—The Secretary, Durham Colleges' Office, 38 North Bailey, Durham (June 23).

HEAD OF THE DEPARTMENT OF PHARMACY AND BIOLOGY in the Central Technical College, Birmingham—The Principal (June 24).

LECTURER IN MECHANICAL ENGINEERING in the Cape Technical College, Capetown—Messrs. J. A. Swing and Co., Ltd., Oldwell Street, London, E.C.1 (June 24).

LECTURER IN METALLURGY AND CHEMISTRY and **LECTURER IN MECHANICAL AND STRUCTURAL ENGINEERING** in the Constanine Technical College—The Director of Education, Education Offices, Middlesbrough (June 25).

LECTURER IN MECHANICAL ENGINEERING in the Borough Polytechnic, Borough Road, London, S.E.1—The Principal (June 26).

LECTURER IN PRODUCTION ENGINEERING in the County Technical College, Wednesbury—The Director of Education, County Education Office, Stafford (June 26).

LECTURER IN PHYSICS in the Derby Technical College—The Clerk to the Governors (June 28).

TEACHER OF ENGINEERING SUBJECTS in the Doncaster Technical College—The Secretary, Education Offices, Doncaster (June 28).

LECTURER IN CHARGE OF THE DEPARTMENT OF GEOGRAPHY in the University of Durham (Durham Division)—The Secretary, Durham Colleges' Office, 38 North Bailey, Durham (June 29).

HEAD OF THE ENGINEERING PRODUCTION DEPARTMENT of the Northampton Polytechnic, St. John Street, London, E.C.1—The Principal (June 30).

ORGANISING TUTOR IN THE SOCIAL SCIENCES in University College, Hull—The Registrar (June 30).

RESEARCH ASSISTANT IN ANIMAL NUTRITION (grade III) in the Hannah Dairy Research Institute, Kirkcubbin, Ayr—The Director (July 1).

DEMONSTRATOR IN CHEMISTRY in Guy's Hospital Medical School, London, S.E.1—Prof. C. S. Gibson (July 8).

PROFESSOR OF VETERINARY PATHOLOGY AND DIRECTOR OF THE RESEARCH INSTITUTE IN ANIMAL PATHOLOGY in the Royal Veterinary College, Great College Street, London, N.W.1—The Bursar (July 10).

PROFESSOR OF METALLURGY in the Imperial College of Science and Technology—The Academic Registrar, University of London, Senate House, W.C.1 (January 31).

PROFESSOR OF FORESTRY in the University of Oxford—The Registrar, University Registry, Oxford.

ASSISTANT IN GEOLOGY in the University of Aberdeen—The Secretary.

A MICROSCOPIST, A PHOTOGRAPHER AND AN ASSISTANT TO DIRECTOR OF RESEARCH to the Printing and Allied Trades Research Association—The Director of Research, 10 Robin Hood Court, London, E.C.4.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Annual Report of the Zoological Society of Scotland for the Year ending 31st March 1939. Pp. 60+6 plates. (Edinburgh: Zoological Society of Scotland.) [235]

Empire Cotton Growing Corporation. Annual Report for the Season 1937-1938. Pp. ii+55. (London: Empire Cotton Growing Corporation.) [235]

John Innes Horticultural Institution. Twenty-ninth Annual Report for the Year 1938. Pp. 24. (London: John Innes Horticultural Institution.) [235]

Ministry of Agriculture and Fisheries: Department of Agriculture for Scotland: Ministry of Agriculture for Northern Ireland and Agricultural Research Council. Reports on the Work of Agricultural Research Institutes and on certain other Agricultural Investigations in the United Kingdom, 1936-1936. Pp. v+337. (London: H.M. Stationery Office.) 6s. net. [235]

Proceedings of the Royal Society of Edinburgh, Session 1938-1939. Vol. 59, Part 1, No. 8: Lunar Atmospheric Pressure Variations at Glasgow. By Dr. B. A. Robb and T. R. Tannahill. Pp. 81-90. 1s. Vol. 59, Part 1, No. 9: Sources of Variation in Human Birth Weights. By Dr. H. P. Donald. Pp. 91-103. 1s. 6d. Vol. 59, Part 1, No. 10: On the Invariance of Quantized Field Equations. By Dr. K. Fuchs. Pp. 109-121. 1s. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [245]

Freshwater Biological Association of the British Empire. Seventh Annual Report for the Year ending 31st March 1939. Pp. 98. (Amble-side: Freshwater Biological Association of the British Empire.) [245]

Institute of British Geographers. Publications Nos. 9 and 10: Transactions; and Structure, Surface and Drainage in South-East England. By Dr. S. W. Woodbridge and David L. Linton. Pp. xvi+4. (London: George Philip and Son, Ltd.; Liverpool: Philip, Son and Nephew, Ltd.) 12s. 6d. [265]

Proceedings of the Royal Society of Edinburgh, Session 1938-1939. Vol. 59, Part 2, No. 11: The Relation between Mathematics and Physics. By Prof. P. A. M. Dirac. (James Scott Lecture.) Pp. 123-139. 9d. Vol. 59, Part 2, No. 12: The Molecular Spectra of the Hydrogen Isotopes. 2: The Assumption of a Common Potential Function for the Isotopic States. By Dr. Ian Sandeman. Pp. 130-140. 1s. Vol. 59, Part 2, No. 13: Expressions for Generalized Hypergeometric Functions in Multiple Series. By Prof. T. M. MacRobert. Pp. 141-144. 6d. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [255]

Amgueddfa Genedlaethol Cymru: National Museum of Wales. Plants in the Service of Man: Handbook to a Temporary Exhibition, May 1st-November 4th, 1939. By H. A. Hyde. Pp. 52. (Cardiff: National Museum of Wales.) 3d. [255]

Other Countries

U.S. Department of the Interior: Office of Education. Bulletin, 1938, No. 13: Statistics of the Education of Negroes, 1935-36 and 1936-38. By David T. Blose and Ambrose Caliver. Pp. vii+67. (Washington, D.C.: Government Printing Office.) 10 cents. [255]

U.S. Department of Agriculture. Circular No. 530: Wildlife of the Atlantic Coast Salt Marshes. By W. L. McAtee. Pp. 28+6 plates. (Washington, D.C.: Government Printing Office.) 10 cents. [255]

Proceedings of the U.S. National Museum. Vol. 86, No. 3068: Two New Atlantic Species of Dog Sharks, with a Key to the Species of Mussels. By Stewart Springer. Pp. 451-468. (Washington, D.C.: Government Printing Office.) [255]

Studies from the Connaught Laboratories, University of Toronto. Vol. 10, 1938. 56 Papers. (Toronto: University of Toronto Press.) [265]

Proceedings of the U.S. National Museum. Vol. 86, No. 3069: A Revision of the Toadfishes referred to Portholeys and related Genera. By Carl L. Hobbs and Leonard P. Sennitt. Pp. 473-496. Vol. 86, No. 3070: Eleven New Species and Three New Genera of Oceanic Fishes collected by the International Fisheries Commission from the Northwestern Pacific. By Wilbert McLeod Chapman. Pp. 501-543. (Washington, D.C.: Government Printing Office.) [265]

U.S. Department of Agriculture. Circular No. 516: Control of Cysticercosis and Broad White on Gerbers. By Floyd P. Smith. Pp. 16. 5 cents. Miscellaneous Publication No. 340: The Wildlife Restoration Program under the Pittman-Robertson Act of 1937. By Albert M. Day. Pp. 12. 5 cents. Technical Bulletin No. 634: Food of Game Ducks in the United States and Canada. By A. G. Martin and F. M. Uhler. Pp. 157+153 plates. 40 cents. (Washington, D.C.: Government Printing Office.) [305]

Scientific Reports of the Imperial Agricultural Research Institute, New Delhi, for the Year ending 30th June 1938. Pp. iv+131+7 plates. (Delhi: Manager of Publications.) 3.4 rupees; 6s. 2d. [305]

Indian Association for the Cultivation of Science. Annual Report for the Year 1938. Pp. 34. (Calcutta: Indian Association for the Cultivation of Science.) [305]

Journal of the Indian Institute of Science. Vol. 22A, Part 8: Reactions of Chromates at High Temperatures, Part 9: Thermal Decomposition of Chromium Trioxide. By D. S. Datar and S. K. K. Jaitkar. Pp. 119-125. 12 annas. Vol. 22A, Part 9: Researches on Utilization of Cane Molasses, Part 2: Preparation of Mixed Calcium Salts of Organic Acids from Cane Molasses and its Technical Applications. By T. R. Bhaskaran, S. G. Pillai and V. Subrahmanyam. Pp. 127-138. 1 rupee. (Bangalore: Indian Institute of Science.) [305]

Canada: Department of Mines and Resources: Mines and Geology Branch, Bureau of Mines. Investigations in Ore Dressing and Metallurgy (Testing and Research Laboratories), July to December 1937. (No. 788.) Pp. iv+137. (Ottawa: King's Printer.) [305]

Field Museum of Natural History. Report Series, Vol. 11, No. 3: Annual Report of the Director to the Board of Trustees for the Year 1938. (Publication 443.) Pp. 305-474+plates 25-35. (Chicago: Field Museum of Natural History.) 1 dollar. [305]

Hurade Septentrionalis Antiqua. 12, 1938. Pp. 248. (Helsinki: Akateeminen Kirjakauppa.) 250 Fmk. [305]

Statens Meteorologiska-Hydrografiska Anstalt. Årbok, 18, 1938. 14. Vattenståndet vid Båstad kuster. Pp. 24. 8.00 kr. iv: Meteorologiska iakttagelser i Sverige, Band 78. Pp. x+108. 7.00 kr. Årbok, 18-19, 1938-1937. vi: Aerologiska iakttagelser i Sverige, 1936-1937. Pp. 12. 3.00 kr. Årbok, 19, 1937. v: Hydrografiska iakttagelser i Sverige. Pp. 12. 3.00 kr. Meddelanden, Serien Uppgifter. No. 26: Temperaturklimatets ändring i nuvarande tid och dess orsak. Av Anders Ångström. Pp. 14. No. 27: Temperature Measurements in an Air Layer very close to a Snow Surface. By Alf Nyberg. Pp. 234-278. No. 28: Bemerkungen betreffend Verdunstung von dem Wasser eines eingetauchten Kessels mit atmosphärischer Umrührung und vom freien Wasseroberflächen. Von Anders Ångström. Pp. 6. (Stockholm: Statens Meteorologiska-Hydrografiska Anstalt.) [315]

Meddelande från Lunds Astronomiska Observatorium. Ser. 2, No. 100: On the Existence of a Systematic Error in the Estimated Magnitudes of Galaxies. By Erik Holmberg. Pp. 19. Ser. 2, No. 101 (Historical Notes and Papers No. 16): Die Astronomie in Griechenland am 18. Jahrhundert. Von D. Kotschal. Pp. 8. Ser. 2, No. 104: Ein Unterster mit nur zwei Hochvakuumröhren für jede Stufe. Von K. M. Foraman. Pp. 6. Ser. 2, No. 105: On the Nature of the Fundamental Equations in Stellar Statistics. By W. Gyllenberg. Pp. 14. No. 153. On the Abel-Schwarzschild Functional Equation and its Astronomical Applications. By Knut Lundmark. Pp. 23. Ser. 1, No. 152: A Statistical Problem of Integration. By Erik Holmberg. Pp. 14. (Lund: Astronomiska Observatorium.) [315]

Sociologische Navorsing van die Nasionale Museum. Deel 1, Stuk 8: A New Frog from Thaba'nobu. By Dr. A. C. Hoffman. Pp. 89-96. **Archeologische Navorsing van die Nasionale Museum. Deel 1, Stuk 9 en 10: Some Aspects in South African Archaeology: A Preliminary Account of New South African Cultures.** By Dr. Ir. A. C. N. Van Hoepen. Pp. 79-98+plates 22-37. (Bloemfontein: National Museum.) [315]

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Population Problems in Relation to Refugees

WHETHER as indicated by the support accorded to the work of the Society for the Protection of Science and Learning, or by the care taken of individual refugees in particular universities, and the efforts made to find opportunities for men of learning to continue their teaching and investigations, the universities of Great Britain have nobly accepted their responsibilities and shouldered burdens which have often involved individuals in real sacrifice. By the universities at least this practical task of caring for refugee men of science and learning has been recognized as an inseparable part of the task of preserving for mankind its full privileges of freedom of thought and investigation. Nevertheless, Sir John Hope Simpson can conclude in his study of the refugee problem* that Great Britain's record in the admission of refugees is not distinguished when compared with that of France, Czechoslovakia or the United States of America.

Even in academic circles, however, the problem has rarely been considered on wider grounds than those of humanitarianism and the defence of freedom of thought and learning. For this reason alone the admirable dispassionate survey of the refugee problem as a whole which has been conducted under the auspices of the Royal Institute of International Affairs is welcome. This carefully prepared and lengthy report gives an exhaustive study of the origins and course of refugee movements as well as a record of the methods adopted internationally, and by individual Governments, and of the immense efforts made by the great philanthropic organizations.

The scope of the survey is restricted to post-War movements which originated in European countries; in the Ottoman Empire and in the Russian Empire; and refugee movements arising from natural causes such as earthquake or flood are also excluded. For all these limitations, the survey gives us the essential background for assessing the significance of the refugee problem and the many factors which are involved in it, as well as the various solutions proposed and the obstacles to such solutions and to the movement or absorption of refugees.

One of the great merits of this survey is the way in which the problem is presented in its true perspective. Indeed it might be true to say that the absence of a sense of perspective has been one of the main factors in creating the refugee problem. The American quota system, the British immigration laws and the virtual closing to immigration of the British Dominions have been the chief factors which issued in the refugee problem. Sir John Simpson makes it abundantly plain how the stopping of these safety valves has led to population pressures which have profoundly influenced the course of post-War history. Markets have ceased to expand; and labour in the more privileged countries is anxious to defend its standards of living against cheap immigrant competition. The spread of State control over every aspect of life in itself tends to render nationalism more readily inflamed.

The refugee problem accordingly cannot be detached from population and migration questions generally. However strongly we may reprobate the immediate political causes of a particular refugee movement, or however justly the conduct or policy of a particular ruler or nation is to be

* The Refugee Problem: Report of a Survey. By Sir John Hope Simpson. (Issued under the auspices of the Royal Institute of International Affairs.) Pp. xv+687. (London, New York and Toronto: Oxford University Press, 1939.) 25s. net.

condemned, such causes rarely stand entirely alone. The disappearance of the right of asylum and of *laissez faire* liberalism from the policy of Great Britain even ten years before the Great War are contributory factors which should make us defer hasty judgment.

There are, moreover, various points upon which further *ad hoc* scientific inquiry is desirable. Information as to the economic effect of refugee immigration is not entirely adequate. Inquiries in Holland and Belgium suggest that in these countries the advent of refugees has resulted in the employment of nationals in numbers greater than the refugee influx. In Great Britain the fur trade appears to have gained by the transfer of Jewish business from Leipzig to London, and it has been stated by the Home Secretary in the House of Commons that as a result of the settlement of eleven thousand refugees in Great Britain, employment has been given to about fifteen thousand British workers who would not otherwise have been employed. Sir John Hope Simpson says that the number of British workers employed as a result of German immigration is at least twice the number of refugees themselves.

Numerous cases are known in which new manufacturing businesses have been initiated by immigrants, but there are many other influences at work and the contributions made by refugee scholars and men of science are difficult to assess. The question would justify a full investigation. Already there is evidence to show that the presumption that the admission of immigrants is likely as a rule to increase unemployment is by no means so well-founded as may at first sight appear. The element of consumption has to be taken into account. It is indeed impossible to determine whether the admission of immigrants is more likely in general to increase or to diminish unemployment. The answer depends partly upon the particular industrial aptitude of the immigrants and partly on the economic circumstances prevailing at the time in the country they enter.

The question has accordingly to be considered, not on hard and fast rules, but in relation to the general employment and population trends in the country admitting the refugees. When reasonably active conditions of trade prevail, unemployment may be reduced by a freer admission of immigrants if these are likely to be suitable for the occupations where the supply of labour is relatively scarce. Such a principle must, however, be applied in a generous and not in a narrow-minded spirit.

Fairly considerable unemployment figures in a particular occupation can easily co-exist with a genuine shortage of labour, partly because of the small margin of workers of low industrial aptitude always to be found, partly because distinct types of work are often included under the same occupational designation, partly because of regional differences or seasonal and other temporary fluctuations. In many countries, even during the recent recession of trade, shortage of labour in certain industries connected with the production of armaments has persisted. A readier admission of immigrants who would have met the needs of these industries even during this period might have been economically advantageous, apart from its beneficial effect on defence preparations.

From this point of view, decisions taken under the influence of an unsatisfactory state of trade may accordingly prove premature and unwise, apart from all humanitarian considerations. Population questions generally, however, make long-range views and policies even more important. The admission of refugees to Great Britain or any other country cannot be wisely considered without regard to the imminence of declining population and its economic results, the consequences of which would appear to be almost completely ignored by the public and the Government alike. The problems of a declining population, with the consequent difficulties of economic adjustment, are in urgent need of scientific investigation and treatment. Industry, for example, has largely ignored the warnings about the effect of a lower birth-rate on the number of those leaving school and on industrial recruitment, and has scarcely begun to formulate plans to meet a shortage of juvenile labour which has been foretold for more than a decade. A scientific investigation of such problems and of the contribution which immigration policy might offer in minimizing some of the difficulties might well lead to a policy towards the admission of refugees both more generous and humane and more economic and scientific.

Sir John Simpson's report leaves no room for doubt as to the need for further impartial investigation of the questions which are linked up with the refugee problem. It may well make some professional associations uncomfortably aware of their own neglect or selfishness, or both. There is no single or simple solution save that of time, and the report should prevent premature or unsound conclusions being drawn from the solution of the problem of the Greek and Bulgarian refugees, for

example. Colonization on a large scale appears to be impracticable, but the problem would be reduced if more active steps were taken to train refugees in countries of temporary refuge, instead of maintaining them in idleness, and to pass them on to countries of permanent settlement as opportunity arises.

If, however, there are directions in which further investigation might yield invaluable results, the immediate problem, Sir John Simpeon insists, is action. The machinery for Government action was created at Evian in July 1938, and the steps that are most urgently required are no longer those which can be taken by private organizations. The purposeful training of intending immigrants under good conditions which maintain their health and morale; the provision of capital for opening up areas not yet developed and for the necessary institutions of civilization are steps which can only be taken by Governments. Sir John believes that if Great Britain and France and some other European countries such as Norway, Sweden, Denmark, Belgium, Holland and Finland, were to agree to take a quarter of the potential refugees from Germany at once, and accommodate them if necessary in camps until they could be dispersed to countries of ultimate settlement, a substantial step would have been taken towards solution of the problem.

This considered judgment of the report that much more than private charity is essential does not, of course, imply that there are no longer directions in which such assistance should not continue to be given. Apart from their share in the work of the universities in the relief of refugee scholars, scientific workers have particular responsibilities in some of the fields of inquiry indicated above. They must be responsible for the conduct of some of the investigations, and pressure from them might well assist to stimulate the initiation of such investigations. Moreover, the report itself might well stir them to re-examine the narrow view of the problem which has characterized some of their professional associations.

Beyond this, scientific workers have the common interest of all citizens in the policy of their Government in this matter. The post-War immigration policy of Great Britain has been exceedingly cautious. It is at least open to argument that a more generous policy might prove in the long run to be wise and sound from the economic point of view, in that it might offer a contribution to the solution of the very serious problems with which we are confronted in the immediate future through our declining population; while there can be no question that the calls of humanity require us to do all within our power to alleviate the distress inevitably associated with the refugee problem.

Haldane as Strategist, Educationist and Philosopher

Haldane, 1915-1938

The Life of Viscount Haldane of Cloan, K.T., O.M. By Major-General Sir Frederick Maurice. Pp. xv+290+8 plates. (London: Faber and Faber, Ltd., 1939.) 18s. net.

HALDANE'S epitaph describes him, proudly but not unjustly, as "A great servant of State who devoted his life to the advancement and application of knowledge. Through his work in fashioning her army he rendered invaluable aid to his country in her time of direst need". The word "fashioning" is peculiar but possibly appropriate. Controversy turns on the use of the Army "fashioned" by Haldane. In 1905, when Haldane first took office, as Secretary for War, there was lack of co-operation between the navy and army on strategical questions. In January 1906, the question of co-operation with the French Army was raised, and Huguet brought back from the

French War Office two proposals for the British Army: (1) *être liée à celle de l'armée française*, and (2) *se faire sentir dès le début des hostilités*. Colonel Lawrence, the uncrowned King of Arabia, says of the French that the only way to deal with them is to say "hoots" to them. Sir Henry Wilson, who became Haldane's principal adviser on strategical questions, was a francophile, more disposed to say this word to the politicians than to the French. Sir Edward Grey, on January 15, 1906, in a letter to Sir F. Bertie, British Ambassador in Paris, had said the word in diplomatic language—our military contribution "won't save France unless she can save herself". Haldane gave unflinching support to Wilson's strategy, notwithstanding strong opposition from Fisher and the 'blue water' school and from Lord Roberts and the conscriptionists. "Pussy", to give Haldane his nickname, turned tiger on occasion. Lord Riddell states in his diary that Mr. McKenna,

First Lord of the Admiralty, declined to provide transport for the 150,000, which Haldane proposed to land on the Continent, and records McKenna as saying: "Haldane put me out, but the scheme was a mad one and I did what was right. We had nothing to gain by making France the strongest power in Europe". To-day, as the author admits, "many people are of the opinion that it would be a fatal mistake for us to use our little Regular Army again to extend the line of a Continental ally at the outset of a War"; but refrains from expressing his own opinion on the question.

Was Haldane's strategy justified in the War of 1914-18? "It is then certain," the author writes with the support of a map, "that if our Expeditionary Force had not been ready for action by at latest the sixteenth day of mobilization (August 20) the left of the French line of battle would have been completely enveloped, and the German plan for the defeat of the French Armies by the fortieth day of mobilization successful, with the inevitable concomitant that the Germans would have been in possession of the Channel ports". Surely this is strategical science-à-la-Bowe! Our "contemptible little army" was in position as arranged, "aligned" on the left of the French Army. A fateful decision! Haldane himself may have had misgiving. Lord Beaverbrook in "Politicians and the War" asserts that Haldane was not in favour of the dispatch of the Expeditionary Force to France; but evidence to the contrary is produced in the earlier volume of this biography.

After the War, Haldane was impressed by the need for co-operation between navy, army and air force and worked in this cause, especially during his second period of office as Lord Chancellor. Ramsay MacDonald's first offer (December 23, 1923) was the Education Office. In accepting the Lord Chancellors'hip, Haldane insisted on relinquishing part of the legal work in order to become chairman of the Committee of Imperial Defence. In a note written in 1925 he states: "I was convinced, and am convinced that the military advice given me was right and that our military problem in 1914 was to send the largest possible expeditionary force to support the French in the shortest possible time. For that I prepared". In a biography written by a distinguished soldier, we should have expected a full, expert, impartial examination of this question.

So much for Haldane as a strategist. Of his later educational work, some information is given. Haldane became president of Birkbeck College and of the Institute of Adult Education. In 1919, he reopened with the Minister of Education (Mr. Fisher) the question of the Bloomsbury site

for the University of London. The offer of the site by the Government was an inept bungle. Haldane's road to the Valhalla of educationists was paved with good intentions, especially in relation to the University of London. He survived to see the site secured for the University by other men and methods. A quotation is given from Haldane's address on November 9, 1920, to the 'Old Students' Association of the Royal College of Science: "From this it will be seen", the author comments, "that he conceived of the University [of London] as constituting a union of colleges and of its future as depending in the main on the development of those colleges". This may be true of 1920; but was not the conception of the University for which Haldane pleaded eloquently in supporting the Bill of 1898 re-constituting the University as a 'teaching' university. "Professor Huxley was a distinguished advocate of the Bill", Haldane said in the House of Commons, "and gave evidence before the Royal Commission in which he laid down a scheme for a university which is now practically embodied in this Bill". 'Unify without fettering' was Huxley's slogan to define the relations of the University to its affiliated colleges. Supplementing the work of the colleges, he wished to see appropriate appliances for study and research, supplying London "with the analogue of the *École des hautes Études* and the *Collège de France* and the laboratories with the *Professor Extraordinarius* and *Privat Doctores* of the German Universities".

The author reveals that Haldane was "the prime mover in the institution of the University Grants Committee which now distributes more than £2,000,000 annually to the Universities of Great Britain". This committee, appointed by *stat* of the Chancellor of the Exchequer, is a constitutional anomaly, for the Board of Education under the Act of 1899 is "charged with the superintendence of matters relating to education in England and Wales". In his book "Politics from Inside", Sir Austen Chamberlain records that Haldane in 1912 talked to him about the administration of the university grants. "He is trying to get them put under the Board of Education which he says has now been reorganised and has an admirable University branch through which he says they would obtain much larger grants". Chamberlain strongly opposed this suggestion. "I have always feared that the Board of Education would seek to impose their views on what ought to be taught upon the Universities and would stereotype the University courses: whereas the Treasury not being in this matter a department of specialists, was content merely to ascertain that the work carried on was of a University standard and that certain other necessary financial conditions were

observed". If, as we are assured, "every university in the Kingdom should remember him gratefully as the prime mover in the institution of the University Grants Committee", we may also be assured that every university will be grateful that his earlier suggestion of 1912 was not adopted.

Further, "every research student [should remember Haldane gratefully] as the instigator of the system of grants now distributed annually by the Department of Scientific and Industrial Research". This Department, established in 1915 as a War measure, should have been established before the War and Haldane was in a good position to put forward the suggestion. If Haldane was concerned with its establishment, the news is not surprising and redounds to his credit.

A few words may be added on Haldane as philosopher. Chapter v entitled "The Age of Relativity" is devoted largely to this subject. Haldane's first philosophical work was entitled "The Pathway to Reality". In May 1921, his "Reign of Relativity" was published, three editions being required in ten weeks, apart from translations into German, French and Russian. This book went far beyond the physical theory of relativity. The third book of the trilogy, "The Philosophy of Humanism", was based on his Donaldson Lectures at Trinity College, Dublin.

His wide-flung search for reality brought him back to his own mind. "The real . . . is akin in its nature to our own minds, and it is not terrifying". In Emily Brontë's words:

O God within my breast
Almighty ever present Deity!

In triumph or tribulation, Haldane was comforted by his sense of divine immanence.

This book does not solve the enigma of Haldane. Must it be that the pathway to reality will never be trodden by an Englishman? Dr. McNair Wilson, a Scot, in his book "Doctor's Progress" makes some illuminating comments. He says of Haldane: "What interested me most however was the strong Scottish flavour of his mind. He was a Scot with all the weakness as well as all the strength of his people. Vain as only Scotsmen are vain; humble as only Scotsmen are humble. Proud and touchy, too, as only Scotsmen are proud and touchy". Possibly, he adds, men of his race never understand the English. "I am sure that the English never really understand the Scotch". One thing the Englishman will claim—the *wish* to understand a great man who "devoted his life to the advancement and application of knowledge" and "rendered invaluable aid to his country in her time of direst need". T. L. H.

Malayan Medicine

A Dictionary of Malayan Medicine

By John D. Gimlette. Edited and completed by H. W. Thomson. Pp. xvi + 260. (London, New York and Toronto: Oxford University Press, 1939.) 7s. 6d. net.

THIS dictionary has been prepared by one of the very few officers of the Malayan medical service who has regarded the study of native medicine as anything but time wasted on effete superstitions. Nor, in fact, are the modern hospitals of the western States of Malaya a proper environment for such studies, workers in them being insulated from the native atmosphere and fully employed in the study of modern medicine and surgery.

John Gimlette had the fortune to follow his profession in the medieval atmosphere of a delightful State remote until lately from high-roads and railways. To enjoy life in such surroundings, to keep the mind alert and to win the confidence of patients assured of the efficacy of time-honoured herbal remedies and by religion opposed to surgery, a medical man must have qualities of sympathy

and understanding and be interested and intelligent enough to adapt to modern ends means on the surface unpromising. John Gimlette was such a man, and if Kelantan was fortunate to get such a doctor, he too was fortunate to discover his life's work in such congenial surroundings. Kelantan inspired his "Malay Poisons and Charm Cures", which has run into three editions, and now this "Dictionary", which has been the labour and solace of his last years, when he was crippled as a consequence of the practice of his profession. He died before it was completed, and the book was finished and seen through the press by Mr. H. W. Thomson, formerly of the Malayan Civil Service. Anyone who has ever written a dictionary will appreciate the labour and care Mr. Thomson has given to his task.

The dictionary will be invaluable as a work of reference for practitioners in Malay districts. For beginners, indeed, it is too elaborate and they will scarcely find the wood for the trees. They will, for example, have to know that before every plant name the Malay prefixes the word *pokok* "plant" or *dahan* "leaf" and that *farum*, for example, without

the word *pokot* means 'a needle' and nothing else. The dictionary includes not only the names of herbs, but also the names of parts of the body, of diseases, of magical and other medicinal treatments. A classified index has been provided by Mr. Thomson as some guide to those who may feel the need of an English-Malay dictionary.

The information under many of the headings like *kemenyan*, 'benzoin'; *ma'ajun*, 'electuary'; *jintan*, 'cumin' is encyclopædic; and the lexicographer gives some comparative data from Arabian and Indian medicine, but this line of inquiry especially in the field of Indian remedies could be much further extended. Oddly enough, Dr. Gimlette seems never to have read or heard of a translation by a Kelantan Malay of a medical treatise very popular with Indian Sunnis, the "*Mujarrabat-i Dirbi*", but as with his usual modesty he admits he had "only a practical and

general knowledge of the Malay language", it is amazing that with that limitation he has produced two works of outstanding merit and permanent value. That such a work could be achieved by one who did not profess to be an expert linguist should be an inspiration to others, and one may hope to see some medical officer ready now to take up the study of the many manuscript and lithographed works that exist on Malay medicine.

No more appropriate subject could be found for a thesis or book by one of the Malays who have graduated from the Medical College, Singapore. There are numerous works on Indian medicine to hand for comparative purposes. More and more, research is discovering the debt that Malaysian culture owed to India both in the Hindu and Islamic periods, but of its debt in the field of medicine, which must have been very great, no study has yet been made. R. O. WINSTEDT.

Physical Science of Glass

The Properties of Glass

By George W. Morey. (American Chemical Society Monograph Series, No. 77.) Pp. 572. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1938.) 62s. 6d. net.

THE glass industry both in England and in the United States is to-day going ahead fast, a pleasing state of affairs which is believed to be due largely to the awakened realization that the soundest foundation for a strong industry is the understanding of its fundamental scientific principles.

The monograph under notice was commenced so far back as 1924 and began with two series of researches to provide necessary information for it, which was then lacking. It has thus been fourteen years in preparation. The literature quoted contains 781 references, of which 399, constituting more than half the total, refer to papers published since 1924; a statement which affords proof that the subject as it is to-day, treated with the aid of physical chemistry and based on physical properties as functions of composition, is largely new.

The result of all this work is an eminently scholarly and exhaustive monograph which is bound to be of immense value to the wide circle who have to do in some way or other with glass. The author's expert knowledge has enabled him to sort the wheat from the chaff in regard to the reliability of much of the information in the literature.

After some introductory sections, in which the history, definition and composition of glass are

dealt with, the succeeding chapters, numbering sixteen in all, deal in turn with the various physical properties. Each is a veritable mine of information relating composition to a particular property. The chapters contain numerous tables, phase diagrams and a certain amount of mathematics with, of course, references to the original papers, which are conveniently arranged for quick reference in the old-fashioned way. There is a comprehensive index at the foot of each page.

The author early gives a definition of glass which is worth citing as showing the attitude of science towards it: "A glass is an inorganic substance in a condition which is continuous with, and analogous to, the liquid state of that substance, but which, as the result of having been cooled from a fused condition, has attained so high a degree of viscosity as to be for all practical purposes rigid."

The relation between composition and temperature with reference to the melting and crystallizing process in mixtures containing several components is nowadays compactly expressed by means of phase equilibrium diagrams which, to the competent, give a great deal of information. The word 'competent' is very necessary, for some of the diagrams are of extraordinary complexity; we commend particularly to the attention of followers of the phase rule since the early days of Willard Gibbs and van't Hoff, who used it to work out the formation of the Stassfurt salt deposits, the sketch of the solid model of the ternary system: Na_2SiO_3 — $\text{CaO} \cdot \text{SiO}_2$ — SiO_2 . This chapter,

entitled "Devitrification", affords an illustration of the progress which is being made in solving these abstruse problems with the aid of the phase rule; similar problems which concern the mixture of silicates present in igneous rocks are being studied in like manner and with remarkable success at the Geophysical Laboratory in Washington.

To many, the chapter on optical properties will be found of special interest; optical glass has been recognized as one of the key materials of civilization and an essential munition. Lens designers, who demand varying relations between refractive index and dispersion, have caused a wide search for suitable glass compositions, which has in turn led to the production of highly specialized glasses—

for example, those which are transparent to X-rays and ultra-violet light, or conversely which are opaque to these wave-lengths: both are now articles of commerce. There can also be obtained coloured glasses which are opaque to all but a narrow spectral range. It is most convenient to have the data in regard to the action of glass on light collected in one chapter, and the extent of the information may be judged from the fact that no fewer than thirty-six optical glasses manufactured by Chance Brothers are listed with their optical properties and approximate composition.

The examples selected indicate the remarkable thoroughness of the book, which is well worth even the high price charged for it.

Experimental Psychology

Experimental Psychology

By Robert S. Woodworth. Pp. xi + 889. (London: Methuen and Co., Ltd., 1938.) 18s. net.

TWENTY years ago it was still possible to get the main results of the application of experiment to the problems of psychology within a reasonably small volume, and several excellent text-books were produced for that time. The rapid increase in the amount of published experimental work has made all such books out of date, and the teacher of experimental psychology has been forced to use seriously incomplete text-books and to supplement them in his teaching by his own knowledge of the technical journals. The task of making a single volume representative of the present position of experimental psychology seemed too laborious for accomplishment. This, however, has now been done by Prof. R. S. Woodworth, and his book will be welcomed by all students of the subject.

Prof. Woodworth has good qualifications for this task. It is particularly fortunate that he is free from a common tendency amongst psychologists to work under the banner of some particular school and to evaluate all work from the point of view of that school. The author's freedom from such fads enables him to deal fairly with experimental investigations of many different types and to recognize valuable work whether it is done by behaviourists or by *Gestalt* psychologists. At the same time, this catholicity of choice does not involve an absence of critical judgment. Few things can be duller than psychological volumes which are mere records of published researches, good, bad and indifferent. Prof. Woodworth seems to have used as his criterion for the inclusion of any piece of experimental work the fact that it

makes a genuine contribution to the understanding of some psychological problem, and the general correctness of his judgment on this matter makes his book both useful and interesting.

If we treat the book as a survey of the present position of experimental psychology, we can find in it causes for satisfaction and a good many for dissatisfaction. This book should be a complete answer to those who complain that in the years since experimental psychology developed, nothing has been found out in psychological laboratories. There is, nevertheless, still much conflict about simple matters of fact, which is a result of the inconclusiveness of many published researches. Many experiments are carried out on too few subjects and with insufficient regard for the necessities of experimental design and of the statistical treatment of results. Very commonly the raw data from which the experimenter draws his conclusions are not published, so that no one else can ever determine how well justified his conclusions are. It is, for example, surprising to find in this book how many of the results of quantitative experiments are given as percentages without any indication of the actual numbers from which they have been derived. The methods of design and report of many experiments seem indeed to have been devised for the purpose of making it certain that no intelligible conclusion shall ever be drawn from them.

This, however, is a matter that is improving and it is to be hoped that severer standards in devising experiments and reporting their results will much lighten the task of a psychologist who, ten years hence, may try to make a new survey of the complete field of experimental achievement in psychology.

R. H. THOMLESS.

A Text-Book of Inorganic Chemistry

Edited by Dr. J. Newton Friend. Vol. 6, Part 4: Arsenic. By Reece H. Vallance. Pp. xxxi+351. (London: Charles Griffin and Co., Ltd., 1938.) 25s. net.

THIS volume of a well-known text-book deals fully with the inorganic chemistry of arsenic. A special feature is the detailed description of the industrial preparation and uses of the various arsenic compounds. In most cases, sufficient detail is given of the experimental methods to make it possible to repeat them in the laboratory, a notable case being the preparation of arsenic hydride. The information is critically presented and is up to date. Very full references to the literature are given, and very few, if any, important papers can have been missed. The physico-chemical aspect is well represented, as, for example, in the very clear account of the rather difficult subject of the forms of arsenious oxide. The section on analysis is brief but full of useful information.

The volume shares with its companions the valuable feature of being equally suitable for reading by advanced students and as a work of reference. It speaks highly for the skill of the author that he has achieved this result, and the volume is one which should be in every chemical library. The editor announces in the preface that the original scheme of the whole work is now complete and that a new edition is in preparation in which, where the amount of new work justifies it, a separate book will be devoted to each element.

Electron and Nuclear Physics

By Prof. J. Barton Hoag. Second edition of "Electron Physics". Pp. x+502. (London: Chapman and Hall, Ltd., 1938.) 20s. net.

THIS is the second edition of the well-known "Electron Physics", which appeared in 1929. It is a remarkably up-to-date summary of the experimental aspects of atomic physics, with a bare minimum of the essential theory. Descriptions are given of nearly forty experiments which are suggested as suitable laboratory exercises; perhaps the most ambitious of these is an experiment on the disintegration of lithium by 50-70 kilovolt protons. It is obviously not the author's intention that any one student should work through the whole of the experiments, but there are very few students who could not learn a great deal by merely reading the detailed instructions and working out some of the numerical problems in this book. The text abounds in valuable practical hints, and in addition there are four special chapters on laboratory techniques (including high-vacuum, small-current, counter and high-voltage practice).

The text suffers frequently in elegance, and occasionally in clarity, from the concentration of so much matter into so small a bulk. This is, however, a most valuable book for the young physicist, and the reader is left with the impression that the physics students of the University of Chicago are singularly fortunate in the enthusiasm of their teachers and the equipment of their laboratories.

H. R. R.

The Statesman's Year-Book

Statistical and Historical Annual of the States of the World for the Year 1939. Edited by Dr. M. Epstein. Seventy-sixth annual Publication: Revised after Official Returns. Pp. xxxviii+1508. (London: Macmillan and Co., Ltd., 1939.) 20s. net.

THIS indispensable statistical survey of the world follows its customary arrangement and once again in some fifteen hundred pages records an amazing array of facts. The British Empire and the United States fill the first two parts of the book, while the remainder—about one half in actual pages—is occupied by other States arranged in alphabetical order. As a rule the book is revised to March in the year of publication and so two European States appear as independent which have since lost that status. The careful revision of statistics from official sources gives this volume an authoritative standing which should make it invaluable in these days when world affairs are much in discussion and factual information is most desirable. Lists of official and unofficial books dealing with each State are a most useful aspect of the volume. There are coloured maps of Central Europe and of the country traversed by the remarkable Burma-China road between Lashio and Chung-king.

Concise School Physics

Electricity and Magnetism. By R. G. Shackel. Pp. viii+467-661. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1938.) 2s. 9d.

THIS is the third and final part of "A Concise School Physics", which is also available in a single volume. It carries the story well up to matriculation stage and contains 144 pages of copiously illustrated descriptive matter, about 34 pages of questions and answers, and four of mathematical tables. The general treatment follows good conventional practice and the writing is very condensed, so that the book reads like copious notes of excellent lectures supported by adequate laboratory work. The author, avoiding educational fads, has obviously striven to make his difficult story as straightforward as possible for beginners. The book is amazingly cheap at the price and it should prove very useful in class work which is being directed by a capable teacher.

Introduction to Physiological Chemistry

By Dr. Meyer Bodansky. Fourth edition. Pp. ix+686. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 20s. net.

Laboratory Manual of Physiological Chemistry

By Prof. Meyer Bodansky and Prof. Marion Fay. Fourth edition. Pp. vii+295. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 10s. net.

PROF. BODANSKY undoubtedly has a flair for writing students' text-books. These two volumes form a pair—theory and practical—suitable for senior medical students or for those taking degree courses in biochemistry or physiology. Both works are now in their fourth edition and are exceptionally good.

J. C. D.

Aeroplane Controls*

By Prof. G. T. R. Hill, University College, London

MAN imposes his will on a machine by the use of a control. We are all familiar in a general way with the kind of control by which many of the machines which transport us from place to place are guided; the most recently arrived means of transport, the aeroplane, has controls which are much more complicated in their effects than we find with earth-bound transportation. The vastly greater possibilities of movement possessed by the aeroplane can be stated with greater precision if we consider the number of degrees of freedom it possesses, and then compare it with trains, cars or ships.

A train or tram running on a straight length of line has but one degree of freedom; it can only move along the line and it needs only a single control—that of speed. It is true that this speed control is usually shared between two controls, one of which is responsible for increase of speed and the other for decrease; but, as on a tram, these may be combined in one handle and are essentially one control. A car has three degrees of freedom, if we consider it when travelling in a wide smooth desert; it can move forwards, under certain conditions it may be skidded sideways, and it can be steered so that it turns about a vertical axis. The same limitations apply to a ship, if we think of a calm sea. In these two cases we find that two separate types of control are required—the speed control, which may be sub-divided as before, and the steering for controlling the direction about the vertical axis.

Coming now to the aeroplane, we find no less than six degrees of freedom. The aeroplane can move forwards, sideways and upwards, and rotate about three axes at right-angles to each other, that is to say, it can pitch, roll, and yaw.

We do not provide direct controls for each of these degrees of freedom any more than we do on a car or ship. The skidding or sideways motion of a car is controlled by special combinations of two controls, the steering and the speed. On an aeroplane four controls of the motion are provided; we control the three rotations and, in addition, the power of the engine by means of the throttle. This last control alters the thrust of the propeller, and on all modern types of aeroplane an air brake is provided which gives negative thrust, so that throttle and airbrake are essentially one control, similar in nature to the speed control on the tram.

Unfortunately, the three rotations are not usually each controlled by a simple movement of one control. Pitching by the use of the elevator is nearly independent of the other motions, but a turn is much more complicated, as it requires a proper combination of rolling and yawing and, on a steep turn, of pitching as well; not only this, but also the motion of pure rolling requires the application of both ailerons and rudder in due proportion, and so does the motion of pure yawing.

Coming now to the indirect control of vertical and lateral motion, we find that a pitching rotation changes the lift on the aeroplane and thus a rise or fall is obtained, though this is of course necessarily accompanied by the pitching rotation; in other words, it is not a simple motion in a given direction. Lateral motion, or sideslip, is produced by a special combination of aileron and rudder control, and with big sideslip the elevator control comes in as well.

The control of an aeroplane thus differs from that of a car or ship primarily in the fact that a much greater variety of motions is possible, and, further, to produce many of the simple motions a certain combination of various controls is needed.

We come now to a discussion of the relation between the movements of the pilot's hands and feet and the resulting motion of the aeroplane. There are three simple kinds of control which may be used; we may have a control of position, or a control of velocity, or a control of acceleration. To give everyday examples, the act of lifting a glass from the table to the lips is a direct control by the hand of the position of the glass; the rotation of the steering wheel of a car is a control of the rate at which the car turns, that is, of its angular velocity, and the pressure on the brake pedal is a control of its acceleration, in the negative sense. Each of these types of control is a reasonable one, though simple experiments performed with beams of light moved successively by the three types of control indicate that the position control is the easiest to manage and the acceleration the least easy.

However, it seems probable that real difficulty arises when a control changes its type with time. Take, for example, the aeroplane elevator control; if the stick is pulled back a little and held there, the first thing that happens is that the aeroplane has imposed upon it an angular acceleration in pitch; this falls away very rapidly, and leaves the aeroplane with a certain angular velocity, and

* From a Friday evening discourse delivered at the Royal Institution on February 17.

ultimately this dies away and the position of the stick controls the attitude and forward speed of the aeroplane.

These considerations lead us directly to a discussion of what qualities in a control are responsible for its being described as *pleasant*. I hold that we should go to great lengths to give pilots the easiest and most pleasant controls that we possibly can, so that by relieving their minds and bodies from all avoidable strain, they may be able to concentrate more fully and effectively on their other duties. A pilot coming to fly an aeroplane which is good on the controls will learn to fly it in the shortest possible time, undoubtedly a matter of tremendous importance in these days; when he knows it well he will love to fly it and will feel at one with his machine, and surely he and his mount will be a more effective combination for either peace or war than the pilot with poor controls, disgruntled, tired and at odds with his craft.

If we are agreed that it is worth while devoting time to a study of the characteristics of a pleasant control, we must admit straight away that while a test pilot, for example, has a very clear idea when he flies a new aeroplane as to whether the control is pleasant or not, he is in great difficulty in defining the quality he observes. While the pilot may describe the control as light, firm, crisp or free from lag, the designer always wants to know *how* light, *how* firm, and so on; in other words, he wants a definite answer in figures, and for all practical purposes so far he has been unable to get any figures which he can interpret usefully.

We are now entering upon dangerous ground, for in addition to studying the characteristics of the aeroplane we have to link up with those sensations that pilots like and dislike; the ancients thousands of years ago were well aware of the perils of attempting to argue about personal taste, but my view is that it is the greatest possible mistake to let this frighten us off the field, and aeronautical research should grapple boldly with these problems, even though they have been aptly described as being "not quite aerodynamics".

Experimental work is now in progress in Great Britain from which it is hoped that a foundation will emerge on which the designer may build up the control qualities of his new design with much greater precision and confidence than is possible to-day. An attempt will be made to codify a pilot's likes and dislikes, not only in general terms but also on a quantitative basis.

The ultimate object of the use of the controls of the aeroplane is to produce the flight path which the pilot desires, and in any quantitative study it is no good measuring the forces and couples which the controls apply without a knowledge of what has to be overcome by those forces and couples.

The functions of the controls may be regarded as four-fold, namely: (i) maintaining balance, or trim, in steady straight or curved flight; (ii) overcoming inertia when starting and ending a manoeuvre; (iii) overcoming air damping, which usually resists motion, but in some important cases assists it in an undesirable way; (iv) overriding the natural stability or instability of the aeroplane.

The first function is well understood, because it is relatively simple to analyse steady flight conditions, and it is fairly easy to make measurements; both on models and also in flight, where there is plenty of time available for taking readings.

The second function of the controls concerns the relation of their power to the inertia of the aeroplane, and the effect of inertia depends of course on the rate at which manoeuvres are carried out, and on absolute size, or size relative to the pilot, whose size is constant. These effects are familiar if we think for a moment of ships of different sizes and study their manoeuvres. Small yachts turn quicker than large ones, and yachts turn about as quickly as aeroplanes of the same size, though of course the forward speeds of the aeroplanes are something like thirty or forty times as great.

It is not, however, in the steady rates of turn, but in the entering and checking of the turn that inertia shows its effect, and although large craft turn slower, inertia effects are greater than on small craft. On a liner, for example, it may take nearly half a minute to check the swing by reversing the helm on a steady turn, and it is this great time lag in the control which makes the operation of bringing a large liner alongside a quay under its own power a very tricky operation. A lag of even as little as a tenth of a second can be noticed in an aeroplane control, and bearing in mind that most aeroplanes have to be brought into relatively gentle contact with the ground at the end of each flight at speeds of the order of sixty miles an hour, lags of much more than a tenth of a second are quite unacceptable to the aeroplane pilot.

The third function of the controls, the overcoming of the damping of the fixed surfaces of wing, tail, etc., provides the general guide to the power required from the control organs; thus the movable elevator, which causes pitching, may be about half the size of the fixed tailplane, which resists or damps pitching motion. Proportions such as this have been reached as the result of long experience, but the harmonizing of the three controls, elevator, ailerons and rudder, still gives rise to a great deal of experiment of the hit-and-miss variety on new types, before they can be regarded as satisfactory.

Then finally, there is the relation of the natural or inherent stability, or instability, of the aeroplane to the power of the controls. I propose to illustrate this point by a homely example. In the case of a cyclist riding at a good speed, so long as his craft is endowed with good stability by virtue of its speed, the control movements of his handlebars are very small, but as the speed falls, so he has to work harder and harder in moving his handlebars more and more violently from side to side, until at last his fullest powers of control are inadequate and he crashes. Now this has a close parallel in the air, where stability deteriorates as the speed falls, just as on the bicycle, and it is always for the slow end of the speed range of the aeroplane that it is difficult to provide adequate control surfaces, particularly when it is borne in mind that these surfaces must also be capable of operation at the high-speed end of the speed range.

It is not possible to discuss questions of stability here in detail, but the intimate connexion which must always exist between stability and control can never, in my opinion, be too strongly emphasized.

This brings my discussion of the general considerations surrounding control problems to a close, and I would now like to refer to the results of some new experimental work and their bearing upon particular difficulties which have arisen from the great increase in performance of aeroplanes in recent years.

The trim and stability of a glider, or of an aeroplane gliding with its engine shut off, present no great difficulties to the experienced designer. When the aeroplane is flying under power, the slip-stream from the propeller passes first over the wing and later over the tail-plane, changing the air forces on any surface with which it comes into contact. Experiments with models show that the slip-stream from each propeller, by the time it has reached the tail-plane of a representative modern type of twin-engined aeroplane, has a nearly flat under-surface. This provides an explanation of why two different types of aeroplane, which may look very similar, behave quite differently in flight. In one case it may be that the tail-plane is below the bottom of the slip-stream, and thus experiences only the air pressures arising from the normal speed of the aeroplane through the air; in the other case, with the tail-plane just in the slip-stream, the air forces may be more than twice as great and the upsetting effect of this on fore and aft balance, or trim, is obvious.

The sizes and speeds of aeroplanes are rapidly increasing as the years go on, and the reason that the aeroplane pilot has not yet found salvation in a power-assisted, or servo, control is to be found in the danger involved if there is lag in the

mechanism. The very minute degree of lag which is tolerable has already been referred to, and by a continuous exploitation of the possibility of aerodynamic balancing of the control surfaces, it has, up till now, been possible on even the biggest types to avoid the need for a servo-mechanism at all. But yet closer aerodynamic balancing will be needed in the future, and a new system has recently been invented by several people in different countries almost simultaneously.

The control flap has its hinge situated well behind the leading edge in the familiar way, but that part of the surface in front of the hinge is entirely shrouded by curtains formed by extensions of the top and bottom surfaces of the main wing, extending back almost to the hinge, with a small gap or vent at top and bottom between their extremities and the moving control surface. The front part of this surface thus works in a kind of box, and the pressure on top of it is controlled by the air pressure existing outside the wing at the position of the top vent, and similarly for the under side; the essential point is that the box is divided into two parts, sealed from each other by



Fig. 1.

the nose of the control surface, which touches at all points in its travel the curved back of the main wing (Fig. 1). The absence of any air flow through the gap which usually exists between control surface and wing is found to avoid the undesirable pressure changes which usually arise on the nose of the control surface as it moves, thus spoiling the balancing over anything but a small angular range. Irving, of the National Physical Laboratory, has been one of the co-inventors, and the results of his first experiments are most promising.

Another development which, like the tricycle undercarriage, is a revival of an old idea and goes back, to my knowledge, to 1904, when it was embodied by the Wrights in one of their patents, is what is known as the *two-control system*. The standard system of to-day, with the three controls, elevator, aileron and rudder, is universal in all countries; at various times attempts have been made to abolish either the ailerons or the rudders. It seems, however, impossible in the light of modern knowledge to design an aeroplane which can carry out perfect turns at all speeds with either a rudder only or ailerons only, and an interesting new arrangement is being tried by a well-known American aeronautical engineer, Weick, of the Engineering and Research Corporation, of

Washington, D.C. Weick connects up both the ailerons and the rudder to a single control wheel, the rotation of which operates them both in a pre-arranged proportion. By this means it is possible to make nearly perfect turns at one speed and very satisfactory turns at all speeds. Encouraging results have attended the early trial flights, in which an experienced test pilot observed that he got smoother riding in bumpy weather with the two-control system than with the standard three controls. If the early promise of this experiment

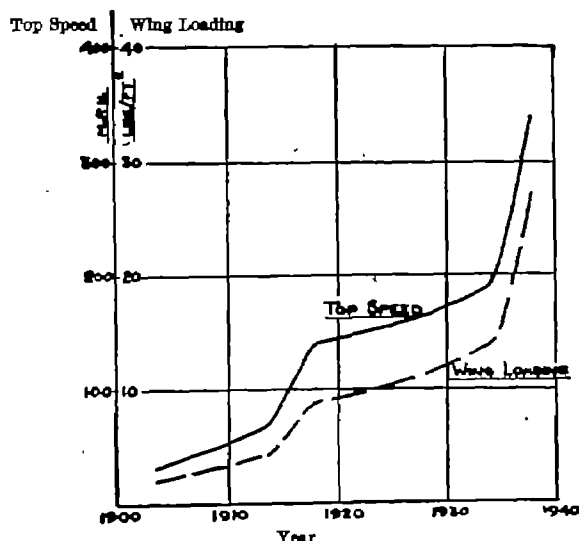


Fig. 2.

is fulfilled, a real advance in simplification of control will have been made, and with the increasing complication of everything connected with the aeroplane, a fundamental step in the opposite direction, such as that proposed by Weick, will be most refreshing to the hard-pressed pilot.

In order to minimize the very real danger of the first test flights on large new types, there is a procedure which has been adopted, notably by

one firm in Great Britain, Messrs. Short Brothers, which consists of building a *flying model* of the large aeroplane. This flying model may be something like half the size of the projected type, and its weight would then be only one-eighth; the control forces are in that case reduced to one sixteenth, and the pilot thus has no difficulty in managing his model. It is of course far quicker and cheaper to modify the model to correct any faults in trim and stability, and it is possible to ensure that the control forces on the full-size aeroplane are within the capacity of the pilot's strength. Then minor modifications should suffice to harmonize the controls and achieve the high standard which we know is possible of attainment.

The large types built by Shorts, just referred to, are the "Empire Boats" and their Service counterparts the "Singapore", and the flying model was known as the "Sealion Senior". Although this latter type was fitted with floats, nevertheless the wings and tail, including all control surfaces, were used as the basis for the design of its larger counterpart; the flying model must take its fair share of credit for the remarkable ease of handling in the air which is characteristic of these fine boats.

The thought may perhaps arise that I am exaggerating the importance of the role taken by stability, and particularly by control, in the advance of the science and art of flight. I have prepared a diagram (Fig. 2) showing the rise in speed, the common criterion for judging progress, and also in wing loading, showing what has been accomplished in the last thirty-five years. It will be seen how speed and wing loading have risen together in such a way that it is impossible to dissociate one from the other, and I hold that it is only through improvement in stability and control that we can now attain the speeds we do by flying safely with wing loadings twenty and thirty times as great as those of the most famous aeroplane of all time—that in which the Wrights made their first flights in 1903.

The Ordnance Geological Survey: Its First Memoir, 1839

By Dr. F. J. North, National Museum of Wales, Cardiff

IN the spring of 1839, R. A. C. Godwin-Austen commenced a letter to H. T. de la Beche with the following words: "I am not much in the habit of buttering my friends, but in the present instance you must not complain at being compelled to pay for a shillings-worth of that commodity". (A shilling was the postage charge for a letter from Newton Abbot to Swansea.) The writer then described his efforts to secure a copy of de la

Beche's "Report", and continued, "I read it before dinner and after: I dipped in it with my tea, and went on devouring it until the 'dead hour'. I was at it again this morning. . . ."

The reference was to the "Report on the Geology of Cornwall, Devon, and West Somerset"—the first volume to be published on behalf of the newly founded Ordnance Geological Survey. It was de la Beche's own idea to supplement the

maps by descriptive memoirs, and Colonel Colby (superintendent of the Trigonometrical Survey) had stipulated that "Mr. de la Beche shall undertake and at his own cost and risk, to publish all these . . . Geological Sections, Memoirs and other matters which may be necessary to illustrate the use of the map, where geologically coloured", but, as shown in a previous note¹, de la Beche had his own way of dealing with the authorities, and the report was eventually published "By order of the Lords Commissioners of Her Majesty's Treasury".

The present note relates to a controversy that arose while the report was being prepared, and by reason of which the work of the Ordnance Geological Survey nearly came to an untimely end.

When de la Beche was surveying in Cornwall, he received a letter which greatly disturbed him. "I am sorry," wrote Colby, "to have to tell you that extremely unpleasant reports of the inaccuracy of your Geological Survey are in circulation, and have got into quarters where the want of geological information renders it difficult to rebut them. . . . Who is the author of these reports I cannot ascertain, but they can only be effectively met by bringing the work forward and shewing its utility. . . . The Government feel that they have paid for a portion of work, which is not before the public, and when the work is impugned they dread their responsibility."

De la Beche lost no time in replying, and his letter contained these paragraphs: "The reports in question arose out of a paper by Messrs. Sedgwick and Murchison, read before the British Association held at Bristol, in which they differed from a copy of the Ordnance Geological Map of North Devon, with which Gardner inadvertently furnished one of these gentlemen, such map being unpublished at the time. . . . The indecent attack . . . the cause of all the present reports, was therefore made without giving me any notice of the subject, and while the Geological Map of N. Devon and the Report were still unpublished. . . . By your kind letter, my dear sir, it is but too clear that I have personal enemies, and unfortunately it is equally clear that they are actively employed against me. While I toil day after day without rest, endeavouring to do my duty to the public, and to return zeal and the best use I can make of my abilities for the confidence reposed in me, they can, and as it appears do, buzz their accusations about, not neglecting the quarters where they conceive they can do me the most mischief, so that do what I will I have no chance."

From Colby's letter and de la Beche's reply it might appear that Sedgwick and Murchison were the instigators of an attack on de la Beche and

that the campaign had been carried out of the geological debating room, where it really belonged, to official circles, where it was calculated to jeopardize the continuation of the Survey. Actually, however, the matter provides an excellent illustration of how misunderstandings arise, and how serious they may become if one of the protagonists is inclined to interpret honest criticism as a personal attack.

As an example of the news that de la Beche was getting, we may take this letter (from a person whose writing I have not yet identified): "I heard from various quarters some time ago that they were persecuting you, and suspected that Lyell and Murchison were at the bottom of it. I went to Greenough to ask him. He told me you were safe, but that Spring Rice [that is, the Chancellor of the Exchequer] had been informed of the truth, and that you would be well looked after. . . ."

George Bellas Greenough, who was president of the Geological Society in 1834 when the first geological maps of Devonshire were published, seems to have done all in his power to smooth away the difficulties, and persuaded de la Beche not, as he was at first inclined, to resign his appointment, pointing out that Colby's letter had very likely "made us more apprehensive of mischief than there is any occasion for".

The bone of contention was that de la Beche had regarded the Culm deposits of Devon—rocks which contain layers of anthracite-like coal, and fossil plants like those of the coal measures—as a member of the 'Greywacke' series, which in other areas was known to underlie, and, therefore, to be much older than the Carboniferous strata.

Finding that the Culm beds seemed to pass downwards without interruption into the undoubtedly older rocks beneath, de la Beche argued that the presence, in the Culm, of plants like those in the coal measures, did not mean that the rocks were contemporaneous with the coal measures, but that the coal-measure plants came into existence much earlier than some geologists supposed, and when he stated as much in his "Geological Manual", published in 1832, Murchison contested the view, and offered to help him to re-write the relevant chapter. He knew, therefore, that Murchison, at least, did not agree with him.

Two years later, de la Beche re-affirmed his views in a communication to the Geological Society, when he was again criticized by Murchison. "You will have heard from Greenough," wrote Edward Turner, the secretary, "how your discovery of coal and its fossils in the greywacke was last Wednesday turned topsy turvy without scruple. . . . Murchison, in fact, said that he had never seen the country, but would nevertheless take upon himself to affirm, so identical were

the fossils with those of the ordinary coal fossils, that your coal also belonged to the Carboniferous beds. . . . Murchison clearly thinks it impossible for the fossils of the carboniferous coal field to occur below his Dudley (that is, Silurian) beds".

Sedgwick, at this period, agreed with de la Beche, and wrote that he had always supposed the Devon anthracite to be in the Greywacke, and was not surprised to learn that the plants were identical with coal-measure fossils. He concluded by saying: "The fossillogists are going Mad. The foundation of our Conclusions . . . must ever rest on the evidence of superposition, given by actual sections. Our friend Murchison has examined an astonishingly fine series of upper fossiliferous greywacke, and finding no coal plants in it, resolved in his own mind that the said plants should not be found in it anywhere else."

The note read at the meeting of the British Association was followed up by a paper read before the Geological Society in 1837, and in the meantime the matter had given rise to much discussion. Lyell, who had succeeded Greenough as president of the Society, had written to de la Beche, asking him to re-consider his position. Among other things he said: "In any district of much disturbed strata the admission of such an anomaly as the identity of the vegetation of two very remote eras on any grounds which were stated seems to me unphilosophical. . . . If you are prepared to say you have changed your mind, pray give me the opportunity of saying it on your authority in my speech."

All this shows that neither Murchison nor Lyell wished to take an unfair advantage of de la Beche; it simply means that they thought he had made a

mistake, and said so in the proper place for such views to be expressed.

Unfortunately, de la Beche was working so far away from London that he had few opportunities for meeting kindred spirits, and he was often, as his letter to Colby suggests, physically tired. Moreover, as the owner of plantations in Jamaica, he had suffered as a result of propaganda connected with the slave trade, which, in the words of Caroline Fox, had given him a "low view of mankind". In the circumstances, it is not surprising that he should have imagined the worst when he received Colby's letter, and learnt that he was being criticized in geological circles.

Although in a half-hearted way de la Beche eventually adopted the identification of the Culm proposed by Sedgwick and Murchison, there are passages in the report which indicate that he was not really convinced that the evidence of fossils could be regarded as determinative, when the field evidence appeared to point to some other conclusion—all of which goes to show the danger of dogmatism when scientific principles are under discussion.

In the controversy to which this note relates, we find doubt being cast upon a principle that Robert Hooke had conceived towards the end of the seventeenth century, that William Smith had enunciated towards the end of the eighteenth, and that is now recognized as the foundation of modern geology: namely, that the assemblage of fossils in a given series of strata is peculiar to rocks of that age, so that strata can be identified by the fossils which they contain.

¹ NATURE, 143, 254-5 (1939). The present note, also, is based upon manuscripts deposited in the National Museum of Wales by the late Colonel J. L. D. Nicholl of Merthyr Mawr.

The Study of Animal Behaviour

THE study of animal behaviour has a long and arduous history. It cannot, however, be claimed that either the scope of the subject, or its methods, have been clearly defined. In interest it ranges from the ecological facts of the interaction of animals and their environments, through the details of life-history and their physiological analysis, on to questions of perception, motivation, learning and adaptive behaviour. Its methods embrace those of the field-worker, those of the physiologist, and those of the psychologist. Its philosophy, again, is in some quarters undefined, in others aggressively, even if vaguely, teleological and organismic, and elsewhere frankly empiricist. With all this diversity, those outside the subject can scarcely regard it as more than a concatenation

of discrete interests and different methods. For the same reason, those within it can scarcely be blamed if their activities cover but a very narrow part of the whole subject. Nevertheless, ever since the turn of the century attempts have been made, in societies and journals abroad, to integrate what is, after all, a distinct, even though very wide, field of scientific exploration.

Great Britain has not been to the fore in this work. Indeed it was only three years ago that a society relating to the subject was founded here for the first time. This society, the Institute for the Study of Animal Behaviour, has as its aims "to promote the study of animal behaviour, to encourage the undertaking of research and the publication of the

results of research in this field", and to carry on any further activities which it may from time to time regard as furthering these objects. It publishes a *Bulletin* which is devoted to reviews of recent advances in the study of animal behaviour, and it also provides research grants to investigators. Occasionally, too, it holds meetings, and it was at one of these meetings, held on June 13 in conjunction with the Zoological Society of London, that Dr. Julian Huxley briefly outlined the aims of the Institute, of which he is president, in the opening remarks to a symposium which dealt with modes of analysis of animal behaviour.

The topics considered in this symposium were perception, motivation, instinct, learning and memory, and in some measure at least the discussion thus emphasized the main compartments of animal psychology. Perception is of primary importance at every level of behaviour. It is the starting point of the responses which animals are constantly making to changes in their immediate surroundings. The methods by which it needs to be analysed are as varied as the forms which it can take. Vision, for example, has to be studied in terms of brightness—discrimination and form and colour perception; and apart from the mere statement of the kind of vision possessed by any given animal, the problem has to be explored from the point of view of the anatomical and physiological mechanisms which subserve these functions—mechanisms which are by no means necessarily the same in different species. Auditory acuity, tactile and thermal sensitivity, to mention just a few other perceptual modalities, each requires its own comprehensive mode of analysis. The particular perceptual problem dealt with at the symposium—insect communication—showed clearly how complicated a process of analysis can be, and how much the perceptual world of one animal may differ from another.

Some insects, as Dr. A. F. Rawdon-Smith pointed out, can discriminate between sounds which differ by a factor other than intensity. Quite clearly they discriminate the quality of a given sound by a process altogether different from human frequency discrimination. For example, a virgin female cricket will react to a telephone that is transmitting the chirruping of a male even when the sound is so distorted as to be unrecognizable to the human ear. Since no insect possesses a cochlea which could subserve harmonic analysis, the only possible basis of discrimination is that different sound qualities produce afferent impulses of different temporal pattern in the auditory nerves. But here, as Dr. Rawdon-Smith explained, a major difficulty is encountered. Owing to the refractory period of the nerve fibres, it is to be expected that they would discriminate only low

frequencies, whereas in fact study of the passage of impulses shows that the auditory receptors of insects are incapable of responding to such frequencies and react only to frequencies of much higher magnitude. The solution to this problem was obtained by means of a carefully designed physiological experiment carried out by Dr. R. J. Pumphrey and Dr. Rawdon-Smith. It was found that the high frequencies given out by stridulating insects are carriers for a low-frequency modulation. High-frequencies themselves have no 'meaning' to insects. Their function is to carry the low-frequency modulation, and it is the latter which characterizes sound to the animal. The mechanism of auditory perception in insects is thus much less akin to that in man than it is to wireless telephony.

Dr. Rawdon-Smith's exposition was an eloquent demonstration of the possibilities of analysis of perception, and of the immense field that awaits exploration. No animal's perceptual world can be regarded *a priori* as being the same as another's. Things which are significant in one world may not be perceived in another, and each perceptual world presents its own problems of organization. The latter have been closely studied, particularly by *Gestalt* psychologists and philosophers, but while the primary issues have at times been obscured by generalities, the actual facts regarding different perceptual worlds in the animal kingdom have always remained the central problem of students working in this field of animal behaviour.

This has not always been the case with animal motivation, for here general issues have frequently obscured definite problems. The study of animal motivation is concerned with the central and peripheral nervous organization which makes response possible, and with the working of this nervous apparatus; with the analysis of other influences, for example hormonal factors, which affect behaviour; and with the definition and measurement of the various 'drives' for the fulfilment of which animals strive. The latter has been a fruitful field of experimental psychological exploration. The investigation of the part played by hormones has also yielded facts of great interest, even though the actual manner in which hormones affect behaviour has not been elucidated as yet. On the other hand, the neurological aspect of the problem has been left mainly in the hands of anatomists and physiologists, in spite of the fact that the fundamental issues of nervous physiology must form the primary facts of a study of behaviour. That they do has, of course, been generally admitted by students of behaviour, but in so far as they have not been immediately concerned in this field of study, animal psychologists have been content to base general theories of behaviour on concepts derived, for example, from the field of

reflex physiology. The rigid 'behaviourism' of Watson was one such general theory. While it did much to organize knowledge of behaviour and to attract attention to the subject, it was far too static in its formulation to survive in the face of a growing volume of facts. Its history, too, exposes the danger of a general theory being so formulated that it does not take into account the possible changing nature of the ideas on which it is based.

This issue was vigorously dealt with by Mr. J. Z. Young, who compared the incorrect conception of a reflex system as something which operates whenever its afferent side is stimulated, with a reflex system in which an afferent impulse becomes effective only when the motor neurons of the system are in a particular state of excitability due to impulses reaching them from other neurons with which they are in synaptic connexion. He went on to consider the importance of the fact that the higher nervous centres are in constant activity. For example, in cephalopods the anatomical arrangements are such that certain combinations of afferent stimuli can set in action self-re-exciting chains of neurons, the continued activity of which facilitates certain pathways. His suggestion is that the setting-up of such activities may constitute the change which takes place in a nervous system during the process of learning. Mr. Young's paper made it perfectly clear that the old analogy of the nervous system as a static telephone exchange which passes on messages to the relevant motor neurons must give way to a conception of an exchange always in active change itself.

Although general theories of behaviour that are based upon neurological concepts may even yet be inadequate, they are much more valuable to animal psychology than discussions as to the reality of concepts such as instinct. Dr. J. A. Loesser's contribution to the symposium, which was substantially the same as an article of his published in *NATURE* of May 27, p. 880, was concerned with this question, and unfortunately his attempt to banish the concept in favour of even less tangible concepts of behaviour cannot be regarded as a successful one. Dr. Loesser's main point is that every organic action represents merely the satisfaction of an impulse, and that in so far as no response of an animal can have any conscious or unconscious relation to self- or race-preservation, it cannot be an instinctive action; therefore there is no such thing as instinct. A hen, for example, does not sit on eggs because she wishes to hatch the next generation of hens, but because sitting on cool curved objects soothes irritating surfaces of her body. This may all be very true, but the fact remains, as Dr. Loesser admits, that whatever the basis of so-called instinctive behaviour, subjective

aims and objective purposes often appear to coincide. The argument is purely one of definition. Instinct is widely defined as that faculty, other than a rational process, which makes inborn animal behaviour seem purposive. As Prof. Lashley effectively argues in a recent article, "the anti-instinct movement was aimed primarily as the postulation of imaginary forces as explanations of behaviour". It scarcely helps the subject to dismiss the presumed hereditary basis of instinct, and to continue talking, as Dr. Loesser does, about the "psyche and consciousness", or the "genuine risk and genuine reflection" of behaviour.

Fortunately, the learning processes and adaptive behaviour of animals lend themselves to a more satisfactory type of generalization than the unlearned reactions which usually go by the name of instinct. The literature on this question is extensive, and the experimental work which is being carried out is as a rule sufficiently well designed to allow of the constant re-testing of the general theories of learning which have been derived from previous studies. An excellent example was given by Mr. G. C. Drew in his contribution to the symposium. One of the well-known theories of learning is the Law of Effect, which states that reactions which are rewarded tend to be stamped in, while those which are punished tend to be eliminated. This hypothesis has been thoroughly substantiated so far as rewards are concerned, whereas recent work has thrown considerable doubt on the part which punishment is supposed to play in the process of learning. Indeed, work by Drew and others has shown that where an electric shock is the punishment in experiments on rats, a mild shock has an equally facilitative effect on the speed of learning whether it be given for the wrong response or for the correct response, whether it be associated with both types of response, or whether it be associated with the reward.

Experiments of this kind are still not as numerous as they might be, nor as consistent with each other as is to be desired, but they are representative of an approach in the analysis of behaviour which is truly fruitful. So, too, were the experimental studies on delayed reaction and memory reviewed by Dr. S. Zuckerman. These concerned the ability of animals to make a discrimination between an incorrect and a correct stimulus when their responses are separated from their perception of the problem by intervals of varying length. Other experiments which were described dealt with the observation that chimpanzees can be taught to regard disks of various sizes and colours as symbols for specific foods. The fact that the animals will work for these disks, fight or beg for them, and hoard them, even if it

be only for a day, until they have the opportunity of exchanging them for the foods they represent, raises a considerable question from the point of view of the genesis of abstract and symbolic behaviour.

If it succeeded in nothing else, the symposium undoubtedly did indicate to those who were present the vast field of interest which can be defined under the term 'animal behaviour'. It is clearly impossible for any one science to deal with all aspects of this subject. This very fact is

one of the best arguments for the existence of an organization, such as the Institute for the Study of Animal Behaviour, prepared to undertake the task of integrating the numerous studies, carried out in different departments of science, which are related under the heading 'animal behaviour'. The task that lies before the Institute is, however, far more than just the reviewing of separate advances in the subject, for this activity cannot but lead to the more responsible one of indicating the lines along which research needs to be directed.

Obituary Notices

Dr. Jan Koliha

THE National Museum of the Kingdom of Bohemia, at Prague, has suffered an irreparable loss in the untimely death of Dr. Jan Koliha, head of the Palaeontological Department of the museum since 1931.

Dr. Koliha was born on May 3, 1890, at Police nad Metuji in Eastern Bohemia, where his father was a teacher. He had already begun collecting natural history specimens in his teens, and when he proceeded to the Charles University of Prague, in about 1900, he studied natural science and obtained the degree of Ph.D. for a dissertation on "The Atrémata of the Krušná Hora Beds" (published in *Palaeontographica Bohemica*).

Koliha next became assistant in geology and mineralogy to Prof. Cyril Purkyně at the Technical University, and also at the National Museum under Prof. Perner. The latter advised him to abandon his studies of the Bohemian Cretaceous and devote himself to the Palaeozoic strata of his country, which are well represented to the south and south-west of Prague.

While still a student Koliha had made the acquaintance of the great zoologist and palaeontologist Prof. Antonín Friš, who died in 1913. Friš lived to see the collections of the National Museum removed to the fine buildings at the top of Wenceslas Square (1892). Here Dr. Koliha, together with the late Dr. J. S. Procházka, acted as assistant to Prof. Kafka. On the death of the latter (1929), Dr. Procházka became the head of the Palaeontological Department until his death in 1931, when Koliha succeeded him. From this year the galleries containing Barrande's collections were called the Barrandeum, and Koliha was given the title 'Custodian of the Barrandeum'. He likewise became responsible for all the palaeontological collections, with the exception of fossil plants, which were under the care of Dr. Němejc.

Dr. Koliha was the chief authority on the Lower Palaeozoic fossils of Bohemia. He is especially to be remembered for his research on the Tremadocian of Eastern Bohemia (1925). Drs. Kodym and Matějka of the State Geological Survey had found black clay shale near Český Brod (East Bohemia) in a locality hitherto supposed to be Cretaceous. Dr. Koliha

examined some of the material and on the basis of the contained fossils proved it to be of Lower Ordovician age. Later he succeeded in correlating it with the Tremadoc Shales. An account of this discovery is given in the *Journal of the State Geological Institute of U.S.R.*, vol. 2, pp. 305 ff. The importance of this discovery was shown by the fact that it placed the Ordovician fauna of Eastern Bohemia in quite another sea to that which existed in the Barrandian basin at the same time. The Tremadocian of East Bohemia belongs to the Baltic-Scandinavian facies.

Dr. Koliha was well known and honoured not only in his own country, but also in Great Britain, Germany, Sweden, and the United States. As a specialist in the older Palaeozoic he was unrivalled, and material from all over the world came to him for determination. He was likewise a good zoologist. He possessed a surprising knowledge of English literature. He was also acquainted with Swedish and Welsh, and spoke excellent French.

Dr. Koliha was a kind friend and a good colleague. He was for many years a member of the Geographical Society of Prague, of the Geological and Mineralogical Society of Czechoslovakia and also of the National Museum Society, to the meetings of which he contributed many inspiring lectures and other communications on palaeontological matters. He died on April 7, after long suffering. His place at the Museum has been taken by his colleague Dr. Němejc.

I am indebted to Prof. Perner of the Charles University and to Dr. F. Prantl, of the National Museum, for some of the details of Dr. Koliha's work and career.

T. OAKES HIRST.

We regret to announce the following deaths:

Dr. E. T. S. Appleyard, research assistant in physics in the University of Bristol, on June 15, aged thirty-five years.

Prof. A. E. Kennelly, emeritus professor of electrical engineering in Harvard University and the Massachusetts Institute of Technology, on June 18, aged seventy-seven years.

Dr. E. Kidson, O.B.E., director of meteorological services in New Zealand since 1927, aged fifty-seven years.

News and Views

Prof. Walther Nernst, For.Mem.R.S.

ON June 25, Walther Nernst, well known as a physical chemist, will celebrate his seventy-fifth birthday. Nernst was born at Briese, West Prussia, and studied at the Universities of Zurich, Berlin, Graz and Würzburg. He worked under F. Kohlrausch at Würzburg, where he took his degree. His thesis connected his name for all time with the thermomagnetic effects he had discovered. Eventually, he became professor of physical chemistry in the University of Göttingen and principal of the laboratory that he had just equipped for this branch of study. Numerous papers dealing with a diversity of problems were published as the result of work in the new laboratory, among them such subjects as the ionic theory of solutions, electrocapillary phenomena, residual current, polarization capacity, over-voltage, the lead accumulator and the theory of nerve stimulation which explains the painlessness of the application of high-frequency electric currents, known as diathermy. The invention of the Nernst electric lamp made the name of the young physicist well known all over the world. In 1924, Nernst became president of the Reichsanstalt. His "Textbook of Theoretical Chemistry", the fifteenth edition of which has recently appeared in Germany, is well known all over the world and has been translated into several languages. During the Great War he spent some time at the front and was decorated with the Iron Cross of the first and second class. In 1920, he was awarded the Nobel Prize for chemistry. Prof. F. Krüger has written an appreciatory article in the May issue of *Research and Progress* (Berlin, N.W.7, Unter den Linden 8) on Nernst's life and work, filled, he says, with most intensive labour but richly rewarded in respect of research and teaching.

NERNST's work covers many fields of theory and investigation. His theory of galvanic cells, published in 1889, in which he applied the new theory of ions to the explanation of the development of electromotive force and introduced the idea of an electrolytic solution pressure, still forms the basis of the theory of the cell. Equally important was his study of the theory of the diffusion of electrolytes and the development of the formula for the liquid contact potential (1888-89). The application of the quantum theory to physical chemistry interested him greatly, and his experimental investigations of the specific heats of solids at low temperatures laid a sound basis for one aspect of this theory. Among other important results was the fact that the specific heat of diamond becomes vanishingly small at low temperatures. This result was a consequence of Nernst's so-called Heat Theorem, or the Third Law of Thermodynamics, which he put forward in 1908. This has the most fundamental importance in chemical thermodynamics and gave a new impetus to

theoretical and experimental studies in this field, in which a large number of workers in all parts of the world took part. Another example of Nernst's insight into fundamental problems was his enunciation of the so-called chain mechanism of photochemical reactions, published in 1918. There is scarcely a branch of modern physical chemistry which has not been enriched by some important contribution from Nernst, and his influence on the development of the science has been most fruitful. His insistence on the equal importance of thermodynamics and the atomic theory at a time when the latter was beginning to fall into discredit in some quarters is a tribute to his sound judgment. As an investigator and as a teacher he stands out as one of the great leaders in science.

Plaque in Memory of Edward Clodd

THOSE who knew Edward Clodd personally and the multitude who were instructed by his numerous books and articles will welcome the placing of a plaque on June 15 on Strafford House, his Aldeburgh home during 1889-1930. It was here that he kept his library, where he spent all his spare time, and to which he retired. Strafford House recalls many pleasant and stimulating occasions to those who were privileged to be Clodd's guests. Throughout a long period Clodd invited mixed gatherings of men of very varied interests—literary men who had made their mark in different ways; leading men in other departments of learning, law, history, economics, and politics; administrators of Protectorates, Colonies, and the like; men who had come to the front rank in chemistry and physics, biology, anthropology, and archaeology. Any particular gathering contained representatives of some of these intellectual activities, each of whom blossomed out under the hospitality of the genial host, whose far-reaching interests embraced most aspects of the humanities and sciences. Not only were the talks and discussions memorable, but also the walks and especially trips in the little yacht the *Lotus*, where Clodd busied himself with sailing and in ministering personally to the material needs of his guests. Strafford House thus became a pleasant meeting place for men and women of varied pursuits and was a transient intellectual centre that had a definite social value for some forty years.

Museums and Schools

AN exhibition designed to demonstrate some of the opportunities for co-operation in function between museums and schools in the work of education opened in the Department of Archaeology and Egyptology of University College, University of London, Gower Street, London, W.C.1, on June 20 and will remain open daily until July 15. The material exhibited

- has been contributed, mainly from their publications, by the museums of London and of the United States of America. It serves to bring out with considerable clarity the very different approach by the museums of the two countries to the problem of education. In London, largely owing to the manner in which the great national collections originated, and the way in which they have been built up, emphasis is laid on the function of the museum as a store-house
- of research and advanced critical appreciation, as well as, of course, as a place of exhibition of such
- part of the national wealth as is embodied in objects of artistic or historical interest and value concentrated in London. In the United States, on the other hand, the museums rely almost entirely upon funds from unofficial sources, whether from endowment or in the form of current income. In consequence, the latter have consistently stressed their educational function, directing it, naturally, in the first instance to the satisfaction of the interests or needs of their more immediate clientele.

This difference is to be noted in the character of the posters advertising the national collections of Great Britain exhibited by the London Transport Board, and those shown here by the United States Museums, which consist of carefully devised and prepared propaganda material. The same difference is to be noted in the character of the two sets of publications. Whereas the English museums have prepared series of postcards and guides which offer a wealth of material bearing upon nearly every aspect of art, science and history, from which teachers are left to select for themselves, in the United States the museums, undertaking the direct educational function, circulate among the schools illustrative material selected by their own education departments, but rely mainly on the organized work and lectures of their own educational staffs, for which special accommodation is provided in the museum building.

Human Problems of Management

In an address at the Commencement Exercises, Massachusetts Institute of Technology, on June 6, Sir Harold Hartley pointed out that, apart from new inventions and discoveries, the great changes in industry in this century have been largely in the direction of transforming traditional methods depending on the personal skill of the operator to scientifically controlled processes in which measurement has largely taken the place of craftsmanship. A new standard of certainty based on scientific measurement has invaded every branch of industry and engineering. The human problems of management, however, are equally important and are much more difficult than the selection and working of inanimate material. Success or failure may depend on the wise choice of men, in which there is no figure of merit as guide. There are also the wider human problems of industry and the collective life of the factory; the emotional response of the individual, the human understanding of the supervisor may influence efficiency and output as much as scientific planning. These human problems

of management, Sir Harold said, become increasingly important with the size of the concern, and the rapid growth of the great corporations constitutes a new factor in our social organization, so that any danger of their inability to utilize human effort to the best advantage is an urgent problem. When an organization becomes too large for personal leadership, it is in danger of losing its character and vitality, of becoming mechanical, with all the loss of efficiency implied thereby in a human agency.

ORGANIZATION, however, implies not only order in the distribution and co-ordination of the functions of the separate parts, but freedom for the individuals within their sphere of action. The remedy for the dangers of specialists through their ignorance outside their limited sphere of knowledge is a synthesis, which is the object of a large industrial undertaking in securing the co-operation of a team of specialists. Its smooth running depends on the ability of each of its component groups to engage intelligently in its particular task in proper co-ordination with the rest. Sir Harold Hartley does not believe that individual initiative disappears with increasing size. Without initiative there cannot be the steady flow of ideas, not merely outwards from the centre but inwards from each section, which is essential for success. The key problem is that of supplying adequate motive power in place of the self-interest motive, which must largely disappear. Accordingly, he stressed the importance of the study of incentives based on personal satisfaction, the development of the team spirit, and of the value of recognition in sweeping away negative inhibitions which hinder the possibility of achievement. It is the business of a leader to find the opportunities for success and to see that everyone is made to feel his part in them and to know that his part is recognized.

Pre-Roman Archaeology in Shropshire

IN view of recent developments in the study of British archaeology and prehistory in the period preceding the Roman invasion, considerable interest is attached to the announcement that the earth-works which crown the slopes of the Wrekin in Shropshire are to be excavated by the Society of Antiquaries of London in co-operation with the Shropshire Archaeological Society. It is thought probable that the Wrekin was the headquarters of the tribe of the Cornovii before they were removed by the Romans to the riverside site of Viroconium or Uriconium, the modern Wroxeter, some time about A.D. 80-70, much as the tribesmen were removed from Maiden Castle to Dorchester in the same period. Uriconium itself, the Roman site, has recently been excavated by Miss Kathleen Kenyon, and it is now the opinion of archaeologists that the time has come to investigate the earlier site. It will be a matter of interest to see whether the suggestion thrown out by Dr. R. E. Mortimer Wheeler of an indication in his recent excavations in southern Brittany pointing in the direction of Shropshire is in any way borne out by the results of the investigation now contemplated.

Permission for the work has been given by Lord Bernard, the owner, and the work will be under the direction of Miss Kenyon. Excavation will begin in the current year, and it is hoped will be completed in 1940. A committee has been appointed for the purpose of raising funds to meet the cost of excavation, of which Mr. A. W. Clapham, president of the Society of Antiquaries, is chairman, with Sir Charles Marston and Sir Frederic Kenyon as vice-chairmen, while among the members of the committee are Lord Harlech, Lord Powis, Lord Baldwin, Sir Charles Peers, Dr. R. E. Mortimer Wheeler and Mr. J. P. Bushe-Fox. Contributions to the excavation fund may be sent to the Assistant Secretary, Society of Antiquaries, Burlington House, Piccadilly, London, W.1.

Imperial Studies in Chinese Archaeology

Owing to the preoccupation of Chinese antiquarians with literary rather than material evidence, an exceptional interest attaches to an imperial scroll now on exhibition in London, which was painted in A.D. 1729 by command of the Emperor Yung Chen. The scroll is of paper, measuring 49 feet long by 24½ inches wide, and forms an illustrated record in colour of some of the personal possessions of the Emperor, including objects in bronze, jade, ivory, pottery and porcelain. More than two hundred objects are represented. To the student of Chinese archaeology and the development of Chinese art, the interest of this early catalogue lies in the fact that the objects range in date from the early Chou dynasty, about the close of the second millennium B.C., down to porcelains of the early eighteenth century of our era. It is, in fact, a contemporary manuscript catalogue, illustrated by hand, of a remarkable collection of antiquities, which are shown as a continuous band of colour plates. At the time the scroll was painted, the Emperor, who died in 1735, was engaged in preparing the plans for his tomb; and it was from this tomb that the scroll was obtained by a British officer at the time of the Boxer Rebellion. It is now on view at the galleries of Messrs. Spink and Son, 5-7 King Street, St. James's, in aid of the Maternity Ward of the Royal Northern Hospital, London. As no scroll of this type has previously been exhibited in Europe, it has been displayed at full length on the walls of the exhibition hall and is accompanied by a key, in which the various objects have been drawn in outline with notes by experts on their type and ceremonial use. In view of the wide range in character and date of the objects depicted, the value of the scroll thus elucidated for archaeological and æsthetic studies is obviously considerable.

The History of Cement

THE summer meeting of the Newcomen Society was held in Suffolk on June 7-10 with Ipswich as the headquarters. The itinerary included visits to the bell cage at East Bergholt, weaving factories at Sudbury and Hadleigh, the post mill at Saxsted, the tide mill and steelyard at Woodbridge and the

works of Ransome's, Sims and Jefferies, Ltd. After the annual dinner on June 8 three papers were read, one of them being by Dr. A. P. Thurston on "Parker's 'Roman' Cement". In 1796, James Parker, of whom little is known, took out a patent for "Cement or Terras to be used in Aquatic and other Buildings and Stucco Work". This cement was made by burning in kilns the hard stone-like concretions called septaria, found around the coasts of Essex and Kent wherever the London clay bordered the shore and formed low cliffs. Previously this material had been used for building, but when the making of Parker's cement began there was a great demand for it, and the practice grew up of dredging it from the bottom of the sea off Walton-on-Naze and elsewhere. In 1857 there were between three and four hundred smacks engaged in this dredging. The principal factories for cement manufacture were at Harwich, and at one of these 'Roman' cement was made until 1890. Joseph Aspdin's patent for 'Portland' cement was taken out in 1824, but it was the improvements effected in its manufacture by I. O. Johnson at Swanscombe which led to 'Portland' cement superseding 'Roman' cement. Dr. Thurston's paper was accompanied by a bibliography of the subject.

New B.B.C. Stations

ON June 14, the revised West Regional Scheme of the British Broadcasting Corporation was brought into operation by the opening of the new transmitting stations at Start Point and Clevedon. These stations now radiate simultaneously the West Regional programme on wave-lengths of 285.7 and 203.5 metres respectively. The Start Point station is situated near the most southerly point of Devon, and is intended to serve the whole of the south coast from Cornwall to Hampshire or Sussex; while Clevedon on the North Somerset coast will serve the areas around Bristol, and the northerly parts of Somerset and Devon which cannot be covered satisfactorily from Start Point. Both stations have been so located as to take advantage of transmission largely over a sea path, and thus avoid the heavy attenuation of signal strength encountered in wave propagation over the poorly conducting terrain of Dartmoor.

SOME technical details of the Start Point station were given in the *Wireless World* of June 15, from which it is learned that the new station is at present using a power of 100 kw., which will ultimately be raised to 150 kw. In order to give the greatest service along the south coast, the aerial system has been designed to give its maximum radiation in the east and west direction, with a minimum, but by no means negligible, radiation in a southerly direction over the English Channel. This directional radiation has been secured by the use of two steel mast-radiators, 450 ft. high, spaced about three eighths of a wave-length apart. Both mast aërials are connected to the transmitter, one directly and the other through a suitable phase-shifting network. This network has been carefully adjusted during the initial test-period to give the desired distribution of signal radiation.

- The carrier-wave frequency is controlled to an accuracy of better than one part in a million by a high-precision quartz crystal, and the modulation arrangements of the transmitter have been designed to give a very high programme quality.

Infestation of Grain by Insects

- A SURVEY of the conditions of infestation in the grain trade in Great Britain was initiated about a year ago (NATURE, June 4, 1938, p. 1004), as a result of which it appeared that research into control and remedial measures against pest infestation of all stored produce was desirable. At the request of a Standing Conference representing the industrial interests co-operating in the work, the Department of Scientific and Industrial Research has agreed to undertake this research and an advisory service for industry. The work will be carried out with the technical and financial co-operation of industry, by the Imperial College of Science and Technology at the Biological Field Station of the College, at Slough, under the direction of Prof. J. W. Munro, professor of zoology and applied entomology at the College, to whom inquiries relating to this new service should be sent. Industrial organizations interested in the work should communicate with W. McAuley Gracie, chairman of the Standing Conference on Pest Infestation, Department of Scientific and Industrial Research, 16 Old Queen Street, London, S.W.1.

National Parks

THE winter number of the *Tree Lover* (3, No. 26, De la More Press, 2a Cork Street, London, W.1) includes an article on the case for national parks, which deals with the report of the Standing Committee on National Parks. In discussing this important question, many fall into the mistake of comparing Great Britain with Canada, the United States and other countries of the New and Old World of much larger size and with extensive tracts of wild, undeveloped countryside where great national parks or game reserves have been formed. These enthusiasts are apt to forget that Great Britain is, compared with such countries, a very small and densely populated island. This being said, the case for such national parks as are, or may be, feasible is a very strong one. As pointed out in the article in question, such a movement "falls in most signally with the aims of the Health Campaign on which the Government is at present engaged. If abundance of Playing Fields is essential for this, still more essential is the provision, or preservation, of national 'walking grounds', and regions where young and old alike can find refreshment and inspiration in the enjoyment of unspoilt Nature". The proposals of the Standing Committee on National Parks are well known. The chief question in connexion with these proposals is where the money is to come from. The suggestion is the Treasury. There is also a considerable body of influential opinion which considers that this question is one for the general public. That in fact if the public really want the national parks a fund should be opened to provide the money for their formation

and upkeep; that the British public will attach a greater value to, and have a greater interest in, the maintenance of national parks provided by their own endeavour than if they are more or less controlled by the Government and therefore nobody's child.

Meteorology for Airmen in India

A PAMPHLET of the India Meteorological Department, having the title "Meteorological Organisation for Airmen", brings up to date the information required by airmen in India who wish to take advantage of available information about actual and expected weather on the various aviation routes in that country. There are several classes of meteorological station in the organization that is concerned with meeting the demands of aviation, of which the most important are the forecasting centres where synoptic weather charts are prepared twice a day, namely, for civil aviation (Karachi, Calcutta and Poona), and for military aviation (Karachi and Peshawar). The India Meteorological Department is responsible for the aviation weather service on the trans-India route from the Gulf of Oman to Akyab, as well as along other internal air routes in India. The positions of the four types of meteorological station more directly concerned with the supply of information—the civil and military forecasting centres, the pilot balloon stations where the winds aloft are measured, and the aeronautical wireless stations—are clearly shown on a folding map. The codes for transmitting information about the weather have become more numerous in the course of years, in proportion as the information required has become more detailed and precise, and practically the whole of this pamphlet is taken up with them. Attention is directed in a foreword to a change instituted on July 1, 1937, which resulted from the establishment of an independent meteorological service in Burma. From that date the Calcutta Meteorological Office ceased to issue weather reports and forecasts for air routes in Burma and the 'general inference' for the Rangoon-Bangkok section, these being taken over by the Meteorological Office at Rangoon, but it has continued to issue reports and forecasts for the Calcutta-Akyab route.

"Earning whilst Learning" in American Universities

THE economic depression in the United States compelled university administrators and students to devise fresh plans for enabling poor undergraduates to pay their way. The Federal Government decided to help, not with scholarship grants but by financing work projects through the National Youth Administration. So new ways were discovered for using student labour and some proved so beneficial to all concerned that they became permanent. A summary of the more important is given in *Bulletin* No. 9 of the Office of Education (Supt. of Documents, Washington, D.C. 10 cents). This gives particulars of factories, printing-presses and other money-earning projects, of co-operative housing and other schemes for reducing students' living costs, and of the 'self-help' colleges which aim at making education as

nearly as possible self-supporting. These are described as strongly Christian in intent and influence, proclaiming the dignity of labour and the fundamental importance of training in heart and hand as well as head. Yale's bursary employment scheme, providing employment for more than four hundred of the residents in its new undergraduate hostels, is described in some detail. It is so popular that well-to-do students have applied for bursary work without stipend, because of the opportunities it offers for personal development. Harvard also has lately introduced an employment scheme in connexion with its new dormitories. The report emphasises the increasing recognition of the value of money-earning labour as a part of education, especially its contribution to character-building, and the advantages of co-operative living arrangements.

The Temporary Ley

THE Welsh Plant Breeding Station, Aberystwyth, has just issued a bulletin entitled "The Temporary Ley", price 7s. 6d. It is divided into four sections. The first compares the results obtained with station-bred and commercial grasses when used in simple mixtures. Although in the first year the commercial seeds gave the best yields, distinct advantages were shown by the station-bred varieties in the third year. Relative aggressiveness of the different species in a mixture is also an important point; timothy, for example, failing to become established when sown in conjunction with cocksfoot or perennial rye grass. Section 2 deals with the yield and persistency of different strains of grass and clover. Mixtures containing indigenous species gave both higher yields and better response to phosphatic manuring than those in which such species were in the minority or lacking. Pasture management and its effect on the sward is the subject of the third section. Swards differing widely in botanical composition were subjected to various systems of management, and it was found that the importance of a species is determined by the individual reaction of the plant to the type of management, as well as its ability to withstand competition from other components of the sward under those conditions. The final section consists of an article by Sir R. George Stapledon, director of the Station, on the establishment and maintenance of temporary leys. This will perhaps be of particular value to the agriculturist as it deals largely with the practical aspect of the question. Final emphasis is laid on the fact that success depends on the combination of a well thought-out seeds mixture with good management.

A Pioneer Garden Journalist

A SHORT chapter of garden history in the early eighteenth century is unfolded by Mr. W. Roberts, in a paper on Richard Bradley, F.R.S. (*J. Roy. Hort. Soc.*, 64, Pt. 4; April 1939). Bradley was the first professor of botany at Cambridge, and though he does not appear to have conferred much sound teaching upon his students, nor given academic dignity to the University, he was responsible for a series of

volumes which exerted considerable influence upon horticulture at that period. "A General Treatise of Husbandry and Gardening" was one of his greatest contributions, and forms the main subject of Mr. Roberts's paper. The text introduces "Such Observations and Experiments as are New and Useful for the Improvement of Land", and, indeed, Bradley's experiments represented his major contribution to horticulture, at a period when it was the fashion only to copy and quote. He states that his expenses in the study of the nature of plants and soils cost him upwards of £2,000, and he also travelled widely. Though his undertaking to establish a Botanical Garden at Cambridge did not flourish greatly, he distributed much garden knowledge of an exact order.

Earthing with Driven Copper Electrodes

A HUNDRED years ago, when electricity was usually generated by the use of frictional or Wimshurst machines and detected by gold leaf electroscopes, it was well known that an electric charge on a conducting surface could be dissipated by connecting the charged surface to earth. It is now found that owing to the increasing electric power behind modern networks, in order to get safe operation special attention has to be paid to the conductor connecting charged metallic objects to earth. Copper electrodes of small diameter cannot be driven with a sledge-hammer unless the ground be soft, as the rod will bend or the top will be deformed. The Copper Development Association of Thames House, Milbank, London, S.W.1, has published a booklet entitled "Copper for Earthing" which gives several useful hints on this problem. The most satisfactory method of driving copper electrodes into the earth is by means of an electric hammer which delivers a large number of light blows. The usual procedure is to choose the wettest or the most low-lying spot in the neighbourhood and drive a copper rod of small diameter into the earth to a depth of about eight feet. The earth resistance is then measured; if too high, several more rods can be driven in and connected in parallel. This is necessary for earthing mains where a possible fault current may be very large. The booklet points out that, even now, earth connexions are sometimes made by a few feet of conduit buried outside the house or under the floor in contact with a small iron plate or with the hot-water piping system. Sometimes even a large electric machine is earthed by binding the wire round a loose rock lying on the ground. In one case the earthing wire was found to terminate in a bottle of water!

London's Water in 1937

THE results of the chemical and bacteriological examination of the London waters for the twelve months ended December 31, 1937, are contained in the thirty-second annual report of the Metropolitan Water Board, recently issued (P. S. King and Son, Ltd., 14 Great Smith Street, Westminster. 10s. 6d.). Much of the report was drafted by the late director, Col. Marold, before his death last July, and the task

of completing it has fallen upon the deputy director, Mr. Denison Byles. The total average output from the works for the year was 310.79 million gallons per day. Of 22,000 routine samples examined bacteriologically, about 98 per cent were of first-class purity (absence of *Bact. coli* in 100 c.c.). Details are given of several researches carried out in the laboratories. In the Bacteriological Section, various methods for the isolation and identification of *Bact. coli* have been tested and compared. In the Biological Section, investigations into the algal flora of raw and stored waters have been continued. In the Chemical Section, a further account is given of the use of a new photo-electric turbidimeter. The chief analytical results for each month in the year of the several sources of supply are given in a series of tables.

The Brotherton Collection

THE third annual report of the Brotherton Collection Committee, University of Leeds, states that a beginning has been made in the work of valuing the Collection, case by case, and of cataloguing the uncatalogued books (University of Leeds: The Brotherton Collection. Pp. 4. Leeds: The University, 1938). A scheme has been drawn up for the purchase of new books, which would be confined to certain authors and subjects wherein the Collection is already strong, so that relative completeness could be obtained. The very extensive collection of pamphlets on Sheffield has been re-arranged. Mr. J. A. Symington, first keeper of the Brotherton Collection, relinquished that office on July 31, 1938, and on the recommendation of the Brotherton Collection Committee, the Council of the University of Leeds appointed Dr. Richard Offor, the University Librarian, to be Keeper of the Collection from August 1.

The Earthquake of May 10, 1939

FROM instrumental reports from Fordham, Georgetown, St. Louis, Victoria, Honolulu, Manila, Pasadena, Philadelphia, Chicago and Burlington, the U.S. Coast and Geodetic Survey has determined the epicentre of the earthquake of May 10 at 7h. 44^m. G.C.T. to be provisionally lat. 51° N., long. 179° W. This is to the south of the Andreanof Islands, which form part of the Aleutian Islands, and is on the circum-pacific ring of instability somewhat to the west of the epicentre of the great earthquake of November 10, 1938.

Conference on Photography

THE Manchester and District Branch of the Institute of Physics has arranged a Conference on Photography, to be held in the Physics Department, University of Manchester, on July 3 and 4, under the chairmanship of Dr. F. C. Toy. Among those taking part are Prof. N. F. Mott, Dr. J. C. M. Brantano, Dr. W. F. Berg, Dr. D. A. Spencer, Dr. S. O. Rawling, E. R. Davies, C. W. Bradley, Dr. J. G. Wilson, Dr. C. A. Adams and Dr. H. A. Bruck. The subjects to be discussed include the atomic physics of photography, colour photography, theories of developers, and

applications of photography in research. Further particulars can be obtained from Dr. W. H. Taylor, Physics Department, College of Technology, Manchester, 1.

Marine Biological Association

At the annual general meeting of the Marine Biological Association of the United Kingdom, Dr. George Parker Bidder was elected president of the Association in succession to Lord Moyné, who had held office for the past nine years. Lord Moyné, Lord Mildmay of Flete, and Sir Reginald Dorman-Smith were added to the list of vice-presidents. Mr. H. C. Maurice, Lord Rothschild, Mr. J. R. Norman and Mr. Morley Neale were elected new members of council.

Announcements

LIEUT.-COLONEL J. H. M. GREENLY has agreed to continue as president of the Institute of Fuel for a further year, and will deliver his second presidential address on October 19. The Council of the Institute has awarded the Melchett Medal for 1939 to H. A. Humphrey, late consulting engineer to Imperial Chemical Industries, Ltd., for the outstanding work he has done in the development of fuel and appliances in connexion therewith.

MARCO TIFFENEAU, professor of pharmacology and materia medica in the Faculty of Medicine, University of Paris, has been elected a member of the Section of Chemistry of the Paris Academy of Sciences, in succession to the late Prof. G. Urbain.

THE German Chancellor has awarded the Goethe Medal for Arts and Science to Prof. Ernst Rudin, professor of psychiatry in the University of Munich, for his work on German racial hygiene.

THE annual meeting of subscribers and friends of the Rothamsted Experimental Station, Harpenden, will be held on June 28, when the principal speaker will be Sir E. Kaye Le Fleming, chairman of council of the British Medical Association.

FOLLOWING the nineteenth annual general meeting of the British Non-Ferrous Metals Research Association on June 29, the Association's new laboratories in Euston Street, London, N.W.1, will be formally opened by the Right Hon. Oliver Stanley, president of the Board of Trade, and a memorial to Thomas Bolton will be unveiled.

THE *Internationale Zeitschrift für Psychoanalyse und Imago*, which was temporarily suspended, resumed publication in March 1939. The present address is 96 Gloucester Place, W.1, and the price 34 shillings.

ACCORDING to the figures issued by the Metropolitan Life Insurance Company, the average duration of life for men in the United States in 1936 was 60.81 years, or 1 year and 3 months longer than in 1930.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1071.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Multiple Activities of Anhydro-oxy-progesterone

THE introduction of anhydro-oxy-progesterone (pregneninolone, ethinyl-testosterone) by Inhoffen and Hohlweg¹ and Ruzicka, Hofmann and Meldahl², and the demonstration by the former authors of its high progesterone-like activity when given by mouth, opens up the possibility of an important advance in endocrine therapy (see, for example, Zondek and Rozin³); but its multiple biological properties also make the substance of considerable theoretical interest.

In our experience, anhydro-oxy-progesterone, tested as described by McPhail⁴, is equally active by mouth and by injection in producing progestational proliferation in rabbits. A total of 5 mgm. in propylene glycol produced the same average response, when given by either route, equal to that given by about 0.5 mgm. of progesterone injected in oil solution. In addition to this strictly progesterone-like activity, the compound, unlike progesterone, will cause growth of the uterus of the immature or ovariectomized rat or mouse without previous treatment with oestrone, that is, it shows metrotrophic activity similar to that of oestrone or testosterone. Thus, injection to the spayed rat causes a mixed oestrone-like and progesterone-like effect. The capacity to produce an increase in uterine weight is about the same whether the substance is given orally or by injection, but there is evidence that oral administration results in progestational proliferation of the endometrium less complicated by oestrous changes than does injection.

In addition to the rather generalized gynaecogenic property of causing growth of the uterus of the immature or ovariectomized animal, anhydro-oxy-progesterone also seems to be oestrogenic in the strict sense that it will cause cornification of the vaginal epithelium of the ovariectomized rat or mouse. Fully cornified vaginal smears were produced by the injection of 2-4 mgm. to spayed rats, and 0.8 mgm. to spayed mice. When the substance is given orally, however, its activity on the vagina is lower, since 4 mgm. produced only a little cornification in the presence of leucocytes in some rats, while 1.6 mgm. did not cornify the vagina of the mouse. Vaginal opening in the rat was also less frequent in animals receiving oral doses than in those receiving equal amounts by injection.

In the capon comb-growth test, anhydro-oxy-progesterone shows weak androgenic activity. Tested on groups of five Brown Leghorn capons, 30 mgm. by mouth produced an average increase in length plus height of 3.5 mm.; 30 mgm. by injection produced an increase of 4.6 mm., equal to that produced by about 0.5 mgm. (5 I.U.) of androsterone. By injection on to the comb, 0.15 mgm. produced an average increase of 2.2 mm.

Of the activities of anhydro-oxy-progesterone investigated, therefore, only its effects on the rodent vagina appear to be less when the substance is given orally than when it is given by injection. In addition to this remarkable activity by mouth, anhydro-oxy-progesterone seems to be the only compound so far described which possesses progesterone-like, metrotrophic, androgenic and oestrogenic properties.

C. W. EMMENS.
A. S. PARKES.

National Institute for Medical Research,
London, N.W.3.
June 2.

¹ Inhoffen, H. H., and Hohlweg, W., *Naturwissenschaften*, **26**, 96 (1938).

² Ruzicka, L., Hofmann, K., and Meldahl, H. P., *Helv. chim. Acta*, **21**, 872 (1938).

³ Zondek, B., and Rozin, S., *Lancet*, **i**, 504, No. 9 (1939).

⁴ McPhail, M. K., *J. Physiol.*, **88**, 145 (1934).

Nicotinic Acid Requirements of Insects: a Biological Test for Nicotinic Acid

THE importance of vitamin B for the growth and development of insects has been stressed by several investigators. But very little is known of the ingredients of the vitamin B complex which are actually required by the insects.

We have found that the moth *Galleria mellonella* can be cultivated on a medium containing one part of yeast and two parts of wax. It was noted that purification of the wax and autoclaving of the yeast in a strongly alkaline solution at 130° during a lapse of time which is sufficient to destroy both the vitamins B₁ and B₂ (riboflavin) does not impair the normal development of the insect. However, its development is stopped if the autoclaved yeast is thoroughly washed with water and alcohol. Upon addition of the aqueous or alcohol yeast extract the development is resumed.

It follows from our experiments that nicotinic acid exerts the same favourable effect as the yeast extract. Nicotinic acid can thus be identified with the vitamin B-component which is indispensable for the development of *Galleria*. This does not certainly imply that vitamins B₁ and B₂ have no influence whatever¹. Since our experiments were not carried out in sterile conditions, the possibility remains open as to the production of these vitamins by some micro-organisms. Anyway, as a matter of fact, no development did take place in the absence of nicotinic acid.

Further experiments have shown that as small a dose as 5-10 γ nicotinic acid per 100 gm. of the medium lacking vitamin was sufficient to produce the above effect. After 8-10 days there were no living larvae left in the medium lacking nicotinic acid, whereas big, well-developed larvae were creeping about

- in the medium with the above-mentioned dose of nicotinic acid. Smaller doses (1 γ) proved insufficient and gave inconstant results.

Thus the development of the newly hatched *Galleria* larvae can serve as a most sensitive biological test for detecting minute quantities of nicotinic acid.

D. RUBINSTEIN.

L. SHEKUN.

Department of Biophysical Chemistry,
All-Union Institute of Experimental Medicine,

Moscow. May 13.

- Trager and Subbarow have recently reported the necessity of the vitamin B₁₂ for the development of the mosquito larvae (*Biol. Bull.*, 76, No. 1; 1938).

Radiations from Radiomanganese

- THE radiations from radiomanganese, ⁵⁴Mn, have been investigated by various experimenters and, as a result, it has been concluded that a γ -ray of energy 1.7 Mev. is present, together with a complex spectrum of negative electrons. This spectrum has been analysed into partial spectra with maximum energies 1.2 and 2.9 Mev. respectively.

I have made, recently, single counter absorption measurements¹ of the β -particles from this body and coincidence experiments utilizing β - γ ¹ and γ - γ ² coincidences in turn. The β -absorption measurements confirm the upper energy limit deduced by previous authors, and are consistent with a β -particle spectrum composed of the above two partial spectra in the ratio of 0.40 : 0.60.

The β - γ coincidence experiments show a correlation of all β -particles with γ -rays. In Fig. 1 are plotted, logarithmically, the β - γ coincidence rate per quantum detected by the γ -counter (curve a), and the β -absorption curve (b). The curves are closely parallel beyond an absorption thickness of 240 mgm. per sq. cm., and the former has been scaled so as to be superimposed on the latter in this region. The coincidence rates are explicable in terms of a γ -ray of 600 kev. ($\pm$ 50 kev.) following the β -particles in the harder partial spectrum and a γ -ray of 2.5 Mev. following those of the softer spectrum. These coincidence experiments yield, directly, an upper limit of 1.1 Mev. for the softer β -partial spectrum.

The γ - γ coincidence experiments, on the other hand, demonstrate the successive emission of two γ -rays by some of the excited ⁵⁴Mn nuclei. The γ - γ coincidence rate obtained can be explained quantitatively by the assumption that the softer

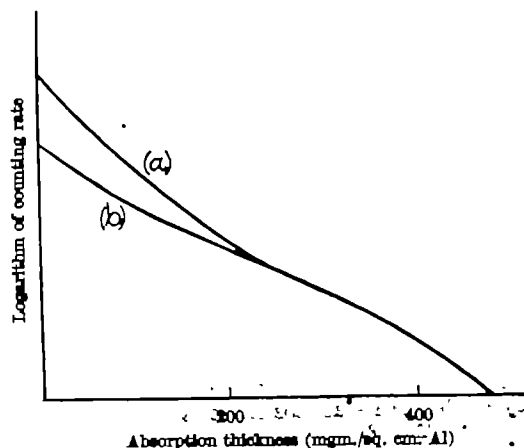


Fig. 1.

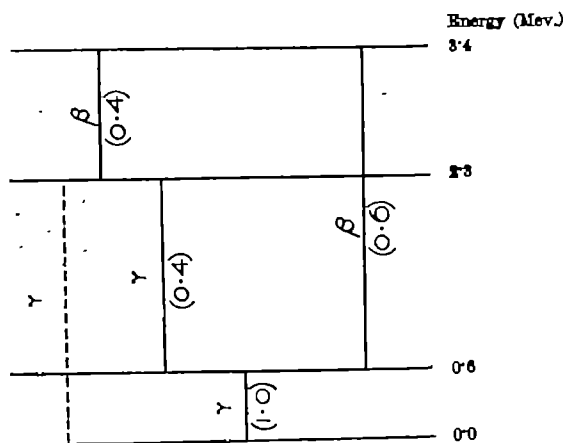


Fig. 2.

LEVEL SCHEME FOR DISINTEGRATION OF RADIOMANGANESE

Figures in brackets represent intensity of radiations per disintegration

β -particle spectrum is associated with two γ -rays of energy 1.7 Mev. and 600 kev., emitted in cascade, this assignment of energies being chosen, in preference to any other pair giving the same γ - γ coincidence rate, since the efficiency of detection of a 1.7 Mev. γ -ray together with that for a 600 kev. ray is equivalent to that for a γ -ray of 2.5 Mev.¹, and the β - γ -coincidence rate is thereby uniquely explained.

The level scheme shown in Fig. 2 is therefore obtained. It predicts a γ -ray of energy 600 kev. of 2.5 times the intensity of the harder γ -ray. The presence of this γ -ray (of 600 kev.) has been confirmed by Ward (of this Laboratory) using a pressure ionization chamber. At the same time, it has been shown that there is no appreciable intensity of the γ -ray transition shown dotted in Fig. 2.

J. V. DUNWORTH.

Cavendish Laboratory,
Cambridge. May 17.

¹ Dunworth, in the press.

² Feather, *Proc. Camb. Phil. Soc.*, 24, 599-611 (1938).

³ Feather and Dunworth, *Proc. Roy. Soc., A*, 168, 566-585 (1938).

Apparent Existence of a Very Penetrating Radiation from Radium and (Radium + Beryllium)

A few years ago, one of us¹ observed a very penetrating radiation emitted by a strong source of radium, having an absorption coefficient in lead of about $\mu = 0.03$ cm.⁻¹. We have recently reinvestigated this phenomenon, as there were grounds for supposing that the radiation might consist of mesotrons. The arguments in favour of this view may be summarized as follows:

Mesotrons may be formed, according to Heitler², in processes such as:

$$h\nu + {}^1_1\text{H} \rightleftharpoons M_+ + {}^1_0n,$$

$$h\nu + {}^1_0n \rightleftharpoons M_- + {}^1_1\text{H},$$

provided that $h\nu$ is greater than 10^8 ev. It is now known that energies greater than 10^8 ev. are liberated during the 'fission' of heavy nuclei. The absorption coefficient of mesotrons in lead is $\mu = 0.03$ cm.⁻¹, which is similar to that of the unknown radiation referred to above.

Further, Joliot and Kowarski³ found some very energetic tracks in a Wilson cloud chamber from silver bombarded with neutrons, while more recently Mouzon, Park and Richard⁴ have reported a few straight β -ray tracks in a cloud chamber ($H = 1,500$ gauss) from uranium bombarded with neutrons.

These facts, taken together, suggested that the observed penetrating radiation from radium might consist of mesotrons emitted occasionally during the breakdown of radium atoms under neutron bombardment⁵.

To test this hypothesis, measurements were made on the radiation from a source of 900 milligrams of (radium + beryllium), by means of a Geiger-Müller counter, made of brass 1 mm. thick, having a diameter of 5 cm. and length of 15 cm., filled with air at a pressure of 7 cm. mercury. Source and counter were each surrounded on all sides by 30 cm. of lead, and space of 50 cm. left between them for insertion of absorbing screens.

A large count, about 250 impulses per minute above the background, was obtained with the 900 mgm. (radium + beryllium). When the latter source was replaced by a 600 millicurie (radon + beryllium) source (having almost the same neutron output), the same large effect was still obtained, showing clearly that the phenomenon was independent of the presence of radium atoms.

A small count was, of course, to be expected from the neutrons from the sources, but not one of this order of magnitude.

The Geiger-Müller counter was then replaced by an air ionization chamber of the same dimensions, connected to a linear amplifier, but no particles were detected having an ionization greater than about one sixth of a polonium α -particle, namely, approximately 20,000 ions.

Absorption measurements in lead gave a coefficient $\mu = 0.03 \text{ cm.}^{-1}$, in agreement with the earlier findings. This value is the same, however, as that found by Goldstein and Rogozinski⁶ for the absorption of neutrons in lead. We therefore decided to eliminate drastically all possibility of neutrons reaching the counter by putting the source, with its lead protection, inside the 'water room' surrounding the cyclotron in the Collège de France. The water tanks are 1 m. wide and 4 m. high, and the ceiling is also covered with 50 cm. of water. Under these conditions, a count of 15 impulses per minute per curie above the background was obtained, which was surprisingly large in view of the small solid angle subtended by the counter. By emptying progressively the water tank between source and counter, the counting rate steadily increased. The maximum rate was calculated to correspond to about 1 impulse per 500 neutrons reaching the counter. Finally, the tank was refilled, and the lead protection of the counter covered with a layer of boric acid 1 cm. thick to absorb slow neutrons. When all neutrons were thus prevented from reaching the counter and its lead screens, the count from 1 curie of (radon + beryllium) diminished practically to zero.

The supposed penetrating radiation from radium and (radium + beryllium) was therefore due entirely to gamma-rays excited by neutrons in the lead protection round the counter, in the brass wall of the counter, and in the air inside it.

Grateful acknowledgments are made to the Union Minière du Haut Katanga for the loan of (radium + beryllium) sources, to the Britannia Lead Company, Ltd., for the loan of eight tons of lead ingots,

to Imperial Chemical Industries, Ltd., for the loan of two tons of lead shot, to the authorities of the Radium Institute for the use of an underground room, and to the Middlesex Hospital and the Radium Institute for (radon + beryllium) sources.

M. E. NAHMIAS.

Collège de France.

F. L. HOPWOOD.

St. Bartholomew's Hospital,
London.

W. H. RANN.

L. G. GRIMMETT.

Radium Beam Therapy Research,
London.

¹ Nahmias, M. E., *Proc. Camb. Phil. Soc.*, **31**, 99 (1935).

² Heitler, *Proc. Roy. Soc.*, **108**, 529 (1938).

³ Joliot and Kowarski, *C.R.*, **200**, 834 (1935).

⁴ Mouzon, J. O., Park, B. D., and Richard, J. A., *Phys. Rev.*, **55**, 668 (1939).

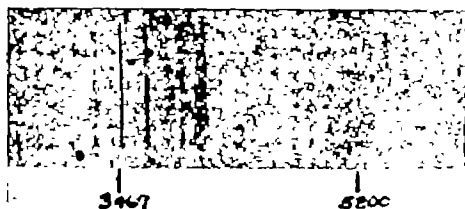
⁵ Nahmias, M. E., *C.R.*, **208**, 339 (1939).

⁶ Goldstein and Rogozinski, *C.R.*, **206**, 885 (1938).

Forbidden Transitions in Nitrogen

It has been possible to observe the forbidden transition $^3D \rightarrow ^4S$ in atomic nitrogen by a method similar to the one which led to an unusually large relative intensity of the green auroral line¹. The essential part of the method is the weakness of the discharge which generates the afterglow.

The first such observations on the high-pressure nitrogen afterglow led to the remarkable enhancement of the $^3P \rightarrow ^4S$ line at $\lambda 3466.4$. When the experiments were repeated, using panchromatic plates, the weaker nebular line at approximately 5200 Å. appeared. No exact wave-length measurements have been made; but approximate measurements indicate clearly that the new line in the green is the expected nebular line². The afterglow in which this line appeared was produced in a small quartz bulb of about 150 c.c. capacity and the pressure was about 30 mm.



A number of experiments during the past year indicate that high pressures and small volumes are favourable for the production of forbidden transitions. The absence of first-positive bands, especially those which are expected on the basis of collisions between metastable atoms and molecules of nitrogen³, is surprising and may mean that either the number of metastable entities is extremely small or that collisions of the second kind between metastable entities are highly improbable.

Further experiments are in progress in order to clarify these points.

JOSEPH KAPLAN.

Departments of Physics and Astronomy,
University of California at Los Angeles.

May 8.

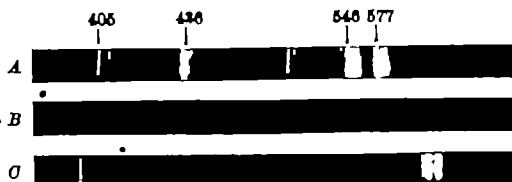
¹ Kaplan, J., *Pub. Astr. Soc. Pac.*, **47**, 257 (1935).

² Bowen, I. B., and Wyse, A. B., *Pub. Astr. Soc. Pac.*, **50**, 348 (1938).

³ Carl, G., and Kaplan, J., *J. Phys.*, **58**, 760 (1939).

Distribution of Fluorescence Excitation of Bivalent Europium in Calcium Fluoride and of Bivalent Samarium in Calcium Sulphate

In an earlier communication¹, it was mentioned that prolonged treatment of rare earth preparations with short-wave ultra-violet radiations produces an effect similar to that obtained with radium rays.



The accompanying reproductions show the effect very distinctly. In all cases the same preparation of calcium sulphate with 10^{-6} samarium was used. The photographs were taken on material sensitized in each case for the required range. A shows the untreated preparation reflecting the light of the mercury vapour lamp. B and C were taken after the preparation was treated for 30 hours with light of the wave-length 240 m μ . The bands then were excited by illuminating with filtered ultra-violet. In C at the left of the band which extends from 689 m μ to 734 m μ also the band at 630 m μ can again be recognized as in B.

The mercury lines marked are those at 405, 436, 546, 577 m μ .

HERBERT P. ECKSTEIN.

Louisville, Ky.

March 27.

¹ NATURE, 142, 265 (1938).

Similarity of the X-Ray Patterns of Tanned and Mechanically Deformed Collagen Fibres

THE X-ray pattern of the collagen of animal skin has been shown^{1,2} to undergo a characteristic alteration on combination of the collagen with various tanning agents. As seen in patterns produced by the ordinary technique (a mass of fibres of random orientation; unfiltered copper radiation; specimen to film distance of from two to five centimetres), this alteration consists of a remarkable diffusion of the originally sharp 'inner' ring (the side-chain spacing of 10-12 Å.). The resultant diffuse halo extends clear into the central spot, and the periphery of the ring loses its original sharpness. In addition to this, the 'outer' ring (the unit backbone spacing of 2.9 Å.) becomes greatly diminished in intensity, and in extreme cases disappears completely. The extent of these changes depends upon the proportion of the tanning agent combined with the collagen, the effect being more pronounced with higher tannin fixations.

It has been suggested^{3,4} that they are due to a distortion of the protein grid, caused by the penetration into the grid of the large molecules or molecular complexes of the tanning agent. In agreement with this hypothesis, it is found that the greatest effect on the pattern is produced by those materials which are of relatively large molecular size and complexity, such as the natural vegetable tannins and the basic chromium salts, while substances of a simpler nature and presumably smaller molecular size produce little or no effect. Formaldehyde and certain synthetic tannins are in the latter group. An exception to this rule is apparently found in quinone, which produces

an effect very similar to that of the larger tannin molecules. This may possibly be explained by a polymerization of the quinone in the alkaline solutions necessary for tannage with this substance.

We have now found that collagen which has been subjected to treatments calculated to produce mechanical deformation of the fibrils shows an X-ray pattern practically indistinguishable from that described above for tanned collagen. In carrying out these experiments, the mass of collagen fibres is first compressed into a coherent disk in a hydraulic press. This is the method we ordinarily use in preparing samples of powdered fibrous collagen for X-ray photography, and such treatment does not change the pattern in any perceptible way. Several such disks are then passed, under great pressure, between the rollers of a machine designed for rolling metal wires. The flattened disks are again reduced to the powdered state by passing through the Wiley mill, and from this powder a disk of the same weight and thickness as the original is formed in the hydraulic press. The pattern obtained from this disk, when compared on the same film with the pattern from one of the original unrolled disks, shows all the changes the characteristic features of which have been noted above. The intensity of the effect increases with additional rollings. We have also found that the same effect can be obtained merely by prolonged grinding of the collagen in the Wiley mill, where the material is subjected repeatedly to the shearing action of the knives.

These experiments have been carried out with purified collagen prepared from ox skin, and also with the tendon Achilles of the ox. Further details will be published elsewhere.

JOHN H. HIGHBERGER.

Department of Leather Research,
Institute of Scientific Research,

HAROLD J. KERSTEN.

Department of Physics,
University of Cincinnati.
April 21.

¹ Jordan Lloyd, D., *J. Int. Soc. Leather Trades Chemists*, 19, 245 (1936).

² Highberger, J. H., and Kersten, H. J., *J. Amer. Leather Chem. Assoc.*, 23, 16, 289 (1938).

³ Jordan Lloyd, D., *J. Int. Soc. Leather Trades Chemists*, 22, 558 (1938).

Magnetism and Polymerization

THE graphs below refer to results we have obtained for the magnetic susceptibility of dimethylbutadiene at the commencement of polymerization. Fig. 1 is for the mass susceptibilities of samples of dimethylbutadiene distilled and sealed in nitrogen, and polymerized in the dark by heat at a temperature of 140° C. Fig. 2 is for a similar treatment of

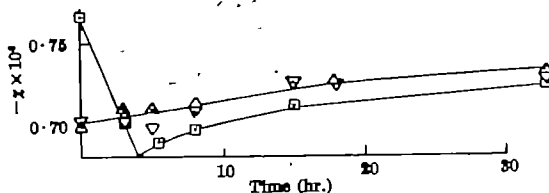


Fig. 1.

—□— Dimethylbutadiene sealed in nitrogen.
—△— " + 1% benzoyl peroxide.
—○— " + 2% benzoyl peroxide.

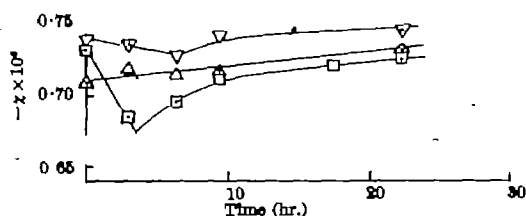


Fig. 2.

- Dimethylbutadiene sealed in *vacuo*.
 —Δ— " + 0.5% benzoyl peroxide.
 —▽— " + 1.0% benzoyl peroxide.

dimethylbutadiene distilled and sealed in *vacuo*. It will be noticed that in the absence of catalyst there is a fall in diamagnetism over the first three hours and that thereafter there is a progressive rise in diamagnetism as is to be expected¹.

We consider that measurements of this type will throw light on the nature of the induction period in polymerisation reactions. Induction periods have been identified with the time of formation of polymerisation nuclei; thereafter the polymerisation proceeds as a chain reaction². It is probable that the polymerisation nuclei are activated molecules, and the simplest assumption to make is that they are free radicals. This would explain our magnetic result, as such free radicals would necessarily be paramagnetic, and their formation in the dimethylbutadiene would result in a fall in diamagnetism.

If the first series of results be examined further, it will be noticed that the initial fall in diamagnetism is in the neighbourhood of 13.6 per cent. It is possible to calculate the concentration of free radicals which would give this lowering if the assumption be made that the free radicals are of the type of dimethylbutadiene with one free electron. The mass susceptibility of dimethylbutadiene by this series of measurements is approximately -0.75×10^{-6} . In a paramagnetic molecule with one free electron³, the paramagnetic contribution to the molecular susceptibility is theoretically 1270×10^{-6} . The diamagnetic contribution in this case is -61.5×10^{-6} . The mass susceptibility of such a molecule will thus be 0.133×10^{-6} . The concentration of free radicals of this type necessary to lower the mass susceptibility of dimethylbutadiene by 13.6 per cent can now be calculated to be 0.10 mols per cent.

If the concentration of catalyst necessary to give a smooth curve be now considered, it is evident that this must be less than 1.0 per cent by weight, or, if the results for the material sealed in *vacuo* be considered, it lies somewhere between 0.5 and 1.0 per cent by weight, for there still seems to be a lowering of diamagnetic susceptibility with 0.5 per cent catalyst in *vacuo*. It is thus necessary to have a concentration of catalyst somewhere between 0.17 and 0.34 mols per cent to give a smooth curve. If we consider that all the molecules of accelerator are active in promoting the polymerisation, it is a significant fact that the concentration of active centres calculated from the magnetic result should lie so near the concentration of the catalyst.

JOHN FARQUHARSON.
 P. ADY.

University College,
 Rangoon.

¹ Farquharson, *Trans. Faraday Soc.*, **32**, 219 (1936).

² Dostal and Mack, *Trans. Faraday Soc.*, **33**, 350 (1937).

³ Stöcker, "Magnetism and Matter", 477.

'Acidity' of Quartz

WHEN quartz powder, obtained by finely grinding pure Brazilian pebble, is put into neutral water the pH is rapidly lowered to about 6.4. This acidity has been attributed to silicic acid, but such an explanation seems unlikely for the following reasons.

Pure quartz has an extremely low solubility in water free from carbon dioxide, namely, only a few parts per million at room temperature, and the rate of solution would not be great enough to cause the acidity produced. Further, the dissociation constant of silicic acid¹ is very small (about 10^{-10}) and there is doubt whether the behaviour of silicic acid can be represented in terms of dissociation constants². Silica sol prepared under conditions where adsorption of hydrogen ions is impossible is quite neutral³. Hence the acidity rapidly imparted to water by quartz dust is probably not due to silicic acid, and it is suggested that carbon dioxide adsorbed on the quartz is responsible for the effect.

Samples of the quartz dust were heated to about 300° C. in *vacuo* until the evolution of gas ceased. After cooling in *vacuo*, these samples were quite without effect on the pH of neutral water. An approximate computation showed that the quantity of gas evolved (all of which may not have been carbon dioxide) was ample to account for the observed acidity. The addition of pure sodium chloride (itself quite neutral in water) increased the acidity of the quartz dust-water system. This is also consistent with the view that the acidity is due to carbon dioxide, for the presence of sodium ions lowers the bicarbonate ion concentration, thus increasing the fraction of the dissolved carbon dioxide that is present as carbonic acid, with a consequent increase in the hydrogen ion concentration.

G. VAN PRAAGH.

Christ's Hospital,
 Horsham.
 June 1.

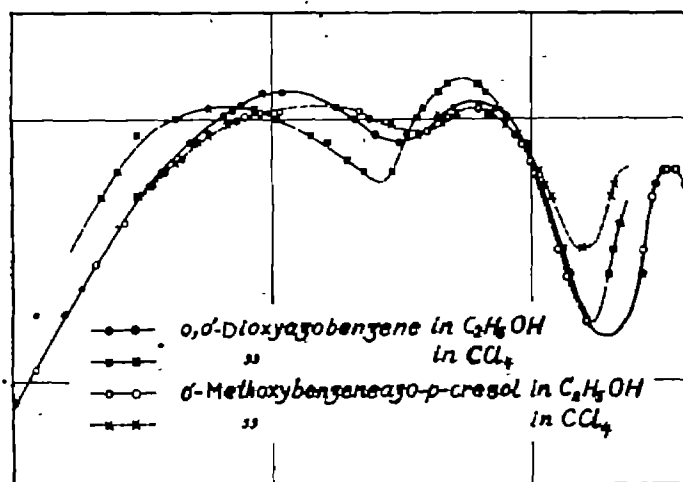
¹ Joseph and Oakley, *J. Chem. Soc.*, **127**, 2814 (1925).

² Britton, *J. Chem. Soc.*, **120**, 425 (1927).

³ Balabek and Kargin, *Acta Physicochem. U.S.S.R.*, **8**, 97 (1935).

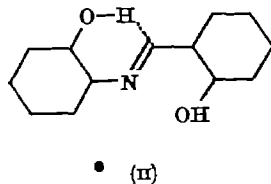
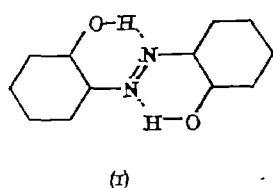
Chelate Structure of *o,o'*-Dioxyazobenzene in Solution

THE idea that the *o*-oxyazo compounds have the chelate structure is now quite convincing. It is supported by much chemical and physical evidence, such as the slight acidity, anomalous chemical reactivities referred to phenolic hydroxyl, small association factor, slight solubility in polar solvents, molecular refraction data, absorption spectra, etc. The strongest support for the chelate structure was found by Hendricks and others¹ in the study of infra-red absorption spectra in carbon tetrachloride solution. On similar grounds they concluded from the absence of the absorption band at $c. 1.4\mu$ corresponding to the first overtone of hydroxyl vibration that *o,o'*-dioxyazobenzene has the doubly chelated *trans-trans* configuration as (1). From the chelation of both the hydroxyl groups in (1), it may be expected that the *o,o'*-dioxyazobenzene, like the *o*-mono-oxyazo compounds, is very slightly acidic. But the former is actually found to be very easily soluble in weak alkali. It may therefore be supposed that the chelate structure of the *o,o'*-dioxyazobenzene is



somewhat different in character from that of the *o*-mono-oxyazo compounds.

Comparison of the absorption spectra of *o,o'*-dioxazobenzene and the mono-methyl ether of its homologue has now shown, as seen in the accompanying graph, that both substances in alcohol give almost the same absorption curve in the whole measured range of the visible and ultra-violet, whereas in carbon tetrachloride they show quite a notable difference. It has been observed² that the absorption spectra of substances having the inner molecular chelate ring structure such as *o*-oxyazobenzene, *o*-oxybenzaldehyde, etc., are generally affected only very slightly by polar solvents, which is now also confirmed with the *o'*-methoxybenzeneazo-*p*-cresol. The exceptional behaviour of the *o,o'*-dioxazobenzene cannot therefore be explained otherwise than as follows: In alcoholic solution the *o,o'*-dioxazobenzene, being stabilized through solvation by the polar solvent molecule, has the structure (II),



similar to that of the mono-methyl derivative (III), with one non-chelate phenolic hydroxyl group, which satisfactorily explains the enhanced acidity or the solubility in weak alkali. The marked displacement observed in carbon tetrachloride, especially of the first absorption band at longer wave-length ($\lambda_{\max}$ at about 400 $m\mu$), is due to the change of the structure, namely, the chelation of the second hydroxyl group in this solvent, in agreement with the conclusion of Hendricks and others³. On the other hand, the *o'*-methoxybenzeneazo-*p*-cresol cannot undergo such a change, so that its spectral behaviour remains normal.

In accordance with this result, the *o,o'*-dioxazobenzene does not combine with dry ammonia in a non-polar solvent such as benzene, carbon tetrachloride, etc., which is in fact the characteristic property of the *o*-oxyazo compounds⁴, whereas in a polar solvent such as alcohol, salt formation occurs very easily.

From the above spectroscopical evidence, it is concluded that the chelate structure of the *o,o'*-dioxazobenzene is rather mobile in comparison with that of the *o*-mono-oxyazo compounds, and that it undergoes with relatively small activation energy the reversible change (I) $\rightleftharpoons$ (II), which is the cause of its enhanced acidity and its marked tendency to the formation of metallic lakes.

A detailed discussion on the structure of the *o,o'*-dioxazo compounds and their alkali salts will be published elsewhere.

HARUO SHINGU.

Kyoto Imperial University,
Kyoto. April 2.

¹ Hendricks, Wulf, Hilbert and Liddel, *J. Amer. Chem. Soc.*, 53, 1901 (1931).

² Unpublished measurements.

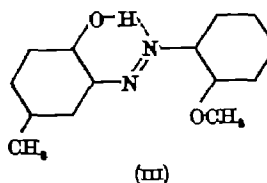
³ Jacobson and Honigsberger, *Ber.*, 35, 4105 (1903).

The So-called 'Colonial Nervous System' in Bryozoa

It was already shown by Darwin¹ that vibracula of all the members of a Bryozoan colony are capable of synchronous movement. This and similar phenomena regarded by Müller (1860) and Hinck (1880²) as being due to the action of the "colonial nervous system" are now usually ascribed to a reaction of each member of the colony to a stimulus transmitted through a non-nervous route.

It was shown, however, by Gerwerhagen (1913³) that in *Cristatella* the colonial wall is provided with a nerve plexus which is connected with nerves of tentacle sheaths of individual polypides. Gerwerhagen regarded this plexus as a motor one. Marcus (1926⁴) considers this plexus as being both motor and sensory. Moreover, he has demonstrated experimentally the transfer of stimuli from one polypide to another both in *Cristatella* and *Fredericella*.

So far, the nerve connexions and transmissions of stimuli from one member of the colony to another have been demonstrated only for the representatives

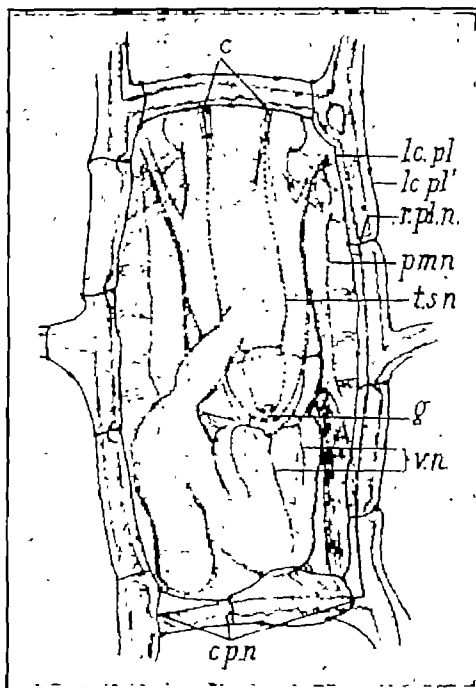


of Phylactolemmata. In Gymnolemmata, on the other hand, such nerve connexions have not yet been detected, and Marcus as well as other workers considers these organisms as being also devoid of nervous stimuli transmissions between the individual members of the colony.

While studying the nervous system in *Membranipora crustulenta* and *M. pilosa*, I found in the cystid wall of each zoecium of these Bryozoa a nervous plexus composed of small nerve cells and long fibres. In *M. pilosa* this plexus forms a single thread winding along the internal wall of the zoecium. This plexus sends nerve fibrils which penetrate through the pores of the anterior and posterior walls and the pores in the communication plates of the side walls into the neighbouring zoecia, where they are connected with analogous plexuses (see accompanying drawing of zoecium of *M. pilosa*; r.p.n., c.p.n.). These plexuses are connected with the nerve fibres of the tentacles which run along

their basal surface (*t.s.n.*). Thus, each plexus is connected with the central nerve ganglion (*g*) of its own polypide as well as with similar plexuses of the polypides of neighbouring zoecia. In *M. crustulenta* the plexus forms a nerve-net in the basal wall of the cystid.

I have also found that the polypides frequently react in groups to the stimulation of the frontal cystid wall, especially in the region of the operculum.



COLONIAL NERVE PLEXUS (= SMOOTH LINE) AND A PORTION OF THE INDIVIDUAL NERVOUS SYSTEM (= DOTTED LINE) IN *Membranipora pilosa*, AS SEEN FROM THE BASAL SURFACE.

g, ganglion; *c*, connexions of the nerves of the tentacle-sheath with the circular colonial nerve plexus; *t.s.n.*, basal nerve of the tentacle-sheath; *lc.pl.*, side trunk of the colonial nerve plexus; *lc.pl'*, a similar trunk belonging to neighbouring individual; *r.pl.n.*, nerve fibre penetrating through communication plate; *c.p.n.*, fibres penetrating through pores; *p.m.n.*, nerve of the parietal muscles; *v.n.*, visceral nerves.

I think therefore that the nerve plexus described above is responsible for the transmission of stimuli from one zoecium to another.

The occurrence of such a system not only in Coelenterata (Parker, 1920¹) but also in more highly differentiated animals such as Bryozoa is a fact of general biological interest.

STANISLAW HILLER.

Institute of Histology and Embryology,
Stefan Batory University,
Wilno,
Poland.

¹ Darwin, Ch., "Origin of Species" (6th London edition).

² Hbnk. Th., "History of the British Marine Polyzoa" (London: J. V. Voigt, 1890).

³ Gerwardt, A., *S. f. wiss. Zool.*, B, 107 (1918).

⁴ Marcus, H., *Zool. Jb. Abt. f. System.*, B, 23, H. 1, 4 (1926).

⁵ Parker, G. H., *J. Amer. Zoology*, 5, 31 (1920).

Distribution of *Rathkea*

THE genus *Rathkea*, one of the Anthomedusae, is represented on the Atlantic coast of North America by three species: (1) the widely distributed *blumenbachii*, (2) the northern *octopunctata*, and (3) the southern *elegans*. The species *octopunctata* is widely distributed in the North Atlantic¹, being found off the coasts of Norway, Barents Sea, Heligoland, the British Isles and New England. Fewkes² noted the presence of *octopunctata* in Narragansett Bay and stated that it is common off the New England coast in March. A well-marked variety of *octopunctata*, namely, *grata*, A. Agassiz, is confined to the Atlantic coast of North America, where, according to Mayer³, it is common north of New Jersey.

On December 16, 1938, a dozen specimens of *Rathkea octopunctata*, var. *grata*, were found in the mouth of the Patuxent River at Solomons Island, Maryland. The number increased greatly during the week following until by December 22 more than a thousand individuals were collected in a fifteen-minute plankton tow. This surface tow was taken with a No. 6 net twelve inches in diameter, and covered a linear distance of about seven hundred feet in water less than ten feet in depth. After nine days, December 25, the number of *Rathkea* began to decrease, and by December 29 only occasional specimens were observed.

An examination of the specimens of *Rathkea* collected on December 22, 24 and 29 shows several points of interest as regards certain taxonomic characters. The endoderm of the tentacle bulbs and the manubrium varied from a deep brilliant orange to a bright red in colour. The bell was more nearly dome-shaped than pyriform in many individuals. The bell measurements ranged from 1.4 mm. to 4.0 mm. in height and from 0.8 mm. to 3.7 mm. in width. The number of tentacles present in the four radial clusters varied from three to five each, while the number in the interradial clusters varied from one to three each. The marginal tentacles were from one and a half times to twice as long as the height of the bell, and were carried out and upward in swimming.

More than three fourths of the total number of medusae examined bore medusa buds on the interradial of the manubrium. About one half of the specimens had two or three medusa buds and thirty individuals had four, one in each interradius. The medusa buds were as large as, or larger than, the manubrium of the parent medusa, and all had at least one tentacle in each of the radii. A few were noticed that possessed two tentacles in the radii.

The conditions under which this form occurred should be noted. The salinity during the latter half of December varied from 13.30 per mille to 15.45 per mille. Corresponding values for the previous month were above normal, ranging from 17.02 per mille to 17.64 per mille. Dissolved oxygen values during the period in question ranged from 7.32 to 8.27 c.c. per litre in contrast to values of 5.40 to 7.40 during November. Temperatures during the December period were characteristically low, ranging from 2.5° to 5.9° C., and represent a contrast to the high values (7.20°–14.6° C.) prevailing between November 17 and December 16. Two factors, the high salinity of November and the low temperature of December, may be of importance in explaining the presence of *Rathkea* in waters south of its normal range.

A possible explanation for the sudden decrease in numbers of *Rathkea* may be found in observations made on *Cyanea* which were collected on December 30. Analysis of the stomach contents of these specimens disclosed the presence of *R. octopunctata* var. *grata* in abundance. As high a number as eighty-four were found in one *Cyanea*, which measured 8.3 centimetres in diameter. Further stomach analysis of each of the *Cyanea* revealed the presence of numerous fragments of *Rathkea*, including medusa buds, marginal tentacles, manubria and pieces of the bell.

ROBERT A. LITTLEFORD.

Chesapeake Biological Laboratory,
Solomons Island,
Maryland. April 20.

¹Mayor, A. G., "Medusae of the World", Vol. 1, Carnegie Institution of Washington, Washington, D.C. (1910).

²Fewkes, J., *Bull. Mus. Comp. Zool.*, Harvard College, 8, 143, plate 1, Figs. 1-7 (1881).

Sound Absorption of Snow

I HAVE only just seen the letter of Messrs. Kaye and Evans on "Sound Absorption of Snow" in *NATURE* of January 14, p. 80.

During my expedition to the Jungfrauoch last summer, we had interesting evidence of the absorptive capacity of snow in a shaft which we dug in the firn. By the time this had reached a depth of about 35 ft., it was impossible for those at the top to hear the words of the men working below, even if raised in a shout, and it became necessary to signal, even at this small depth, by means of a bell.

G. SELIGMAN.

Warren Close,
Combe Hill Road,
Kingston Hill,
Surrey.

Points from Foregoing Letters

THE biological activity of anhydro-oxy-progesterone when given by mouth has been further tested by C. W. Emmens and A. S. Parkes, who find that it has metrotrophic, androgenic and oestrogenic properties. It causes cornification of the vaginal epithelium of the ovariectomized rat or mouse and progestational proliferation of the endometrium, to a somewhat less extent than when given by injection, but is equally effective in producing an increase in the weight of the uterus.

It is stated by D. Rubinstein and L. Shekun that nicotinic acid is indispensable for the development of the moth *Galleria melonella*. As a very small dose of nicotinic acid, that is, 5-10 γ per 100 gm. of the deavitaminated medium is required, the development of the newly hatched *Galleria* larvae can serve as a most sensitive biological test for detecting minute quantities of nicotinic acid.

The radiations from radiomanganese, ⁵⁴Mn, have been investigated by J. V. Dunworth using the coincidence method. β - γ and γ - γ coincidence measurements together with single counter β -absorption measurements enable a consistent level scheme to be suggested. An additional γ -ray of 600 kev. of high intensity was predicted and its presence in the ⁵⁴Mn spectrum has been confirmed by A. G. Ward using a pressure ionization chamber.

In following up earlier work suggesting the emission of mesotrons from (radium + beryllium), M. E. Nahmias, F. L. Hopwood, T. E. Banks, W. H. Ramm and L. G. Grimmett find that the observed effects were due to gamma-rays excited by neutrons in the lead protection of the Geiger-Müller counter.

The nebular line at 3486.4 Å. in atomic nitrogen has been observed by J. Kaplan in a high-pressure afterglow in nitrogen. The unusually high relative intensity of the forbidden lines appears to be characteristic of afterglows which are generated by weak discharges. The weaker nebular line at 5200 Å. appeared on panchromatic plates.

H. P. Eckstein has shown that by irradiation of rare earths with short-wave ultra-violet a result can be obtained which is comparable to the effect of radium treatment. The trivalent samarium originally

present shows after irradiation the characteristic bands of divalent samarium produced by radium treatment.

J. H. Highberger and H. J. Kersten find that collagen fibres (prepared from the skin or the tendon Achilles of the ox), after they have been subjected to strong mechanical deformation by rolling or prolonged grinding in the Wiley mill, show an X-ray pattern practically indistinguishable from that obtained with tanned collagen fibres.

J. Farquharson and Miss P. Ady find from measurements of the magnetic susceptibility of dimethylbutadiene, as it polymerizes, that in the complete absence of accelerator there is an induction period during which there is a fall in diamagnetism, probably due to the formation of paramagnetic centres in the dimethylbutadiene. On calculating the concentration of such centres, it is found to be the same as the concentration of catalyst necessary to give a smooth curve.

G. Van Praagh finds that quartz dust which has been heated to 300° C. *in vacuo* does not affect the pH of neutral water, and suggests that the acidity usually observed is due to adsorbed carbon dioxide.

From observations on the absorption spectra in alcohol and in chloroform, Haruo Shingu concludes that the chelate structure of *o,o'*-dioxynobenzene is rather mobile in comparison with that of the *o*-monooxyazo compounds. It undergoes readily a reversible change which gives it an enhanced acidity and a marked tendency to the formation of metallic lakes.

S. Hiller has demonstrated in *Gymnolemmata* the existence of nerve connexions and transmissions of stimuli from one member of a colony to another. This shows a more general occurrence of such a system in Bryozoa.

The presence of the northern variety of *Anthomedusa Rathkea octopunctata* as far south as the mouth of the Patuxent River, Maryland, is ascribed by R. A. Littleford to the unusual low temperature, and to the high salinity in the previous month. The medusae decreased in number due to the predatory activities of *Cyanea*.

Research Items

Dental Caries in the Punjab, Northern India

A RECENT diet and health survey of the Kangra District, Punjab, Northern India, carried out by the Public Health Department and Dr. D. Curjel Wilson, has shown a high incidence of rickets and osteomalacia, and definite vitamin D, calcium, and phosphorus deficiencies in the diet of the population. Fifty children with rickets were examined clinically and dentally by G. F. Taylor and C. D. Marshall Day (*Brit. Med. J.*, May 6, 1939). A radiological examination of ten subjects showed that four had no caries, and in the remaining six, fourteen cavities only were found—an average of 1.4 cavities per head. In 96 temporary and 135 permanent teeth, two cavities were in the temporary, and twelve in the permanent teeth. The children came from a hill district and live in primitive conditions, the diet consisting mainly of carbohydrates, with relatively small proportions of protein and fats. Meat and fruit are almost entirely absent; and very small quantities of milk and vegetables are consumed. Sugar is rarely eaten. Two meals a day only are taken, of rice and chapattis made from home-ground flour. Rickets and osteomalacia are common. It is concluded that vitamin D deficiency alone does not cause either dental caries or hypoplasia of the teeth. The low incidence of dental caries and the excellent teeth and jaw formation are characteristic of the peasant of the Punjab, and have not been seen equalled by the authors in either Great Britain or America. An investigation of the teeth of 800 school children of the middle class in Lahore, having a diet more in keeping with European standards, including soft carbohydrates and sugar, showed an average of 6 cavities per head. The evidence appears to lend support to the 'detergent' theory of Sir Wallace, which postulates that the physical nature and cleansing action of the diet is more important than other factors in the promotion of dental caries.

Parthenogenesis in Vertebrates

A RECENT issue of the valuable series of monographs "Actualités Scientifiques et Industrielles", No. 651 (Hermann et Cie., Paris) falls into the group dealing with "Biologie et Reproduction" and has been written by the editor of the group, Jean Rostand. Parthenogenesis in invertebrate animals is well known and a usual method of multiplication in not a few species; but it is less often recognized that natural parthenogenesis of a limited kind occurs among fishes and batrachians, is in varying degrees a regular occurrence in the unfertilized ova of birds, and has long been known in mammals, both in ovarian and free ova. The phenomenon is generally confined to a rudimentary segmentation, limited in extent and, as in birds, proceeding more slowly than the segmentation which follows fertilization, although conforming with it in its general lines. The discovery of natural parthenogenesis led to the development of artificial parthenogenesis and this, particularly amongst batrachians, has led to a long series of experiments in which a wide variety of physical and chemical activators has been studied. The 62 pages of "La Parthénogénèse des Vertébrés" give a succinct account of present knowledge of both natural and

artificial parthenogenesis, and point to gaps which future investigation might profitably endeavour to close. For example, no success has attended attempts to prolong the natural parthenogenesis which is normal in ova of domestic fowls, nor has anything been done here to test artificial activators. Amongst reptiles no positive evidences have yet been discovered of parthenogenesis, natural or artificial.

Cactus-feeding Moths of the Family Phycitidae

A SMALL Argentine moth (*Cactoblastis cactorum*) of the above family has largely saved a great area in Australia from being converted into desert owing to the spread of prickly pear. Plants of this kind are common over the United States, Mexico and South America, where they are kept more or less under control by various insects and by competition with other plants. Nearly half a century ago a few prickly pear plants were introduced into Australia from North America and were intended solely for gardeners. The continent had no indigenous cacti and these few examples proved to be the progenitors of millions which ran wild. The invasion is now a matter of common knowledge, and by 1925 more than sixty million acres in Queensland were rendered useless by prickly pear. After almost every possible method of control had been considered or exploited, salvation came in the form of the inconspicuous small moth *Cactoblastis*, the larval activities of which eventually reduced the prickly pear to a state of real control, and fifteen million acres are now available for settlement and cultivation which had previously become completely useless. Various Lepidoptera have larvae which feed upon cacti, and many of them belong to the family Phycitidae. These have recently been classified by Carl Heinrich, senior entomologist of the U.S. Bureau of Entomology and Plant Quarantine (*Proc. Nat. Mus.*, 86, 331-413; 1939). This information is now available for Australian and other entomologists. So far as is known, it is only the species *C. cactorum* that is really effective as a controlling agent under Australian conditions. The other species caused but little effect on the plant, mainly, perhaps, because their larvae feed scattered in an individual fashion, whereas those of *C. cactorum* feed in companies and may amount to many thousands on a single plant. Altogether there are no fewer than eighteen genera, including nearly fifty species of Phycitidae, the larvae of which are known to feed on prickly pear.

Fungal Rotting of Sequoia Timber

THE Californian redwood tree, *Sequoia gigantea*, does not appear to be a common host for parasitic organisms, but J. A. Macdonald has recently described a fungus which has rotted the wood of young trees growing in Scotland (*Ann. App. Biol.*, 24, No. 1, 83-86, Feb. 1939). Cultural and microscopical characters show that the species concerned is *Coniophora puteana*. Several species of *Coniophora* have been described as secondary parasites; but it seems clear in the present investigation that the organism is acting as a primary pathogen. The fungus can attack blocks of healthy *Sequoia* wood, and can also infect lime, maple, horse-chestnut, hornbeam, alder, oak, elm, beech, willow and birch.

Properties of Virus

Hideo Moriyama and Shunkichi Ohashi have recently published a review of their own and other modern researches upon the physico-chemical nature of viruses (*J. Shanghai Sci. Inst.*, Sect. 4, 4, 63, Feb. 1939). They describe a general method for the isolation of virus protein, and show that the activities of ultra-microscopic organisms are inseparable from such material. With regard to virus production in the host, it is stated that "viruses can be considered as a coagulant of protoplasm-proteid, in which some chemical change is produced by the physico-chemical influence of the virus". The problem is complicated by the fact that other minute particles of protein are known, which have no virus activity, and the paper under review considers the minute physical and chemical differences between these two similar states of protein. Immunity to virus attack is considered, and also the fascinating problems as to how viruses arise, and whether they can have separate multiplication away from living host cells. Animal viruses provide almost all the data, though plant viruses are occasionally mentioned to demonstrate similarity to their related zoological parasites. A plea is also made for a new subject of 'virology', and, indeed, the paper forms an excellent summary for teaching purposes.

Virulence of Bacteriophage

MANY different kinds of virus which attack animals and plants show considerable range of virulence. It would be reasonable to suppose that the same character would be observed for bacteriophage, a virus disease of bacteria, and there have been several investigations of this problem. Hideo Moriyama and Shunkichi Ohashi (*J. Shanghai Sci. Inst.*, Sect. 4, 4, 51-51, January 1939) have recently worked with a phage of *Bacillus coli*, and they find no confirmation of the statements made by earlier workers that the size of a phage plaque upon an agar plate culture of the bacteria is inversely proportional to the size of the phage particle producing it. The size of plaque is considered to be governed solely by the velocity of multiplication of the phage. Thus strains of phage which produce large plaques are more virulent than those which can only make small ones under similar conditions. The differing virulence of various strains tends to be perpetuated in subsequent culture. Lowering of virulence can, however, be induced by incubating phage with bacteria in media containing neither calcium nor magnesium salts, or in media containing citrate or oxalate radicals, and this induced change appears to be of a permanent nature.

Changes in Level of Land

The relative vertical movement of land and sea is generally so slow a process that its detection by measurement rather than by inference is difficult. There is a considerable amount of evidence of such changes on the coasts of Europe in recent geological times. The only method, however, of detecting movement in progress is to keep a careful record of sea-level by one or more autographic and continuously acting tide gauges. H. L. P. Jolly has discussed this problem in a paper on "Supposed Land Subsidence in the South of England" (*Geographical J.*, May 1939). The Ordnance Survey tide gauges erected at Dunbar in 1913, Newlyn in 1915, and

Felixstowe in 1917 provide some data. Precautions are taken to rule out any purely local subsidence or a settling of the structure carrying the gauge. The Dunbar record shows no aggregate change of mean sea-level over twenty-three years, but those at Newlyn and Felixstowe show a rise of sea-level during twenty-five and twelve years respectively. The Felixstowe record was interrupted in 1929. Mr. Jolly discusses at length the nature and value of the evidence, and notes that a gauge was established last year at King's Lynn and that another is projected on a site in the north of Scotland. The question of relative vertical movement between one part of the land surface and another will be settled when it becomes possible to carry out a new geodetic levelling of Great Britain. Comparisons between the first levelling in 1840-60 and the second in 1912-21 are vitiated by inaccuracies in the older works.

The International Temperature Scale

THE International Conference in 1927 defined the International Temperature Scale so as to conform as closely as possible with the thermodynamic scale according to measurements then available, and regarded it as capable of improvement as more accurate ones were obtained. Since that time, more accurate methods of measurement have been devised and Dr. H. T. Wensel, of the U.S. Bureau of Standards, has examined the results and has made suggestions for securing greater accuracy in the definition (*J. Res. Bur. Stand.*, April). Below 660° C. the scale was defined by the standard resistance thermometer, from 660° C. to 1,063° C. (the gold point) by the standard thermocouple and then up to about 5,000° C. by the Wien radiation formula. Dr. Wensel suggests that 630.5° C., the freezing point of antimony, should be substituted for 660° C., and that the Planck formula $I = c_1/\lambda^5 (\exp(c_2/\lambda T) - 1)$ should be substituted for the Wien above 1,063° C. He considers that the most accurate values of the constants are $c_1 = 3.732 \times 10^{-4}$, $c_2 = 1.436$, $\lambda_m T = 2,892 \times 10^{-4}$ and σ of Stefan's expression for the total radiation $= 5.70 \times 10^{-4}$, all in c.g.s. units. More accurate values of a number of auxiliary constants than were available in 1927 are also given.

Parabolic Orbit of a Comet by a Graphical Method

T. CROSS has developed a method of finding how a preliminary orbit of a comet can be determined graphically to an accuracy of about 1' (*J. Brit. Astro. Assoc.*, 49, 6; April 1939). The method is similar to that described by G. F. Chambers in "A Handbook of Descriptive and Practical Astronomy", but contains numerous simplifications. It has also certain features in common with M. Davidson's method by means of a model in which three dimensional measurements are possible (see *Mon. Not. Roy. Astro. Soc.*, 90, 5; March 1930). Cross has taken Finster's Comet as an illustration, and has obtained an orbit very close to that which was computed for an interval of 10 days. It is necessary to use a fairly large scale to be certain of four-figure accuracy. Of course parallax and light-time corrections are superfluous in the method, and those who are skilful as draughtsmen will find it possible to obtain a preliminary orbit, assuming parabolic motion, without a great mathematical equipment. The method is not suitable for finding the orbit of a minor planet.

Composition and Temperature of the Upper Atmosphere

ON May 4, in the lecture theatre of the Royal Institution in London, a joint discussion on the upper atmosphere was held by the Chemical Society, the Physical Society, and the Royal Meteorological Society. Instead of attempting to cover the whole subject, it was thought advisable to confine the discussion to topics in which the sciences represented by these societies were equally interested: chemical composition, density, and temperature. The electrical state of the upper atmosphere, the study of which is exclusively the domain of the physicist, was for example touched upon only in so far as it has a bearing on the subjects mentioned. Six speakers had been invited briefly to introduce various aspects, and after their contributions a general discussion was opened. Time permitted only a statement of experimental results; their theoretical explanation would probably be an appropriate subject for another meeting.

Prof. F. A. Paneth (Durham) reviewed recent attempts towards the direct chemical investigation of the stratosphere. This research was undertaken in order to decide to what extent the air of the stratosphere can be considered as being at rest; if it be fairly undisturbed by convective currents, then we should expect to find in the stratosphere the percentage of the lighter gases increased at the expense of the heavier ones. Two gases have been used for this comparison: the 'light' gas helium and the 'heavy' gas oxygen. (In the case of helium a special survey had first to be carried out to prove that on the surface of the earth its abundance shows no variations.) The results of the two dozen or so analyses so far made in England, Russia, Germany and the United States indicate that the helium and oxygen content is constant throughout the troposphere, and in the stratosphere up to about 20 km.; but that above this height the amount of helium is greater; and of oxygen smaller, by a few per cent. Even above 20 km. there is, however, no regular increase of this change in composition with height. The obvious conclusion is that in these layers diffusive separation of lighter and heavier gases makes itself felt, but that the atmosphere is still far from being undisturbed by turbulence.

It was mentioned that the three gases which are present in the troposphere in varying concentration, namely water vapour, radon, and ozone, lend themselves also to direct chemical investigation, and that attempts at their measurement in air samples from higher strata are in progress.

The following speaker, Prof. S. Chapman (London), pointed out that the chemical evidence obtained indicated that the conditions at heights somewhat above 20 km. seem specially to favour diffusion, because of the exceptional stability of the air at those levels. This is apparently due to an upward increase of temperature for some distance above 20 km.—a subject more fully dealt with by later speakers. It seems, however, unlikely that this diffusion process has free play at greater heights, because in this case the lightest gases, hydrogen and helium, would there entirely predominate over nitrogen and oxygen, in contradiction to the spectroscopic findings with which Prof. Chapman dealt in the main part of his address. The spectrum of the

auroral light is due almost, if not entirely, to oxygen and nitrogen, and shows no trace of hydrogen or helium.

Besides revealing that the atmosphere throughout its whole content is principally a nitrogen-oxygen mixture, spectroscopic evidence has given information about the state in which these two gases are to be found. The emission spectra of the aurora and of the night-sky show bands due to molecular nitrogen; in the strongly excited auroral emission, light comes from ionized as well as neutral nitrogen molecules. Neither of the two emission spectra shows bands of molecular oxygen, but in both of them lines due to atomic oxygen are prominent. This dissociation is probably almost complete above 100 km.; lower down, molecular and atomic oxygen coexist, and also their combined form ozone. Nitrogen is more easily ionized than dissociated by sunlight; the regular presence of ions in the upper atmosphere is indicated by radio evidence. The ions present are probably molecular nitrogen N_2^+ and atomic oxygen, O^+ ; negative oxygen ions O^- are also likely to be formed, by attachment of electrons to neutral oxygen atoms.

The vertical distribution of ozone was discussed in more detail by Dr. G. M. B. Dobson (Oxford). It can be found either by sending up an instrument in a balloon and measuring the amount of ozone above the instrument at any height, or by making observations from the ground. The latter method can give the information wanted if the changes in the absorption of zenith light by ozone are watched while the sun is rising or setting; from the curves thus obtained the vertical distribution of ozone can be calculated in a somewhat complicated way. It is all the more gratifying that the results agree very well with measurements made by the balloon method. Over Europe the concentration of ozone increases steadily from the ground, reaches its maximum between 20 km. and 25 km., and decreases rapidly at greater heights. The details of the distribution seem to depend on the geographical position and on meteorological conditions; it is not yet clear whether over America the rate of increase of ozone is the same.

The other three speakers dealt with the closely interrelated problems of the density and temperature of the upper atmosphere.

Dr. F. J. W. Whipple (Kew) first reviewed the results obtained by direct temperature and density measurements by means of free balloons, which in general have not gone above 25 km. although a few have reached, or slightly surpassed, 30 km. (The frequently quoted record of an attained height of 35 km. is probably untrustworthy, due to instrumental failure.) The lowest temperature ever recorded in the upper atmosphere was 182° K. at a height of 16 km. above Batavia. Such low temperatures are only found by ascents in the tropics; European ascents show in nearly every case temperatures in the stratosphere between 220° and 280° K.; in no case has any indication been found of any considerable departure from the uniformity which characterizes the stratosphere. In the lower atmosphere the density is greater in winter than in summer, but in the upper atmosphere this relation is reversed, the transition taking place at a height of 8 km.

In the second part of his address, Dr. Whipple discussed the use of air-waves for sounding the upper atmosphere. The fact that there are zones of abnormal audibility outside the 'zones of silence' suggests that the sound waves can travel through the air at a considerable height and then be deflected back to ground. The usual explanation given is that the uniform temperature of the stratosphere extends to some limiting height and that above that height temperature increases uniformly. The result of calculations of this kind is that the height of the trajectory of an air-wave is generally a little above 40 km. Sometimes, when the time of passage is exceptionally long, the computed height is considerably greater, 60 km. or more, but in such cases the results are more open to doubt. The velocities found for the waves correspond with temperatures averaging about 280° K. at 40 km., 310° K. at 45 km., and 335° K. at 50 km.

The first proof, however, that the temperature of the stratosphere beyond heights which can be reached by sounding balloons is not constant but increases considerably, was not provided by sound observations but inferred from the heights of appearance and disappearance of meteors. Prof. F. A. Lindemann (Oxford) explained this evidence, which was found by him and Dr. Dobson as early as 1922. The meteor phenomena can only be accounted for by the assumption that the density of air at heights around 100 km. is about a thousand times as great as the hypothesis of a constant temperature from the bottom of the stratosphere upwards would lead us to expect, and so the conclusion is reached that the temperature below the 100 km. level must be considerably higher; the scarcity of meteors disappearing at heights of about 55 km. was the first indication of a rapid rise of temperature in this region. Not only the sound phenomena discussed by Dr. Whipple, but also recent optical observations by F. Link on the variation of the zenithal brightness of the sky during the twilight hours are in excellent agreement with the meteor evidence.

Dr. E. V. Appleton (London) gave an account of the structure of the higher atmosphere as elucidated by the radio-physicists. In the radio exploration of the ionosphere two quantities are measured, namely, the height of reflection and the coefficient of reflection. Both quantities yield information of interest.

From the measurement of the heights of reflection on different frequencies, the electronic structure of the various layers can be deduced, from which it is possible to estimate the values of the 'scale height' H at the appropriate levels. A thick layer is produced by the absorption of solar radiation if the atmospheric density varies slowly with height (large H) and vice versa. There is evidently some factor operative which brings about an increase of H between 100 km. and 300 km., for at the level of the E Layer (100 km.) the scale height is found to be 11.0–11.5 km., whereas at the level of the F Layer (300 km.) the scale height is 40–50 km. An increase of scale height can only be the result of an increased temperature or of the presence of a light atmospheric constituent such as helium. The former is considered by Dr. Appleton to be the more likely; the calculated temperatures are 385° K. for the E Layer and about 1400° K. for the F Layer. Measurements of the reflection coefficient of radio wave yield approximate values of the air density at the level of reflection. These indicate molecular densities of 10^{12} and 10^{10} at the levels of Layers E and F respectively.

From the evidence from sound described by Dr. Whipple, it seems necessary to assume temperatures of more than 330° K. at 50–60 km. height. Since radio observations indicate a temperature rising from a lower degree than that at about 90 km., there should be a temperature fall between 60 km. and 90 km. Recent radio experiments seem to show directly that at a height of 75 km. there is a temperature of only 200° K. The technique applied in the study of this region (the use of wireless waves of about 18 km. length) was only touched upon by Dr. Appleton, but described in greater detail by Mr. J. A. Ratcliffe (Cambridge) in the course of the general discussion which followed the introductory addresses.

Another important contribution to the general discussion was made by Dr. D. F. Martyn from Australia. He communicated the results of 19 months' continuous observations of the maximum ionization densities of the F_2 region, carried out at half-hourly intervals in two stations in Australia, which seem to prove a connexion between this ionization and the meteorological conditions at the ground. This relationship can, in Dr. Martyn's opinion, scarcely be explained by changes in the temperature of the upper atmosphere. The most likely explanation appears to be that there exist large-scale movements of air in the high atmosphere in parallel with the main air mass movements at low levels—that, for example, a large influx of tropical air at low levels is accompanied by an influx of air of special characteristics (probably high humidity and/or low ozone content) at the very high levels up to 250 km.

For those attending the meeting, it must have been satisfactory to learn that the items of information obtained by such widely different methods about the conditions in the upper atmosphere can be put together into a consistent picture. There are still many gaps to fill, due not only to the scarcity of the material yet collected but also to the obvious limitations of the methods; while the sampling and direct measuring is confined to the heights which sounding balloons can attain, the optical, acoustical and electrical methods can only reveal the chemical and physical state of certain heights in which peculiar phenomena occur. It is, on the other hand, very gratifying to see that where overlapping occurs, the results obtained by entirely independent methods corroborate each other or, at least, are not contradictory. One can, therefore, attempt to summarize the main points of our present-day knowledge of the composition, temperature and density of the upper atmosphere, as reflected in this discussion.

The atmospheric gases (with the exception of water vapour, ozone and radon) are present in constant proportion up to the height of approximately 20 km. Between 20 km. and 30 km. the helium content increases, the oxygen content decreases by a few per cent, but there is no indication that this separation process of light and heavy gases becomes more marked with height: the total atmosphere is essentially a nitrogen-oxygen mixture. Under the influence of sunlight these two gases are ionized, and oxygen dissociated, so that the higher atmosphere consists mainly of nitrogen molecules and oxygen atoms, while lower down there is also molecular oxygen and ozone. Ozone has its highest concentration per volume at about 25 km.

The temperature decreases fairly regularly from the ground level upwards, assumes (in the latitude of

Great Britain) at 10–11 km. height a value of about 220°K . which remains constant to at least 30 km. From a few kilometres below 40 km. upwards, the temperature increases until it reaches at 50–60 km. more than 330°K ., whereupon it falls again, to a lower level than that of the stratosphere; the minimum, of about 200°K ., is reached between 70 km. and 90 km. From here onwards the temperature rises again; at 100 km. it is about 380°K ., at

300 km. it is in the neighbourhood of 1400°K ., and may increase still further with height.

Thanks to the rise in temperature from 40 km., and again from about 90 km. onwards, the density of the atmosphere is much greater above these heights than would be caused by gravity distribution if the temperature of the stratosphere remained constant. At 100 km. it is of the order of 10^{12} molecules/c.c., at 300 km. it is still 10^{10} molecules/c.c. F. A. PANTH.

Institution of Gas Engineers

THE seventy-sixth annual general meeting of the Institution of Gas Engineers, held in London during June 6–9, was noteworthy as the centenary of the death of William Murdoch, the versatile Scot, who is acclaimed as the father of the British gas industry. Mr. Robert Robertson, engineer and manager of the Bristol Gas Co., presided.

In a symposium on the present and future prospects of the town's gas industry, eleven Dominion and Overseas engineers, describing the conditions in their own countries, revealed that the idea of distilling coal for lighting gas arose in several places, but it was recognized that no one deserves more credit than Murdoch for establishing the practicability of coal gas manufacture.

These contributions showed that in every country the rise of newer industries such as those of oil and electrical supply has exerted an influence on the use of gas in certain directions, accentuated by the greater efficiency of appliances. Nevertheless, the merits of a clean gaseous fuel has sufficed not merely to maintain but also to increase the consumption of gas even in those countries where all coal must be imported while hydro-electric power is abundant. The president of the Swiss Gas Association, for example, says that in spite of the great financial efforts of the electrical industry, the Swiss housewife appreciates the value of the gas flame with its instantaneous heat, its great power and quality of being visibly regulated within wide limits.

In Norway the need for coke has a dominating influence, and the gas industry can supply only 8 per cent of the country's needs. Large losses, apparently, have been incurred there by too optimistic investments of public funds in hydro-electric works in the erroneous belief that the power so generated might replace gaseous fuel.

The president's address—a review of the development of the gas industry—contained a notable announcement of a new departure in its policy of organized research. In this, the industry has been a pioneer, for thirty years ago—long before the days of research associations—the Institution began the practice of supporting co-operative research. During this time it has furthered a programme of research done at the University of Leeds, and the president's address referred to nearly fifty reports issued from this source. In the meantime, many gas undertakings, contractors and associations concerned with by-products have produced an increasing volume of experimental work. It is estimated that about a quarter of a million pounds in the aggregate is spent annually in development work. Nevertheless, such is the state of flux in the utilization of fuel that a widening of the organization of research is projected.

Until recently, investigation could be confined to established practice of making and using gas, but to-day the industry is seeking to widen the range of coals suitable for gas making and to convert these into solid, liquid and gaseous fuel in any desired proportion—even to complete gasification by the use of high-pressure technique. It is now proposed to establish a Gas Research Board supported by the subscriptions of gas undertakings and manufacturers of plant and appliances. The first president will be Sir David Milne Watson, and a director of research will be appointed. The Board will be constituted so as to qualify for Government grants if and when this is thought desirable. It is proposed to use the facilities available in existing institutions—at least in the immediate future. The functions of the Board will be: (1) the collection and dissemination of information concerning research of interest to the gas industry, (2) the provision of contact and co-ordination between research workers similarly engaged, (3) the observation and reporting of work in progress and (4) planning and arranging of future work.

Dr. E. F. Armstrong gave a lecture in memory of Murdoch tracing the growth of the gas industry and speculating on its prospects.

Non-technical readers would be interested in a paper by L. W. Andrew and A. Barrow on comfort heating by gas. To-day gas is being increasingly sold on two-part tariffs which encourage the freer use for major heating and raise the question as to the extent to which it can replace solid fuel for continuous heating. The advantages of cleanliness, flexibility and reduction of labour have long been recognized, particularly for intermittent heating. For central heating, solid fuels, especially coke, have appeared to show an unassailable advantage, but coal gas is increasingly entering this field when cleanliness, high rent and automatic control offer sufficient inducement. 'Central heat' is normally conveyed by means of hot water, but 'central' heat can more cheaply and simply be conveyed in a potential form as coal gas, and the problem to-day is to devise means for converting this into effective and acceptable sensible heat.

The paper distinguishes between 'warmth' and 'comfort'. For comfort, it would appear to be desirable to have air at $50\text{--}60^{\circ}\text{F}$. in movement without perceptible draught, supplemented by radiant heat received on the front of the body from an incandescent source. Shorter infra-red rays of length below 3μ capable of penetrating the skin, according to L. Hill, are of particular value. In addition, tradition in Great Britain requires an open fire with the character associated with the open coal fire. The authors believe that these requirements can be met by

combining 'background' heating by flameless appliances with suitable gas fires. For continuous domestic heating they think the radiating gas fire will take a new form, whether in some measure resembling the coal fires of the past—as it may in the near future—or taking a more revolutionary form. In support of this view they exhibited a gas fire of new design such that any ordinary person walking past would take it for a coal fire of conventional type. Instead of the formal geometrical radiants, it exhibited a face of black mass enclosing glowing cavities surmounted by a play of real flames. There must be many to-day

who would find it worth while to pay something extra for the merits of a coal fire without its demerits.

For commercial buildings new designs of overhead radiating panels—both high and low temperature radiators—are now available. In factories, the 'unit heater' which provides a stream of warm air directionally propelled offers many advantages. All these offer considerable advantages over central heating by circulation of hot water, and the paper suggests that great developments may be expected in gas heating.

H. J. HODSMAN.

Structure of Trilobites

By Dr. W. T. Calman, C.B., F.R.S.

THE trilobites are generally recognized as occupying a key position in relation to the phylogeny of arthropods, and until we have some certainty as to their structure and relationships it is not possible to speculate profitably about the mutual affinities of insects, crustaceans and arachnids. In the course of the last sixty years, a great deal of information regarding their appendages has been obtained, for the most part by American paleontologists; but the results of different investigators have not been easy to reconcile and very divergent conclusions have been drawn regarding the systematic position of the group.

Dr. C. D. Walcott, who was the first to obtain definite information about the appendages, worked chiefly on the Ordovician genus *Ceraurus*, which he studied in thin sections. Dr. C. E. Beecher (whose final memoir was completed after his death by his pupil, P. E. Raymond) studied abundant material of *Triarthrus*, from the same epoch, as exposed in surface view by splitting the rock. The results of these two workers seemed to reveal an extraordinary difference of structure in the limbs of the two genera. The legs of *Ceraurus* were provided by Walcott with a pair of corkscrew-shaped gills attached near the base, while those of *Triarthrus*, according to Beecher, were simply biramous, with the outer branch segmented and fringed on one side with flattened filaments. Taking up the subject again towards the end of his life, Walcott maintained that the 'spiral gills' really existed but now allotted only one of them to each limb and provided it with a row of flattened filaments like those described by Beecher in *Triarthrus*. In a review of Walcott's paper¹, I pointed out that the row of filaments, attached to the successive turns of an open helical spiral, would not remain in one plane as they are seen to do in the fossils, unless the spiral were rigid to an improbable degree.

Dr. Leif Sterner, in an important memoir², discusses the whole subject in the light of a re-examination of Walcott's and Beecher's preparations. He has also applied Sollas's method of serial grinding and reconstruction to *Ceraurus*, and has obtained some very interesting and convincing results. In the first place, the fundamental differences which Walcott supposed to exist between the appendages of *Ceraurus* and *Triarthrus* have disappeared. The spiral structures are proved to depend on misinterpretation of the sections. In *Ceraurus*, as in *Triarthrus*, the appendages are simply biramous, with an outer

branch consisting of a segmented stem fringed on one side with a single row of flattened rod-like or filamentous structures which may, or may not, have served as gills. In view of the poor state of preservation of the appendages in *Ceraurus* and the obscurity of the traces that they have left in the rock, it is not surprising that many details of their structure must remain uncertain, but Sterner appears to be justified in claiming that all the trilobites so far studied have appendages built on the same plan. Beyond this, however, his far-reaching deductions can only be treated with much reserve.

Impressed with his discovery in *Ceraurus* (and, very doubtfully, in other genera) of a 'precoxal' segment to which the outer branch of the limb is attached, he designates this outer branch 'pre-epipodite' and deduces from this that the trilobites have no close relationship with the crustacea but are, on the other hand, intimately associated with the eurypterid-arachnid group. To do this, he has to minimize the importance of those characters in which the trilobites diverge from the Arachnida and approach the Crustacea. To anyone with a sense of morphological values, however, the flagelliform pre-oral antennules, the five pairs of biramous gnathopod-bearing head appendages following them, and the furcal filaments (of *Neolenus*) far outweigh the fact that the peduncle of the biramous limbs is unsegmented; as it is, by the way, in not a few Crustacea.

The resemblances between trilobites and primitive arachnids have been often pointed out and are generally admitted; but Sterner does not strengthen his case by taking seriously Schultze's far-fetched comparisons between trilobites and ticks (Ixodidae). To reason from fortuitous and isolated coincidences of structure is to play into the hands of those who are so ready nowadays to proclaim the bankruptcy of morphology and phylogeny. Anyone who is tempted by such slapdash methods may be recommended to consider the numerous and striking resemblances between trilobites and isopod Crustacea, and then to study carefully the evidence for the derivation of the Isopoda from primitive Mysidacea, which have scarcely anything in common with trilobites except that they are arthropods.

¹ *Geol. Mag.*, 38, 553 (1921).

² 'Studies on Trilobite Morphology. Part I. The Thoracic Appendages and their Phylogenetic Significance'. (*Norsk Geol. Tidsskr.*, 19, 143-723, 12 pls., text-figs.)

University Events

CAMBRIDGE.—Dr. L. E. R. Picken, of Trinity College, has been re-elected to the Balfour studentship, for research on the molecular morphology of living cells.

Grants from the Balfour Fund have been made to the following: D. A. Webb, of Trinity College, £20, for expenses whilst working at the Millport Marine Station; to D. A. Webb, of Trinity College, £40, for expenses whilst working at Prof. Krogh's Laboratory in Copenhagen; Dr. C. H. Waddington, £25, towards the expenses of visiting the Marine Laboratory, Woods Hole; M. G. M. Pryor, of Trinity College, a sum not exceeding £40, for expenses whilst working under Prof. Kühn in Berlin; Dr. V. J. Chapman, £25, towards the cost of an expedition to the West Indies; Dr. R. J. Pumphrey, £20, for expenses whilst doing research at the Plymouth Marine Station.

The Frank Smart studentship in botany will be vacant on October 1. Any graduate of the University is eligible for the studentship provided that not more than eighteen complete terms have elapsed after his first term of residence. Women also are eligible. The successful candidate must devote himself to research in botany under the direction of the Professor of Botany. A student may be appointed for one year or for two years. The value of the studentship is £210 a year. A candidate must send his name, with a statement of the course of research which he proposes to undertake, and such evidence of his qualifications as he thinks fit, to Prof. F. T. Brooks, at the Botany School, on or before September 30.

OXFORD.—At Encaenia on June 21, the following among others received honorary degrees: *D.Sc.*, Sir Edward Mellanby; *D.C.L.*, the Marquess of Lothian, Sir Maurice Gwyer, Admiral Sir Herbert Richmond and the Hon. Vincent Massey.

Dr. Robert Gunther has resigned his appointment as honorary University reader in the history of science at Oxford. He will remain in charge of the Museum of the History of Science. Work on the Oxford dictionaries, hitherto carried out in the lecture room of the old Ashmolean Museum, is being transferred to the new Bodleian extension.

Dr. E. G. T. Liddell, Trinity College, and Mr. D. L. Hammick, Oriol College, have been elected members of the Hebdomadal Council.

Prof. R. S. Troup is resigning the professorship of forestry on July 31, 1940.

E. F. Caidin, Queen's College, has been elected to a junior research fellowship (in chemistry) at Queen's College. Dr. A. H. Cooke, Christ Church, has been elected to a lectureship in physics (the equivalent of a research fellowship) at Christ Church. Miss A. Pellow, St. Hugh's College, has been elected to the Moberly senior scholarship (in engineering).

The following new appointments have been made: E. B. Ford, Wadham College, reader in genetics; C. F. W. R. Gullick, lecturer on economic geography; Dr. R. A. Hull, St. John's College, demonstrator and lecturer in physics; R. N. Chrystal, demonstrator and lecturer in entomology; A. C. Hoyle, Pembroke College, and Dr. N. V. Polunin, Christ Church, demonstrators and lecturers in botany.

SHEFFIELD.—Prof. R. P. Linstead has resigned from the Firth chair of chemistry, on his appointment to the chair of organic chemistry in Harvard University.

Science News a Century Ago

Giraffe Born at Zoological Gardens

ON June 25, 1839, Prof. Richard Owen read to the Zoological Society "Some Notes on the Birth of a Male Giraffe at the Zoological Gardens". The animal was born on June 19. The period of gestation, said Owen, had been, as nearly as possible, ascertained to be fourteen months, eighteen days, or fifteen lunar months. The young animal, when born, was perfectly motionless, and apparently dead, or strangled, its lips and nose being tinged with blood; but after gentle friction had been used for a short time, breathing and motion quickly followed. The mother was in no way depressed or debilitated. The animal came into the world like other ruminants, with the eyes open, but the hoofs were disproportionately large, and very soft and white at their expanded extremities; the skin was marked as distinctly as in the adult; the horns were represented by stiff and long black hairs, and the mane was well developed.

Allan Cunningham (1791-1839)

ALLAN CUNNINGHAM, an eminent botanist and traveller, was born at Wimbledon, Surrey, on July 13, 1791, his father being a gardener. Having become connected with the Gardens at Kew, he became known to Sir Joseph Banks and on September 4, 1814, he was appointed botanical collector in the southern hemisphere for the royal gardens. Sailing from Plymouth in October 1814, he did not return to England until July 1831. In turn he visited Rio de Janeiro, and parts of Brazil, New South Wales, New Holland, Van Dieman's Land, New Zealand and Norfolk Islands. Though after his return home he was in somewhat indifferent health, he was offered the post of colonial botanist in New South Wales, but declined it in favour of his brother Richard, who, however, was killed by natives in April 1835. Cunningham now accepted the office and proceeded to Sydney, but his strength failed him and he died on June 27, 1839, at the age of forty-eight years.

Becquerel's Electrical Experiments

"M. BECQUEREL," said the *Athenaeum* of June 29, 1839, "has read the first part of a memoir before the French Academy of Sciences, containing an account of his new experiments on the electric forces of contact. These led him to conclusions concerning the causes of certain effects which differ from those of Davy, who ascribed them to mere contact. M. Becquerel refers them to friction and hopes to prove it by the following experiments. First, two conducting plates made of platina were adapted to an excellent electroscope; one of them was touched with a very dry piece of chalk, and the other with the finger; on separating the plates, it was found that no electric effect had been produced. Secondly, a layer of calcined lime, highly dried, was spread on a piece of wood, equally dry; upon this was carefully placed, so as not to allow of friction, a plate of copper, fixed to a handle; it was then put in contact with one of the plates of the condenser, while the other was touched with the finger. After repeating this several times, no electric discharge was obtained, but if the copper disc were placed on the lime with friction, the condenser was charged after touching a few times, and the greater the friction the stronger the charge."

Societies and Academies

Paris

Academy of Sciences (C.R., 208, 1445-1540, May 8, 1939).

J. CHAZY: Value at infinity of the solutions of certain differential equations.

C. MAUGUIN and J. LAVAL: Fourier lattice and thermal agitation.

H. COLIN and J. AUGIER: A novel glucide in the Floerke of the genus *Polysiphonia*—the α -D-mannoside of sodium L-glycerate.

G. BERTRAND and L. SILBERSTEIN: Boron content of soil. Although present in most soils, the quantity is so small (10-30 mgm. per kgm. of fine soil), that its estimation is only possible with specially purified reagents.

F. GRANDJEAN: The 'probability' of the existence of organs and of characters.

H. VINCENT: New experimental researches on hepatic 'dysphylaxy' in coli bacillary infection.

G. GIRAUD: A type of problem relative to elliptic equations with two independent variables.

J. DE LAPPARENT and R. HOGART: Leverrierite of the lateritic formations of French East Africa.

M. KRAEMER: Fermat's theorem.

E.-J. GUMBEL: Duration of decline as a measure of independence.

S. CHIRUBINO: Kronecker's index and the algebraic correspondences between curves.

L. BERG: Limiting values of analytical functions of two complex variables in domains possessing an observable bounding surface.

H. GUILLIEMET: Influence of the periodic transversal movement of the leading edge of the wing of an aeroplane on the reaction exerted by the fluid.

R. LINDUO and J. VILLEY: The permanent limiting discharge flow of a current of air around a source.

J. DUFAY and J. GAUZIT: Application of interference to the study of stellar spectra.

J. MARIANI: Geometric interpretation of spin.

G. BIHNE: Integration of M. De Donder's equation.

D. DERVICHIAN and M. JOLY: Transformations of higher order in mono-molecular layers.

L. AGOSTINI: An apparatus for measurement of the specific heats of gases working on very small supplies of gas.

MME. M. MORNAU-HANOT: Transport of electric charges by droplets.

A. MARSAT: Some consequences of the diffusion of light by corpuscles suspended in the atmosphere.

MME. S. VEIL: Liesegang periodicities by attack, in gelatin, of coarse solid suspensions.

A. PORTVIN: Specific character of structures formed in the fractional decomposition of austenites with cooling as a function of the temperature of the isothermal stage.

M. MOUSSEON and R. GRANGER: Some optically active stereoisomeric alicyclic acids, alcohols and aldehydes.

G. DARENS: Action of aqueous solutions of ammonia on halogen derivatives: new method of preparation of aliphatic diamines.

R. VINILLEROSSA: Mechanism of formation of thioacetic dichloride: polymolecular anhydride-chlorides of thioacetic acids.

F. SALMON-LEGAGNEUR: α - α -Diphenylsuccinic acid.

P. FLURY and MME. R. BOISSON: Action of periodic acid on acetone and on diethylacetone.

J. LAVAL: Diffusion of X-rays outside some directions of selective reflection by crystals [possibly due to thermal agitation].

M. BRENETTOFFER: Lower Cenomanian of the fosse coconienne (Hautes-Alpes et Drôme).

H. BERRIER: Magnetic results for 1939 from the coast of French Somaliland.

MME. A. VASSY and E. VASSY: Influence of solar radiation on the mean temperature of the atmospheric ozone.

C. COMBIER: Some new problems raised by the photography of the shadow of the earth.

P. QUINCY: A counter of large ions giving directly the spectrum of mobilities.

J. DEBRACH: Variations of the effective nocturnal radiation, in the course of clear nights.

M. SIMONET and P. DANHEBEAU: Meiosis in two hybrids of *Cistus*, *C.* $\times$ *hybridus* Pourr. and *C.* $\times$ *rodiei* Verg. var. *antipolitensis* Dans.

MME. M.-L. VERRIER: The theory of Exner and the comparative histophysiology of compound eyes.

A. PERRARD: Numeration of the Purkinje cells in the cerebellum of various birds.

E. WOLFF: Action of diethylstilboestrol on the genital organs of the chick embryo. It has a powerful feminizing effect, analogous to that of oestrone.

N. PERAKIS: Magnetochemical analysis of the egg of the urchin (*Echinus melo*).

F. OBATON: Influence of colchicine on the development of *Photobacterium phosphoreum*. It increases the luminosity of cultures, due to acceleration of development.

G. JEANNERET, C. WANGERMER and G. RINGENBACH: Electric charge of the blood and transfusion shock. Post-transfusion shock depends on the sign of the electric charge of the donor's blood.

Amsterdam

Royal Netherlands Academy (Proc., 42, No. 3; 1939).

J. BÖNNIKEN: Steric conditions in the cyclic acetone-acetals of the *ortho*-diphenols.

R. WEITZENBÖCK: Projective invariants of four and five straight lines in the four-dimensional space R_4 .

MISS W. A. LUB: Isotopic constitution of nickel and chromium. The existence of the ^{61}Ni isotope with an abundance of 0.1 per cent is confirmed and that of the ^{54}Cr isotope rendered probable.

P. G. MOLENAAR: A differential invariant of the second order of the binary cubic differential form.

W. BEIJERINCK: Diatoms from the brooks of the province of Drenthe (Holland).

H. G. BUNGENBERG DE YONG and O. BANK: Behaviour of microscopic bodies consisting of biocolloid systems and suspended in an aqueous medium.

(4) Vacuolation phenomena of complex coacervate drops at a constant temperature. Formation of foam structures and of thin-walled drops with a large central vacuole. (5) Gelatinized hollow spheres. Temporary invagination to gastrula-like bodies by mechanical or osmotic removal of water from the central cavity.

Cracow

Polish Academy of Sciences (April 3, 1939).

J. SAMBONOWICZ: The Carboniferous in the basin of the Upper Bug. Six borings, over an area of 1,300 sq. km., have proved the existence of the Carboniferous below the Cretaceous, which increases in thickness from 111 m. in the east to 287 m. in the west.

MME. J. RABMENT: Hepaticos of the Silesian Beakid.

MME. I. MIKULSKA: Material for the study of the Araneids as a constituent element of the biocoenosis in some forests of the Silesian Carpathians.

Forests of the *Fageto-abietum* type are richest in number of species, while small numbers are found in beech plantations.

J. ST. MIKUSKI: Ephemeropteran fauna of the torrents giving rise to the Vistula. The two streams show hydrographic and faunistic differences; judged by the Ephemeroptera found, they are middle altitude rather than high mountain streams.

Moscow

Academy of Sciences (*O.R.*, 22, No. 1; 1939).

S. BERNSTEIN: Determination of a series of given functions from the values of the extremes and of the successive remainders.

G. ŠILOV: Ideals and sub-rings of the ring of continuous functions.

I. GULFAND and A. KOLMOGOROFF: Rings of continuous functions on topological spaces.

W. S. IGNATOVICH: Contributions to the grid theory (2, 8).

I. L. ZIL'MANOV: A new method of helium liquefaction by means of the Jotie-Thomson effect.

N. B. BYZOV, M. JURAVIČA, A. KOMAR and G. ČUPAROV: Iron crystal orientation in magnetite reduced by hydrogen.

V. L. GRANOVSKY: The time of the restoration of controllability in a gas discharge.

G. B. RAWLINSON: The dependence of viscosity of fatty acids with high molecular weight on the temperature and the degree of their saturation.

V. KASSATOVICH: Electronic deflection in the surface layers of metal alloys.

F. P. SAVARENSEY and N. V. KOLOMINSKY: Friction and cohesion of coherent rocks.

G. G. LAHMENKIN: The orientation of quartz crystals in veins of the Alpine type in the sub-hercynic Urals.

A. A. YATSKO-KHMELEVSKY: An anatomical study of the propagation of fungus hyphae in a dead forest of *Picea orientalis* Carr.

A. ŠERŠEVICH: The body temperatures of reptiles in natural surroundings.

A. BILODUBOV: Variation in structure of the alimentary canal in sturgeons, in connexion with nutrition.

O.R., 22, No. 2; 1939.

I. M. VINOGRADOV: A new improvement of the method of estimating trigonometrical sums with primes.

B. GRENENKO: The limiting theorems for sums of independent variables.

S. V. KRAVČOV: Critical frequency of flicker and indirect stimuli. Some correlations of different receptors in our colour vision.

N. T. FEDOROV: Some regularities underlying the effect of indirect stimuli (*Nebeneffekte*) upon the discrimination sensitivity of the eye.

N. T. FEDOROV and V. I. FEDOROVA: The number of light-sensitive substances in the retina.

V. I. NIKOLANOV and A. G. KOGAN: A new method of production of potassium nitrate by exchange decomposition of potassium chloride with nitric acid at low nitric acid concentrations and temperature.

A. A. TRAPENIKOV: Mechanical properties of 'two-dimensional' caoutchouc. The micellar structure of caoutchouc.

D. McCONNEL: Isomorphic substitutions in apatite.

N. V. BELOV: Some isomorphic substitutions in the apatite group.

I. A. KOROBKOV: The age of the Sakaraul horizon.

Forthcoming Events

[Meeting marked with an asterisk is open to the public.]

Monday, June 26

ROYAL GEOGRAPHICAL SOCIETY, at 8.—Annual General Meeting.

Tuesday, June 27

BIRKENHEAD COLLEGE, at 8.—Sir Percy Nunn: "Education and Reality" (Haldane Memorial Lecture).

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.45.—Annual Meeting. H. J. Brahmholtz: "Archaeology in Peru: Recent Progress" (Presidential Address).

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

LECTURER IN CHEMISTRY AND PHYSICS in the Borough Road College, Islington.—The Principal (June 25).

LECTURER IN MECHANICAL AND CIVIL ENGINEERING in the Sunderland Technical College.—The Director of Education, Education Offices, 15, John Street, Sunderland (June 28).

ENGINEERING ASSISTANT (Junior Grade) to the Conservators of the River Thames.—The Secretary, Thames Conservancy, 2-3, North Street, Strand, W.C.2 (June 29).

SCIENTIFIC OFFICERS (Physics, Chemistry and Mechanical Science). SCIENTIFIC OFFICERS (mathematics and physics), ASSISTANT (grade II, mathematics, physics and chemistry), ASSISTANTS (grade III, mathematics and are welding) in the Research Department Royal Arsenal, Woolwich, S.E.18.—The Under-Secretary of State (O.S.) War Office, London, S.W.1 (June 30). Quote A.P.P. 147B.

LECTURER IN PRODUCTION ENGINEERING in the County Technical College, Wednesbury.—The Director of Education, County Education Office, Stafford (July 3).

ASSISTANT LECTURER IN MATHEMATICS in University College, London.—The Secretary (July 3).

PRINCIPAL AGRICULTURAL OFFICER in the Federated Malay States, Burma.—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (August 14). Quote S.153B.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1840 (1934; 1936): The Lateral Stability of Highly Loaded Aeroplanes. By L. W. Bryant and Dr. A. G. Pugsley. Pp. 11. 2s. net. No. 1845 (1936): The Protection of Magnesium Alloy Sheet against Corrosion by the use of Benzene containing High Purity Chromates. By L. F. Le Brocq. Pp. 24. 2s. 6d. net. (London: H.M. Stationery Office.) [16]

Scientific Proceedings of the Royal Dublin Society. Vol. 23 (N.S.), No. 10: An Apparent Connection between the Presence of Colloids and the Osmotic Pressures of Copepod Leaves. By O. Roberts and B. A. Styles. Pp. 119-123. 6d. Vol. 23 (N.S.), No. 11: Embryogeny in *Sarcophages* and its relation to other Podocarpa. By J. Doyle and W. J. Looby. Pp. 127-142. 2s. Vol. 23 (N.S.), No. 12: Studies in Part 5: Extraction of Peat with Ascarope-like Petroleum mixed Solvents. By J. Reilly, D. F. Kelly and J. Duffy. Pp. 149-156. 6d. Vol. 23 (N.S.), No. 13: Studies on the Ultimate Composition of Biological Material. Part 5: Glandular Tissues. By Robert Pease and William Robert Pearson. Pp. 157-160. 6d. Vol. 23 (N.S.), No. 14: Report of the Irish Radium Committee for the Year 1938, including Reports from Oswald J. Murphy and Oliver Chanda. Pp. 161-174. 1s. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [26]

Other Countries

Division of Fish and Game of California: Bureau of Marine Fisheries. Fish Bulletin No. 53: Measures of Abundance of the Sardine, *Sardinops caerulea*, in California Waters. By Frances N. Clark. Pp. 48. (Terminal Island, Calif.: California State Fisheries Laboratory.) [318]

Egyptian University: Faculty of Science. Report for the Session 1934-1935. Pp. 11+123. Report for the Session 1935-1936. Pp. 11+94. Report for the Session 1936-1937. Pp. 112. Report for the Session 1937-1938. Pp. 100. (Cairo: Government Press.) [16]

Ceylon. Part 4: Education, Science and Art (G.). Administration Report of the Marine Biologist for the Year 1938. By A. H. Malpas. Pp. 611. (Colombo: Government Record Office.) 10 cents. [16]

Publications of the Lick Observatory. Vol. 14, Part 3: The Spectrum of Nova Aquilae (1918). By Arthur B. Wyse. Pp. 89-116+ plates 7-10. (Mt. Hamilton, Calif.: Lick Observatory.) [24]